Chap 1 Achievements

Perennial pastures (exotic grasses and lucerne) have been the mainstay of the program, accounting for over 70% of all works completed. Around 200 ha/yr of high density tree plantings, as revegetation, break of slope or protection of discharge areas, have been completed since 1996.
Trends in area planted annually are very responsive to seasonal influences, more so because of the high proportion of pastures that make up the works activities.
It is now understood that the targets set in 1989 and modified in1995 were inadequate for dealing with dryland salinity. It will require at least a twenty-fold increase in on-ground work activities to meet the end of valley targets.
Much of the extension and education activities of the Plan have focussed on the traditional landholder base. There is a need to adapt the plan to a changing community structure across the catchment.
The importance of pastures has already been emphasised. Perennial pastures are no longer promoted for recharge management, in areas where the annual rainfall is over 650 mm. Where they abut onto remnants landholders are also required to keep a 20m buffer between the pastures and the remnant.
In the past five years closer links with farm forestry and plantation ventures have been developed. This has culminated in the development of decision aids to allow investors, processors and growers to evaluate the opportunities for commercial tree growing activities in the catchment.
The cropping program is no longer supported by the salinity program. This is due to increasing costs of program support and the recognition that improved cropping practices offer only small gains in control of recharge when compared with other perennial vegetation options.
Community education has been an important part of the SMP since it began. The community education program has been highly successful in raising the level of awareness of salinity. The challenge throughout the life of the plan has been to convert this awareness into action. In recent years, through work by Curtis (2000) and others, we have developed a better understanding of the change process and the pressing need to move away form voluntarism to more equitable business based solutions.
After 12 years there s still many questions that need to be answered. High on the list is the processes by which salt reaches the streams or is discharged to the landscape; this is important information for effective targeting of works. Other notable issues include identifying assets, beyond water quality, and the threats posed to those assets.
Local Area Planning has been heavily promoted in the last three years as one way to involve the community more in the processes of natural resource management. Local area plans in their simplest form have been developed for the whole of the dryland catchment.
Making sure that costs of natural resource management are shared equitably has been an important plank of the GBDSMP to date. The cost share arrangements have undergone constant revision as the need to capture multiple benefits has grown.
In 2000 a new grant system was developed-the Environmental Management Grants. These combined salinity, biodiversity and soil management outcomes in assessing the value of government contributions to and the conditions placed on grants. The purpose was to maintain equitable cost sharing arrangements while at the same time ensuring that works were properly targeted and reflected the priorities of funding agencies

Priority Activities

Since the original Goulburn Broken Dryland Salinity Management Plan (SPAC, 1989) was developed, the focus of implementation has remained the establishment of vegetation on high recharge areas. These include:

- high density trees,
- low density trees on land with less than 600mm annual rainfall,
- lucerne, and other deep-rooted perennial pasture.

Discharge sites were also to be protected using suitable salt tolerant species. The 1995 Review of the salinity program led to some changes in the type of works promoted.

- the use of perennial pastures as a recharge control option was limited to areas with an average annual rainfall of 650mm or less.
- break of slope tree planting was promoted as a groundwater interception option in appropriate landscapes.

- tree planting in 'potential discharge areas' was promoted through the establishment of high-density tree plantations in areas close to active discharge sites. The aim was to prevent further spread, using similar principles to those behind Break of Slope plantings.
- Groundwater pumping was also recommended, but was limited to on-site groundwater use due to the lack of salt disposal entitlements for dryland areas.

The option of '*living with salt'* was not accepted by the Salinity Program Advisory Committee (SPAC), nor has it formally been accepted since by the Implementation Committees of the CMA. It is now clear that it is unrealistic to continue to ignore the living with salt option.

The original GBDSMP divided the catchment into 13 Land Management Units (LMU's). These LMU's (see Figure 1) were defined by their hydrogeological characteristics and potential salinity risk, and were used to prioritise where works would be carried out in the catchment.

The priorities and proposed actions for the various LMU's are reported in the 5 year review.

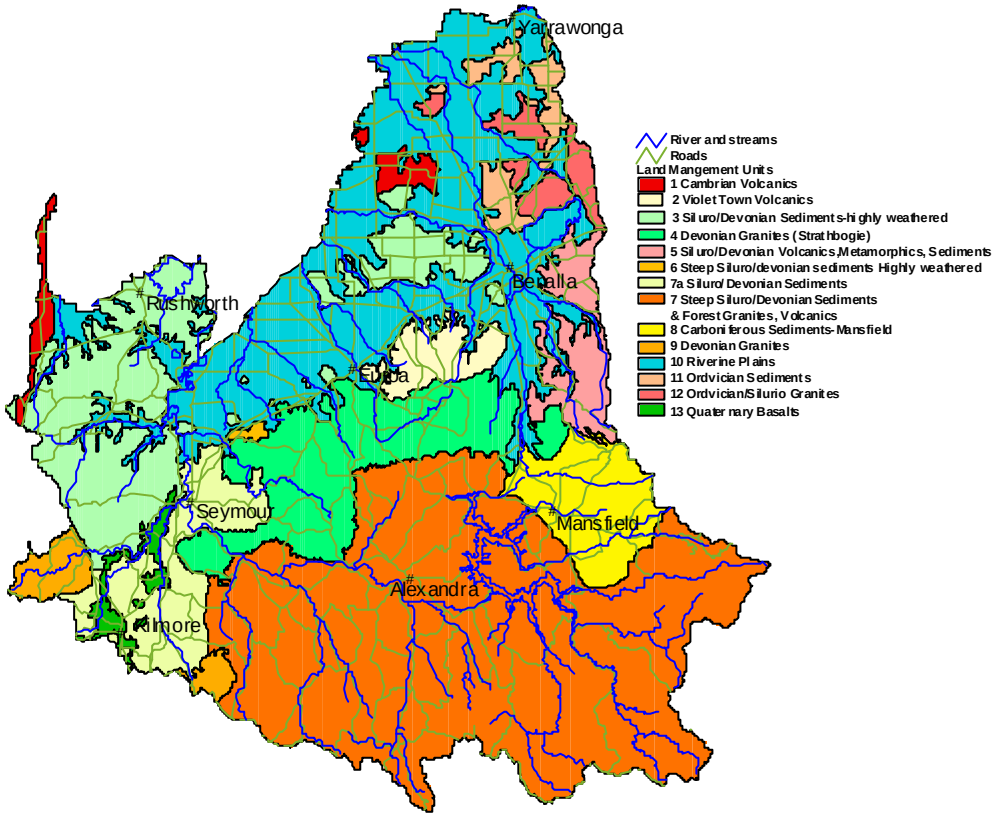
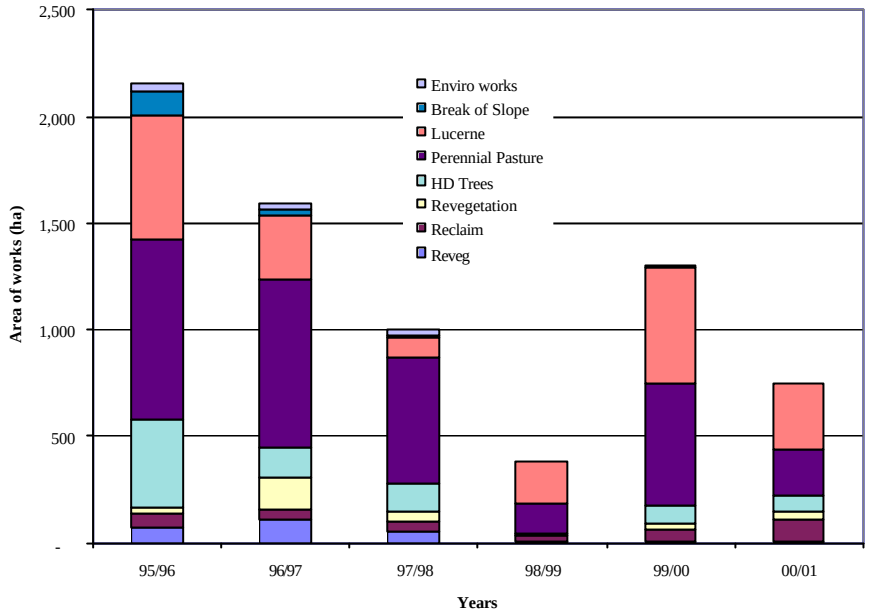


