

State Salinity Action Plan 1996

Review of the Department of Conservation and Land Management's programs

January 1997 to June 2000



Report to the Executive Director
Department of Conservation
and Land Management
Compiled by K J Wallace



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Currency of Report

While this report has been updated to incorporate some developments as recent as May 2001, the bulk of the report was completed during early December 2000, and is current at that date.

Disclaimer

This report is a review commissioned by the Executive Director, Department of Conservation and Land Management. The report was compiled by K J Wallace with assistance from a range of staff from the Department, and from the Forest Products Commission.

As well as reviewing Departmental programs described in the *Salinity Action Plan*, particularly those funded through the plan, the document is designed to stimulate discussion and contribute to the broader debate on salinity and its management. The recommendations and other comments in the document do not represent the policies of the Executive Director, the Department or the Minister for the Environment and Heritage, and Water Resources.

Cover

Main picture: The impact of rising salinity levels is clearly seen at Taarblin Lake.

Insets, from top: Yellow eyebright is almost extinct in other States, but the largest known population is found in Western Australia's Lake Muir Recovery Catchment; oil mallee seedlings ready for planting; a groundwater pump on the floor of Toolibin Lake, placed there to help protect the lake from becoming saline.

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PREFACE

Salinity is this century's first major challenge to sustainable land use and conservation of natural diversity in Western Australia's south-west agricultural region. While there will be many more such challenges, how we tackle salinity will set the pattern for our approach to natural resource management in the agricultural landscape. It will test whether we creatively meet and solve natural resource problems, or merely cope with them. Our ability to generate and implement innovative solutions to salinity and manage the associated social and cultural changes will shape our future and that of our children. It will determine whether we achieve sustainable land use and conserve natural diversity.

The *State Salinity Action Plan*, published in November 1996, provided the first integrated approach to salinity along with an injection of new funds to boost management action. Given the profound impact of salinity management on conservation of natural resources, it is essential we review progress regularly, identify and debate problems and issues, and adapt our salinity management responses.

It is in this spirit that I endorse this report, a review of the Department of Conservation and Land Management's salinity programs funded through the *State Salinity Action Plan*. For each program the report describes progress, identifies successes and problems, and recommends future action. This review also makes a timely contribution to the State Government's recently appointed Salinity Taskforce.

While I do not necessarily support all the conclusions and recommendations contained in the report, together they provide a basis for frank and constructive discussion of key aspects of salinity management. Some may be surprised at the frankness of the report and its openly self-critical nature in places. However, over the past decade some opportunities have been missed due to a lack of critical analysis. It is time for natural resource management to move beyond this phase.

I am proud of the Department's achievements in delivering such a complex set of programs in such a short period of time. One of the lessons so far is that there needs to be a wider understanding in the community of the hard work required to develop and implement such a demanding combination of planning, research and on-ground action.

I encourage people to read the report and join the constructive debate we need to help us evolve our salinity management so that we achieve salinity goals.



Dr Wally Cox
Executive Director

June 2001

EXECUTIVE SUMMARY

The release of the *Salinity Action Plan* in November 1996 marked significant new investment in salinity management by the State Government. Phased-in funding of an additional \$10 million per year was allocated, including \$4.65 million per year to biodiversity-related programs managed by the Department.

These programs are the primary focus of this Review. The Department's programs to develop new industries based on commercial woody revegetation are also discussed, but normal recurrent expenditure by the Department is not described. The Terms of Reference for the Review were to:

- review the Department of Conservation and Land Management's programs under the *State Salinity Action Plan* and its successor, the *Salinity Strategy*; and
- make recommendations for the future of the Department's programs under the *Salinity Strategy*.

Overview of programs managed by the Department to 30 June 2000

Initial progress of programs established under the *Salinity Action Plan* was slow until preliminary planning and investigations were completed and resources (human and other) established. However, the Department's role as an on-ground manager prior to the salinity programs greatly assisted funding to 'hit the ground'. Any serious attempt to manage salinity and conserve biodiversity will build on the funding and delivery processes already in place. Recommendations to achieve this are set out under the brief discussion on each program later in this section, and a funding summary is provided in Table 1 on page 7.

Although overall the early phases of programs have been slow, by June 2000 there were significant achievements. For example, in the Crown Reserves Program outcomes included extensive rehabilitation and revegetation work (nearly 850 hectares), strategic land purchases and greatly improved management of Crown reserves. The Department is now in a position to re-orient this program to make it more strategic and to increase the involvement of local landholders and groups.

The Natural Diversity Recovery Program is, in terms of on-ground biodiversity goals, the largest targeted program ever initiated in the south-west agricultural region. Work in recovery catchments is developing our understanding of salinity and how to manage it as well as protecting public assets. However, work in these areas has also been a reminder of the significant resources and long time periods required to make an impact. Where salinity is a major threat to biodiversity, current levels of funding will allow only small parts of the south-west agricultural region to be managed for recovery. Additional resources are essential if the program is to be expanded.

Two programs developing economic, environmentally sound solutions to recharge control are the Development of Tree and Shrub Crops for the Low/Medium Rainfall Zone and the Oil Mallee Program. If these programs receive the necessary support, they will deliver vital building blocks towards constructing sustainable, agricultural landscapes. The Department remains committed to the expansion of these essential programs, and the delivery of profitable perennial crops that integrate sustainable land use and biodiversity conservation.

Table 1: Current and proposed funding in millions of dollars for salinity programs managed by the Department

Program	Budget 2000–01*	Proposed Budget 2001–02	Proposed Budget 2002–03	Proposed Budget 2003–04	Proposed Budget 2004–05	Proposed Budget 2005–06
Crown Reserves	1.250	1.250	1