Figure 1 Land management units in the Goulburn Broken Dryland

Achievements against targets 1995 -2001

The original GBDSMP established targets for works in the different LMU's. These were amended in the 1995 Review to reflect what could be achieved given the level of investment by Government in the Salinity Program. The targets set in 1995 are shown in Figure 3. The major changes were:

- the reduction of targets for low density trees
- the doubling of targets for the area of high density trees
- a five fold increase in targets for the area of lucerne



Overall achievements are shown in Figure 2. It clearly shows that perennial pasture and lucerne have been the mainstay of the works program (see table 2 and Appendix1)..

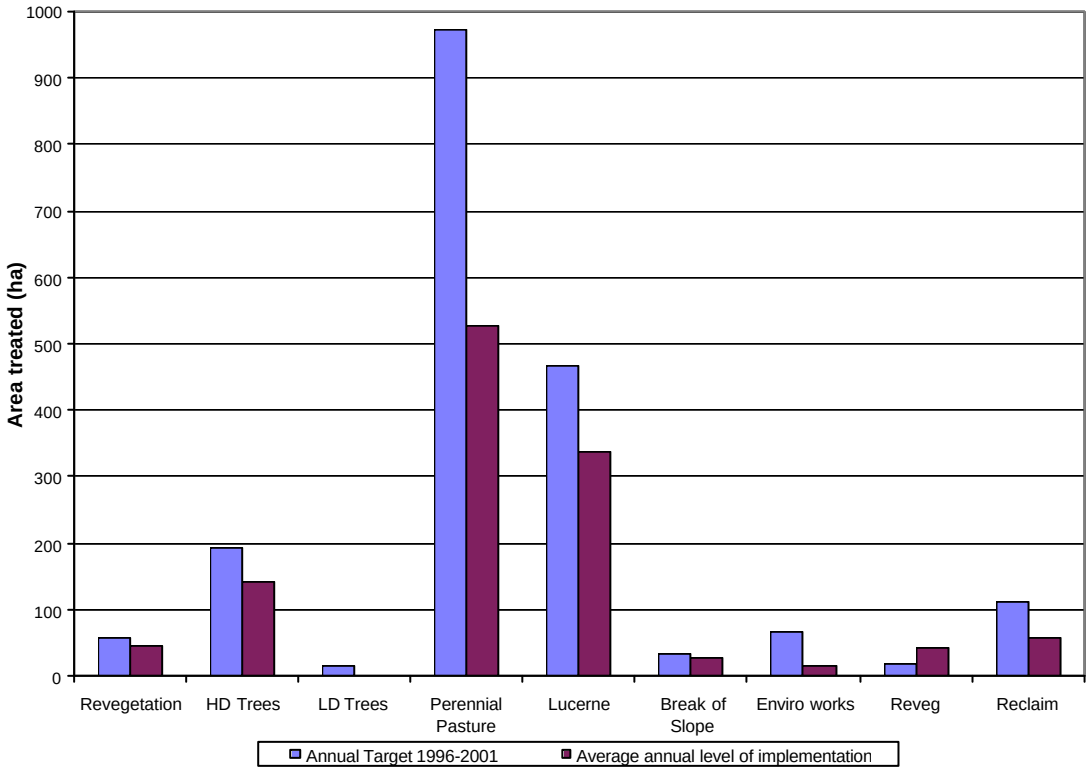


Figure 2 Average annual works compared to annual targets 1995-2000

Table 1shows the variability in annual works which is characteristic of natural resource programs. High variability is due to changing seasonal and market conditions. There is some evidence of a slow

down in the overall rate of works with time which may reflect a waning interest or falling capacity on the part of the community to participate in works programs.

Table 1 Variability in annual works program 1995-2001

	Recharge							Discharge		
	Reve-getation	HD Trees	LD Trees	Perennial Pasture	Lucerne	Break of Slope	Native vegetation protection	Reve-getation	Reclaim	GW Pumps
95/96	24	420	10	839	586	111	38	72	66	1
96/97	150	135	-	798	291	32	27	109	50	1
97/98	48	132	-	588	94	12	28	58	44	3
98/99		7	-	141	197	-	*	7	27	
99/00	23	92	-	568	548	10	*	5	61	#
00/01	43	68	0	224	305	-	*	6	102	#
Total	287	855	10	3,157	2,020	165	94	256	350	5

Over the years since the 1995 Review, there have a been several changes in the emphasis of works including a:

- decline in the role of perennial grass pasture because of questions over its capacity, in high rainfall areas, to affect recharge significantly and the threat that grasses such as phalaris pose to environmental values
- reduction in the investment in discharge treatment, mainly in response to budget cuts to the programs
- increased emphasis on the protection of remnant native vegetation

The average area treated per year over the first five years of Plan implementation (1,220 ha/yr) is very similar to that achieved in the following 6 years (1,199 ha/yr) (see Figure 3).

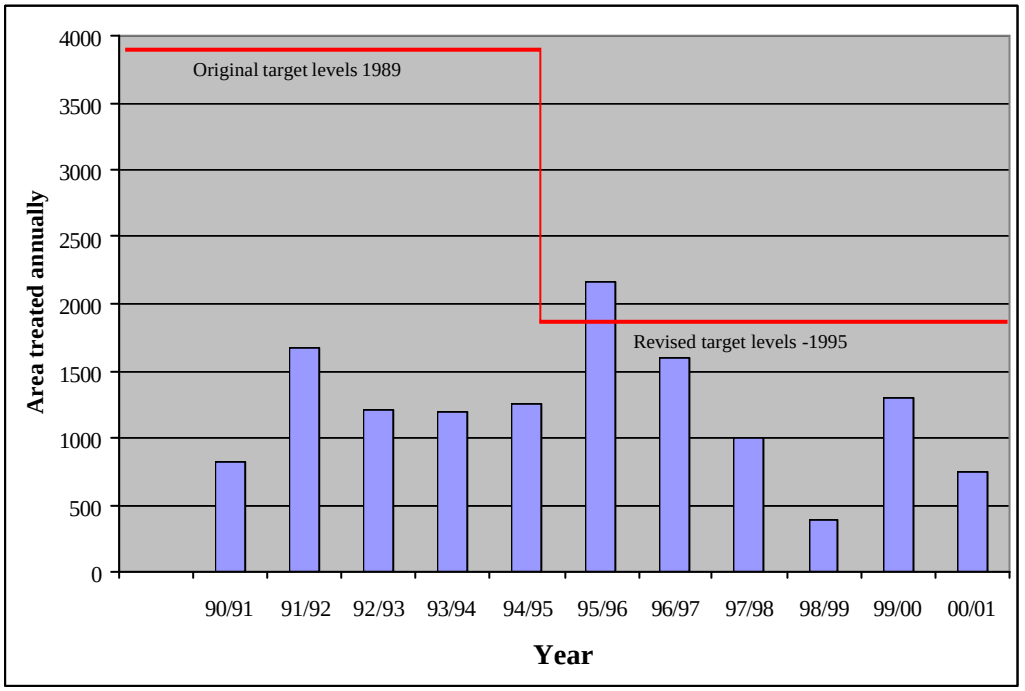


Figure 3 Area treated annually

Achievements by LMU

As expected the level of achievement has varied across the catchment. This has in part been a result of funding, location of staff, enterprise differences, seasonal conditions, and priority placed on the various work activities. Table 2 shows achievement for the six-year period for each of the LMU's, along with the percentage of 1995 target achieved.

Of the total works, 74% of the area has been treated by pasture of one type or another. Of this, 26% has been treated by perennial grass pasture, a control option that has since fallen out of favour.

Of the total area treated, 18% was using high-density trees. This equates to 1,200 ha over 6 years, or an average of 200 ha each year.

The number of grants approved has remained steady at around 300 per year, which suggests that the interest in salinity control works has not altered. However, there has been a decline in the number of approved grants actually undertaken and completed, which points to a growing perception that cost-share arrangements were not equitable, and that other demands on landholder time and labour were affecting their capacity to do the works required.

Table 2 Works achieved for each LMU between 1995-6 and 2000-01. **Figures in brackets are percentage of target achieved**

	High and moderate recharge							Discharge	
LMU	Native Revegetation Ha	High Density trees ha	Low density trees ha	Perennial Pasture ha	Lucerne Ha	Break of Slope ha	Enviro works	Revegetation ha	Reclamation ha
1a	-	2 (2)	-	74 (25)		-	-	8	37 (62)
1b	-	43 (72)		331 (46)	385 (58)	-	-	6	10 (33)
2	46 (153)	42 (28)	10 (33)	26 (9)		139 (77)	-	11 (37)	18 (20)
3	43 (72)	89 (148)	-	199 (41)	310 (65)	-	2	49 (408)	6 (14)
4	-	12	-	-	-	-	-		-
5	116 (193)	147 (98)	-	129 (43)	45 (150)	26 (87)	-	27 (225)	45 (75)
6	32 (107)	89 (40)	-	595 (38)	200 (67)	-	24 (29)	6	112 (49)
7a	20 (28)	40 (33)	-	284 (33)	-	-	-	1	50 (56)
7b	-	114 (127)	-	658 (110)	-	-	-	33	58
8	-		-		-	-	-	-	-
10a	2 (17)	19 (24)	-	104 (36)	323 (43)	-	50 (93)	29	5
10b	1 (8)	7 (23)	-	48	502 (418)	-	-	-	1
10	5	37	-	3.53	225	-	-	27	14 (233)
11	-	31 (129)	-	26 (29)		-	-	-	1 (17)
13	-	12 (33)	-	6 (3)	-	-	-	-	-
LMU not recorded	-	22	-	196	31	-	-	-	7
Total	265 (77)	706 (60)	10 (11)	3029 (53)	2021 (71)		76 (19)	206 (181)	364 (52)
Annual targets 1996-2001	57	195	15	973	765	35	67	19	112

Environmental Management Grants

In 2000, steps were taken to change the cost-share arrangements with landholders, so that they reflected the true cost of undertaking works. These were managed through the new Environmental Management Grants scheme (EMGs). Although it is too early to be sure about the impact of the new grant system, there has been a slight increase in the number of grants written, buta large increase in grants being completed. Also the average area of works of each grant is greater. By the end of March 2002, there

have already been 300 ha of high-density revegetation works, and 200 ha of remnant vegetation protection works, completed for the financial year.

Adequacy of targets

It is now clear that the targets set in 1989, and modified in 1995, were not adequate to address the salinity problem. This, coupled with the difficulties of reaching those targets, points to the need for a radical shift in the delivery of the program and its focus on on-farm works. This issue will be taken up in Chapter 4.

Extension program

The model of extension applied in the GBDSMP has essentially remained unchanged over the 12 years of its implementation. It is largely based on the philosophy of agricultural extension, using a combination of one-on-one and group extension techniques where appropriate. For the most part the aim has been to convince landholders of the appropriateness of better natural resource management and assist them to implement the works. Various attempts have been made to prove the profitability of preferred management practices, usually without a full understanding of the financial consequences (including peak debt, pay back period and borrowing requirements) or a proper recognition of the difficulty of changing long held practices or beliefs. Barr (1999) has analysed the process of change and it is notable that for the most part the extension agencies deal with only a small part of the process of change (see Community Education section).

A major difficulty in assessing the achievements of the extension program has been the lack of any suitable measure of success. Measures to date have been limited to the uptake of grants. Two crucial questions that need to be addressed in the short term are: 'To what extent the SMP relies on on-farm works program to achieve its goals?' and 'How does it best maximise the effectiveness of service delivery to the community?'

Community Links Officers

In 2000, and in response to the need to lift implementation rates, a program was developed to employ local community representatives to work within their communities as salinity extension officers. This was designed to provide a known contact person, and to overcome the problems of transient agency staff being unable to develop a rapport with local communities. Three part-time Community Links Officers were employed originally; this has since been expanded to six. Their role is to contact landholders, provide information on revegetation or remnant protection works, to prepare grant submissions, and to provide follow-up advice and support. The program has been very successful in expanding networks within local communities. It is believed that this closer link to the community is one of the reasons for the higher conversion rates. It has allowed a more pro-active approach to generating interest in works, more consistent follow-up on expressions of interest by landholders in grants, and the provision of information which is more specific to individual landholders' needs and interests. This closer contact with the community, along with the EMG's, is the reason for the improved rate of conversion of grants to works.

Communication Strategy

Effective communication with the regional community is essential for the successful implementation of the GBDSMP. However effective and efficient communication processes have proved to be difficult to achieve. A communication strategy was prepared with the objective of improving information flows to the community, and establishing protocols for communication between agencies. The plan was accepted by the Implementation Committees, but never formally implemented. It has since been replaced by other strategies of similar intent. The number of communication strategies, and the on-going call for better communication processes, points to:

- an as-yet unresolved definition of the true problem of communication within the catchment;
- a failure to properly identify the objective of a communication strategy; or
- a lack of commitment by service agencies to adapting to changed circumstances and changes in target groups.

This remains an important issue for the community groups and agencies to resolve. Any such attempts should focus on reviewing and, where appropriate, implementing what already exists (see Community Education Program).

Community education program

As a result of the Five Year Review of the Salinity Program, the objectives for Community Education program were broadened to:

- raise awareness of salinity and related Landcare issues within the community, particularly those communities directly affected by salinity in the Goulburn Broken Dryland;
- increase the community understanding of salinity and related land degradation issues;
- motivate the community to implement works recommended in the Goulburn Broken DSMP; and
- provide education programs to community groups and schools.

The review also flagged that the development of a Communications Strategy was a high priority, and that this strategy should develop programs for:

- Farming community
- Community groups
- Local government
- River Management Authorities
- Schools and other educational institutions
- NRE Staff
- C&LPB (now CMA)
- Water boards
- General Community

Successful programs such as the Community Salinity Grants Program, Saltwatch, Waterwatch and Watertable Watch would continue.

Achievements 1995-2001

The achievements for the Community Education Program for years 5 – 12 of the GBDSMP are as follows:

- Field day displays, tours, brochures, newsletters, television commercials and newspaper articles
- Development of a Communications Strategy for the Dryland in 1998
- Commencement Links Landcare support in 1999
- Development of Landcare Management Guidelines in 1999
- Community Liaison Position in the Upper catchment
- Survey of Landowners in 2000 to explore the willingness and capacity to manage dryland salinity
- Workshop on communication of NRM issues in 2000
- Development of an educational video
- Saltwatch in 2001, included 18 schools and 400 children
- Local Area Plan development
- Development of a Weed Booklet
- Education Kit for schools in conjunction with the Landcare Networks (in progress)
- Production of a resource booklet for NRM in the dryland catchment (in progress)
- Developing a information kit for Local Councils to send out with rates notices or when land changes hands (in progress)

The Community Education Program has been subsumed by the Landcare Support positions in the last two years. To the extent that Landcare plays a key role in the generation and transfer of information, this is a natural progression. When the support for Landcare is coupled to the work in schools and the development of education kits, we have a program that looks very much as it did 10 years ago.

It has been shown that awareness of salinity is high in the catchment, at greater than 90%, although there is no clear description of what the 'awareness' means. It could mean anything from being aware that there is a salt problem somewhere 'out there' to a full understanding of how salt is released into the landscape, the implications of that salt release and the appropriate means to deal with it.

Work by Curtis *et al* (2001) has also shown that land managers are unlikely to be concerned about salinity unless they have direct experience of its impacts. Curtis, when asking land managers about best management practices for salinity management, reported that landholders felt they had sufficient information or knew where to get information if they so required it. This suggests that efforts to provide information to landholders have been successful insofar as they appreciate the problem, but

probably not as successful in convincing landholders and the community in general of the extent or severity of the problem.

The Community Education Program, as it was originally conceived, has been successful. It has created a wide awareness of the problem, developed close associations with school programs through Saltwatch and Waterwatch, has been instrumental in the on-going support for landcare, and has been largely responsible for the heightened appreciation of social issues in the dryland.

There are some unique characteristics of natural resource programs that have been glossed over in the development of extension and education programs. These are:

1. the reliance on altruism at the expense of self-interest. There is an expectation that landholders should be prepared to sacrifice some part of their lifestyle in support of 'green' values.
2. the high level of community investment associated with natural resource programs. This brings with it a different set of accountabilities compared to industry funded programs more typical of agricultural extension programs.
3. the cause and effect relationships between actions and outcomes is far more tenuous in natural resource issues than other production issues. This increases the uncertainty about the appropriateness of actions being promoted to protect natural resources. It is well established that landholder interest in action wanes as the uncertainty of what they are being asked to do increases.

The assumptions now and then are listed in **Table 3**.

Table 3 Assumptions supporting the GBDSMP (MacFarlane 2002)

Assumptions at the start of the GBDSMP	Now
Awareness of a problem leads to action	• Awareness of a problem does not always lead to actions due to other social and economic priorities.
Most people recognise and understand the problem	• Very few people understand the problem and its causes in any detail.
Information leads to action	• The information required by individuals and parts of the community varies enormously. • Action is the result of a long chain of processes and information gathering is but one part of that process
Our information is sufficient	• Most of our information is technical. The key information on financial and social impacts is rarely considered • The available technical information is rarely sufficient to compel land managers to act
Land managers are homogenous	• No two land managers are the same in attitude, education, experience, business demands or aspirations
Our solutions are profitable and adaptable	• With few exceptions most of the proposed solutions have high financial risk and require new skills and changes to farming systems
Everyone wants to do their utmost to protect the natural resources of the catchment	• Most people are driven by short-term demands or have long term aspirations that do not take into account the condition of natural resources.
Salinity is a problem that can be managed with a strong on-farm focus	• Current information suggests that the scale of works required to remedy the problem of dryland salinity precludes relying on existing farming systems.
There will be sufficient support to landowners who want to protect natural resources	• There is neither sufficient support in terms of dollars or technical expertise to support all landowners who want to protect natural resources
By educating Landcare members we will be educating the rest of the community	• Landcare members are only a small part of the community and the program needs to include other groups.
Management of salinity in dryland areas can largely be accomplished using vegetation options	• The dryland salinity problem is amenable to control using vegetation in some parts of the landscape. Other parts of the landscape cannot be protected. Engineering solutions are an important part of the management of the impacts of dryland salinity in the short term

Our understanding of the assumptions behind the Plan have grown enormously over the past five years. This change is an example of how Plans develop and change with time. The challenge is what to do with the improved understanding.

It needs to be recognised that the changed assumptions have two important implications. First, and most obviously, are the implications for how we manage the Plan and how we interact with land managers. The second, and probably more important, is how we define and then work with an expanded target audience.

Pasture Program

The pasture program has been responsible for the majority of the area treated over the last 6 years (5,177 ha), through grants for the establishment of lucerne and perennial grass pasture. Much of this was effectively targeted to the Riverine Plains area and within the high priority LMU's 6 & 7a.

Lucerne

The water use of lucerne has been assumed to be similar to that of trees, and lucerne pastures were assumed to remain in place for 30 years or more, with no fall-off in water use. For pastures to be retained this long, requires a very high level of management, and there are few land managers who can, or want, to retain a lucerne pasture for so long. For the most part, lucerne is grown in rotation. The practice of intercropping lucerne is not widespread. This means lucerne is, at best, similar to perennial grass pasture in its water use patterns (GBCMA, 1995), and most likely only 40 to 50 % as effective as trees as an on-farm water use system. Nevertheless, lucerne remains an attractive option for producers in the catchment. As stated earlier, it is the one of the few management options showing an increase in implementation. rates.

Perennial Grass Pastures

The establishment of perennial grass pastures (particularly Cocksfoot and Phalaris) was a major focus of the original GBDSMP. Assistance for establishment of perennial grass pastures is now only provided in areas receiving less than 650mm annual rainfall. This is because their effectiveness in creating a large enough water deficit over the summer-autumn period is hampered by restricted root development in acid soils, with shallow A horizon. These are common characteristics of higher rainfall areas in the Goulburn Broken. In any event, their potential to create a soil water deficit under grazing is somewhat less than first thought at the inception of the Plan.

The Implementation Committees, in response to concerns raised by environmental groups, has placed restrictions on the use of exotic perennial grasses. In order to prevent the spread of Phalaris and Cocksfoot into remnant native vegetation areas, a 20 metre buffer is now required between perennial grass pasture and areas of remnant vegetation on roadsides.

Native Grass Pastures

The Salinity Program has investigated the potential role of native grasses in salinity management. It has been found that native grasses, on their own, did not increase water-use sufficiently to be considered a viable recharge management option, particularly in the higher rainfall areas. However, it is recognised that a well-managed native pasture with a good cover of perennial grass species such as Kangaroo Grass (Themeda), Wallaby Grass (Danthonia), or Weeping Grass (Microlaena) will be much more effective for recharge control than a weedy or annual pasture.

The management of existing native pastures to promote the spread of the surviving perennial species needs to be encouraged. Research and experience has shown that management of native pastures, through appropriate rotational grazing systems, can quickly lead to the spread of native grass species. It is likely that this is the most effective way to promote native grasses. At present, the cost of native grass seed and its low availability make the sowing of native grass pastures uneconomic.

Low-input management of remnant native pasture can be a cost-effective salinity treatment option where perennial pasture establishment or revegetation is either not economic, or not desired by the landholder. This approach appears particularly well suited to cleared high recharge hill country, on steeper slopes or where soils are shallow or stony.

It was also recognised that native grasses have a role in other issues beyond salinity management including the preventing soil erosion and maintaining or enhancing biodiversity.

Management

The water-use of all pastures is influenced by how they are managed. In general, management which optimises productivity can also optimise recharge control benefit, since water-use is directly related to pasture growth.

Set-stocking practices, or heavy grazing pressure over the summer-autumn period, compromises the effectiveness of pastures for recharge control, by reducing the leaf area and hence the transpiration potential. More intensive pasture management systems, such as the cell-grazing approach and appropriate lime and fertiliser applications, will increase the cover and vigour of perennial species, leading to increased productivity and increased water use. To date, this approach has not been widely adopted. This is due, in part, to the costs of additional fencing and stock water points, and its demands for continual and intensive monitoring and management.

Farm Trees Program

Trees are the most effective biophysical agent for controlling recharge, when planted at a sufficiently high density. The 1995 review recommended that the density of tree planting funded by the Program be increased to 500 stems to the hectare. This was subsequently adopted and implemented.

The review also recommended that a farm forestry/commercial forestry strategy be developed, as it was necessary to greatly increase the area planted under trees. Since then, considerable interest in farm forestry has developed as a result of work carried out by the Farm Forestry North East Program. Commercial hardwood plantations have been established by Eastern Plantations Forestry Limited, and significant progress has been made towards the establishment of a plantation hardwood industry. Plantations of Blue Gums and other hardwood species totalling several thousand hectares have been established across the North East.

In 1999-2000 a trial was undertaken in co-operation with the Co-operative Farm Forestry Initiative program to establish 10 farm forestry sites of 10 hectares or more in priority salinity areas in the below 650 mm rainfall zone. This now stands as a model for future development of farm forestry in the lower rainfall zones.

Our understanding of the effectiveness of trees for recharge control has developed significantly. Examples include the Break of Slope plantings, and investigations into where in the landscape plantations can best be located to maximise salinity benefit whilst still providing commercial return.

Cropping Program

The cropping program is no longer supported by the salinity program in the Goulburn Broken because of shifts in priorities of DNRE. It is highly unlikely that improved cropping management can significantly reduce recharge, unless new perennial crops are introduced or new techniques developed to manage recharge during fallow periods. However, improved management of crops in an altered landscape will be necessary across the Riverine Plains as part of an overall package of better management practices. The integration of lucerne into the cropping-pasture rotations remains a responsibility of the pasture extension component of the Plan.

Saline Agriculture Program

In the 1995 review it was considered that saline agriculture would never be a significant part of the Plan and was ranked a low priority. While there is no immediate urgency, the saline agriculture program will become an important component of the Plan in the future.

Saline discharge and groundwater management program

Groundwater pumping and reuse has been trialed as a salinity control measure by the GBDSMP in the Nagambie, Tatong, Lurg, Dookie and Colbinabbin areas. Pumped groundwater has been used for irrigation of lucerne, pasture, grapes and timber plantations. Investigations have been carried out on where to best target groundwater pumping for salinity control, and incentives are available for test drilling and groundwater pumping developments in priority areas across the dryland. There is currently a moratorium on further pumping from deep lead aquifers in the Nagambie area until sustainable yields are determined.

Generally, this can be an effective approach where groundwater yields and salinities are suitable, and where a sufficiently high value use of the water makes it an economic investment. Typically, it is the economic and social issues, rather than technical feasibility, which limit the application of this approach.

Since the dryland has never had access to any Salt Disposal Entitlements (SDE's), there has been no capacity to dispose saline groundwater to streams in the dryland. This still remains the case.

A set of possible conditions that, if met, would allow disposal of saline groundwater or diversion of saline surface or sub-surface water, was to be set out in the proposed Dryland Drainage Strategy. The completion of a Dryland Drainage Strategy was seen as a high priority in the 1995 Review. At the time of writing, the preparation of this strategy has been subsumed into the wider Floodplain Management Strategy, which is currently at a draft for comment stage. There is still a need to establish the rules by which salt disposal in the dryland can be managed, within the requirements of the MDBC SDE cap.

It was also suggested that the formation of a salt credit market might allow trading of SDE's into the dryland. Such market structures are still some way off.

Environmental program

The integration of the salinity program with the biodiversity and native vegetation management programs in the catchment is now all but complete. The Environmental Management Grants scheme combines environmental and salinity management outcomes in one assessment and prioritisation process. Funds from biodiversity and salinity programs are combined to ensure multiple benefits. The bioregional planning approach will be integrated with the EMG system when it is finalised.

The priorities of the Environmental Program of the GBDSMP have been superseded by the priorities under the Regional Native Vegetation Plan. The Salinity Program will continue to support the principles established under Victoria's Native Vegetation Management Framework.

There will need to be further co-ordination of monitoring data in the future, to better understand the threats and risks posed to biodiversity by dryland salinity. For example, it is highly unlikely that a significant level of expenditure can be justified to protect or enhance native vegetation in areas of the Riverine Plains where the predicted expansion of salinity and waterlogging makes that vegetation unviable.

Monitoring Program

Works monitoring

The past 6 years have seen substantial advances in the monitoring of works. The catchment developed its own program for monitoring works, the New Incentive Tracking System (NITS), which enabled monitoring of the progress in grants, from the initial site visit through to completion of works. The advantages of NITS were that it made data-entry easy, and compiled information on a central database. This concept was then picked up in a Statewide initiative under the Regional Data Net project, where the role of NITS was supplanted by the Catchment Activity Monitoring System (CAMS). While still supplying the functionality of NITS, CAMS is a web-based monitoring system able to be deployed Statewide.

Groundwater monitoring

The groundwater monitoring program was reviewed by CLPR (Cheng, 1999) which made a number of recommendations on improving the efficiency and cost-effectiveness of the program. The objective of the study was to improve the existing bore monitoring network and identify any shortcomings. This analysis included whether sites, or bores within sites, were required or redundant, their suitability to improving our understanding of groundwater processes, and the recommended frequency of bore readings.

The data has been used in several major studies (SKM, 1996; SKM, 1999; ANU, 2001; CLPR, 1999). A comprehensive report and analysis of bore trends was also produced by CLPR (Cheng, 2001).

Major gaps identified in the review, and since confirmed in the study by ANU (ANU, 2001), still exist at the Plains-Upland interface and in the upland area of the South West Goulburn. The recommendations required a significant increase in expenditure on monitoring which was agreed to by the Implementation Committees.

Stream monitoring

Two reports were produced by SKM on stream monitoring (Sinclair Knight Merz, 2000a, Sinclair Knight Merz, 2000b). They reported on the suitability of sites for monitoring stream salinity and flows, and made recommendations on filling in data gaps. The stream salinity monitoring data has been the basis of a number of important studies in the catchment, particularly the reports on catchment salt and water balance by SKM and ANU (Sinclair Knight Merz, 1996; Australian National University, 2001).

Environmental monitoring

Environmental monitoring continues in a modified form. At present, the environmental condition of Shire Dam Swamp, Dowdles Swamp, and Tahbilk Lagoon are regularly monitored and information forwarded to Water Ecoscience.

The monitoring of the condition of remnant vegetation stands now falls under the Regional Native Vegetation Plan. Development of appropriate measures for the extent and quality of native vegetation is progressing.

Discharge monitoring

The catchment continued to participate in the Statewide discharge monitoring program, coordinated by CLPR. The GB Dryland rejected a request to expand the program, because of concerns over the value of information generated. A subsequent review of the program led to a trial assessment in the summer of 1999/2000 of a more generalised mapping of discharge areas. Whilst the trial was successful, there have been no further resources allocated to discharge monitoring. This situation will have to be

reviewed in light of the projected increase in dryland salinity in the catchment, and the Broken and North Goulburn Plains areas in particular.

Community input

A second community input study was carried out in 1997 (DNRE, 1997). The results of the study confirmed the previous work by Madden (1992) that the amount of works (high-density trees and perennial pastures) completed by the community was 7-10 times the level of work supported by the natural resource programs of Government. The method followed did not allow us to identify the extent to which the additional works corresponded to priority areas, but it can be assumed that the effectiveness of these additional works is something less than 7-10 times because they are not necessarily well targeted.

Research and Investigations Program

The outcomes of the Research and Investigations Program have been used to develop much of the current strategic thinking in the Salinity Program, and as such are reported throughout this document. A short summary of the main developments follows.

Pastures

It is now generally accepted that perennial grass pastures in high rainfall areas (above 650 mm) have little advantage over annual pastures, especially under grazing. This is also exacerbated by:

- high pH soils in parts of the catchment which restricts root development, and
- thin soils on much of the highlands, which further limits the potential to create a sufficient soil water deficit to buffer against winter recharge.

As a consequence a decision was taken to no longer provide support for pasture establishment in areas where annual rainfall exceeds 650 mm.

Sub catchment hydrology

Priorities

Cheng (1999) and SKM (1999) developed a method to prioritise catchments according to their salinity levels and salt load levels, and risk of dryland salinity. This work was subsequently modified to provide a separate prioritisation by stream salinity and salt load, which will form the basis of priority setting in the future.

Catchment Characterisation

Under the Tools for Managing Salinity Project, the national catchment classification system was adapted to the Goulburn Broken catchment (Dyson, *unpub*). This defines the characteristics of 13 groundwater flow systems in the catchment, according to such qualities as aquifer properties, time to reach equilibrium, likely response to treatment, salt stores, risk and probable location of dryland salinity, and recharge risk areas. When combined with the priority sub-catchments, it provides a method for targeting works within high-risk groundwater flow systems, in high priority sub-catchments.

Goulburn Broken Salt and Water Balance Study

SKM (1996) provided a comprehensive analysis of salt and water balances for the five sub-regions of the catchment. It was this work that first highlighted the emerging problem of rising groundwater on the Riverine Plains. The study, in its efforts to partition salt fall and rainfall between the different components at a sub-regional level, also highlighted the difficulty of trying to extract too much information from too little data.

Salt and Water Balance (ANU, 2001)

Because of the difficulties encountered during the SKM work in 1996, and with the availability of improved methods of trend analysis, a study was commissioned to review the hydrologic status of the upland areas and stream trends across the catchment. The study differed in some areas from the 1996 work, particularly concerning stream trends, and in its estimates of recharge rates in the South West Goulburn area. It also highlighted the effect of lack of data in key areas (the Plains-Upland interface and the South West Goulburn). However, the conclusions support the general acceptance of high salt loads emanating from the South West Goulburn and high risks of dryland salinity in the Riverine Plain.

Broken and North Goulburn Plains Study

As a result of the coarse analysis on the Ultimate Salt Loads study and the Salt and Water Balance Study, further work was carried out on the Plains area of the catchment deemed to be at high risk of dryland salinity. The purpose of this study was to better estimate where dryland salinity would occur in the landscape, and what measures, if any, could be taken to control it. At the time of writing no results have been published.

Farm forestry

CLPR (2000) reported on the suitability of a range of different species for commercial forestry across the dryland. It showed that much of the catchment was suited to different species, but did not include an analysis of growth rates and hence commercial prospects. Commercial forestry potential on the Riverine Plains is limited to those areas overlying groundwater of low salinities. A spin-off from the study was an estimate of the area that was at risk of high water tables. It provided a somewhat less dramatic, though still alarming, estimate of area at risk than that produced by SKM (SKM, 1996; SKM, 1999).

Heartlands

The National Heartlands program selected a site in the Honeysuckle Creek catchment for long-term monitoring of salinity control programs. The site was selected as being representative of the low rainfall mixed cereal-livestock farming system in the Murray Darling Basin. The program has included extensive use of airborne geophysical sensing of sub-surface salt and water stores. Whilst not a high priority area in the Goulburn Broken dryland, the project offers the opportunity to explore some cutting edge science and trial a multi–disciplinary approach to landscape change.

Break of Slope Analysis

An analysis of the effectiveness of Break of Slope plantings was completed (CLPR, 1999) which showed that there was an effective drawdown up to 100 metres from the plantation at one site, but far less impact at another site. More work is required to determine the appropriate density and management of Break of Slope plantings to maximise their water use.

Engineering

Plan Co-ordination

Geographic Information Systems

The past 6 years has seen an enormous growth in the application of GIS technology to salinity management. This has enhanced our capacity to visualise the problems, and to integrate across issues such as water quality, native vegetation, and pest plants and animals. Spatial analysis has allowed us to predict the impact of reforestation on catchment yield, and better estimate the areas available to tree planting. It will also allow us to develop, for the first time, a catchment-wide recharge map as part of the overall priority setting process.

Local Area Planning

The need to integrate the Regional Management Planning process with community engagement processes is being met through the Local Area Planning project. This is designed to directly involve local communities in the management of natural resources. Twenty-one individual LAP's have been prepared, covering most of the Dryland. These have been combined into six collective Local Area Plans.

Local area planning in the dryland has particular challenges that are not well recognised by decision-makers. These include the vast area, the difficulties of engaging large segments of the population, the general decline in service delivery to the dryland and the attendant social problems, and the complexity of the issues that need to be dealt with. Nevertheless, there now exists a framework for negotiation with local communities on resource allocation to, and priorities in, the Local Area Plans.

The next stage is to link the LAP's to the Regional Management Planning process, and to then extend the LAP's to include other issues of importance to the community, either through direct action or by establishing links with other community initiatives. Local Area Planning needs to evolve into an ongoing communication process with local communities.

Economics/Sociology

Several studies were completed on the economic and social conditions in the catchments. Lavis (1997) reported on the true cost of establishing perennial pasture in the catchment, which showed there was a very wide range of costs (from $80/ha to over $300/ha), with a mean of $180/ha. As a consequence, the cost-share arrangements were adjusted to reflect the higher rate (increased from $120/ha to $180/ha).

A study was done through Charles Sturt University (Curtis *et al*, 2000) to evaluate landholder attitudes to natural resource management. It was a valuable and wide-ranging study, which included an analysis of the characteristics of the catchment population. In common with many other studies, it showed the catchment to be ageing (average age 58), with a concern for, but limited capacity to address, salinity issues. Only landholders directly affected by salinity recognised the magnitude of the problem and, by and large, landholders are not swayed by problems on other people's properties. Succession planning is still a major issue, with very different perceptions between generations on the fate of the family farms. Time and money are major constraints to any additional on-farm works, with more than two-thirds of the land holder population involved in some form of off-farm work. Rates of turnover of land ownership are very high, at 10% per year, particularly in the south of the catchment. At the same time, in other parts of the catchment, older members of the community are trapped on their farms, unable to sell their property, and unable to run it successfully as a commercial enterprise. There is at present a tendency to reduce cropping on the Riverine Plain because of the high costs of cropping and the low viability of many farms.

The report pointed to the need to better manage the transition of property ownership, because the most likely place to effect a change in the conditions of land use is at the point of sale. The report also highlighted the difficulty many landholders have had, and will have, is making time or resources available to carry out on-farm works, as well as limited community perceptions of the severity of the salinity problem.

Staff

The 5-year review recommended that staff levels need to be better managed, particularly through the identification and retention of core positions with longer-term contracts than were then on offer. Changes in Government policy have largely superseded this issue, but there is still a need to recognise the core services that need to be maintained.

Cost share

The Land Protection Incentive Scheme (LPIS) which assisted landholders to rehabilitate their land was well-developed at the commencement of the GBDSMP in 1990. The LPIS scheme was developed by the Soil Conservation Authority in the 1960's. It was established as an incentive undertake works; it was not based on any cost sharing principles.

Developments between 1989 and 1995

Several significant changes to grants and cost-sharing were approved by Government in the period 1989 to 1995.

These were:

- A change in the cost-sharing for the establishment of perennial pasture on high recharge areas.
- Break of Slope Planting.
- Groundwater pumping at Nagambie – including generic guidelines to expand groundwater pumping to other parts of the Catchment.

Perennial Pasture

The original incentive rates for perennial pasture establishment on high and moderate recharge were based on an average cost of establishing pasture of $120/ha. The cost share arrangments agreed to in the Government response to the GBDSMP were:

Very high priority Land Management Units 6 & 7a	50% ($60/ha)
other LMUs	25% ($30/ha)

The higher incentive rate for LMU 6 & 7a was based on the high salt loads emanating from these areas

and their impact on downstream users.

The Goulburn Broken Salinity Program Advisory Council (SPAC) became concerned with the low uptake of grants for perennial pasture in LMUs other than 6 & 7a. In resposne to this a rate equal to that for LMU 6 & 7a was approved for all high recharge areas in the catchment.

Break of Slope Plantings

The concept of interception of groundwater flow rather than direct interception was accepted in 1994 as an option for a few specific areas in the catchment. Incentive rates to encourage initial plantings to enable field assessment were endorsed by SPAC.

Groundwater Pumping

Groundwater pumping was not included in the initial Plan, due to a lack of information. Detailed studies since 1990, particularly of the groundwater levels in the Goulburn Deep Lead, led to the encouragement of groundwater pumping in the Nagambie area and the investigation of its relevance in other areas. Grants were made available to encourage this approach. The value of the grant was based on the equivalent salinity benefits to what high-density trees would cost.

The new rates at this time are shown below.

Table 4 Incentive rate in the Goulburn Broken dryland

New Incentive Rates	High Recharge	
	Public	Private
Break of Slope tree establishment	75	25
Pasture establishment (Incl. Lucerne)	50	50
Groundwater Pumping	$90/ML Max 80% & $13500	

Developments between 1995 and 2001

In the last five years, there has been a continuing change to the incentive/grant program and the concepts of cost sharing.

Major improvements have been made so that incentive rates reflect the current real costs of the implementation of works, and to better value the benefits of the works by looking at multiple benefits.

Detailed salinity investigations have led to some modification of programs so that some works are now not eligible for incentives. These works include:

- Establishment of perennial pasture is now not approved as a salinity control measure in areas with an annual rainfall over 600mm.

- Additional groundwater pumping in the Nagambie area is now suspended until further investigation is made of the Permissible Annual Value (PAV) of the deep lead aquifer

Cost share principles

The concept of cost share was developed in the late 80's and early 90's with the implementation of the salinity management plans. It was through these that cost-sharing based on the share of benefit derived from the works was first used in the Goulburn Broken.

The argument for sharing the cost of works in proportion to their benefit is now accepted widely in the community. The difficulty has been, and remains, the identification of costs and benefits to be included in cost share arrangements along with the lack of commonly agreed principles for such arrangements.

The GBCMA recognises the following cost share principles:

Duty of care – natural resource users and managers have a duty of care to ensure that they do not damage the natural resource base. They are responsible for making good any damage incurred as a result of their actions.

Beneficiary pays – when it is not possible to attribute damage, then primary beneficiaries should pay. Existing and future users are expected to pay for activities which provide private benefits. Contributions from secondary beneficiaries will be negotiated with the primary beneficiaries.

Government contributions for public benefit – government contributes primarily for activities which produce public benefits. Governments may contribute to land and water management activities that have a private benefit, where the cumulative uptake of these activities provides significant public benefit and government support is required to facilitate this uptake.

The Authority has identified four groups of beneficiaries. They are, the Federal Government, State and Local government (as representatives of the regional community) and the landholders. The Authority considers that the most appropriate policy is for the beneficiaries to share equally the "Public" component of the costs. Landholders will continue to pay for the major proportion of the required farm activities.

The costs of undertaking works, which includes capital costs, opportunity costs, maintenance costs and operating costs, has been identified as a major impediment to implementation.

These additional costs can almost double the cost of works (see Chapter 6) and are borne solely by the landholder. In most cases the landholder does not receive an equivalent benefit; the work is carried out in the expectation that the wider community does receive at least an equivalent benefit.

Environmental Management Grants system

As a result of a review of the incentive schemes a new Environmental Management Grants system (EMGs) was developed. EMGs combine three important principles

1. The cost share is based on the true capital cost of works for fencing and pasture or tree establishment. This costing is reviewed annually.

At this time the additional contribution of landholders from lost opportunity costs, replacement costs or depreciation and maintenance costs within fenced sites are not recognised in the cost share arrangements.

2. The benefits are assessed on multiple outcomes, including salinity, biodiversity and water quality

The use of a multiple benefit approach to incentives was pioneered in the Goulburn Broken Catchment, initially for GBCMA Partnership Grants (Waterway Grants). This approach has allowed the additional benefits of the proposed works to be taken into account in determining incentive rates. The development of the EMG system is the result of an integrated approach, at the on-ground level, for management of natural resource programs.

3. The benefits are assessed on the basis of catchment plans

To ensure that the community benefit is maximised the level of grants offered to landholders reflects the importance of the work to overall condition of the catchment. This is based on the priorities established through the action plans which underpin the Regional Catchment Strategy.

The implementation of EMG's has led to a large increase in the number of grants being taken up in 2001-2002. More time is required to properly evaluate whether or not the new system will attract a larger number of applications for assistance with works. The evaluation criteria for the EMGs are shown in Appendix 2.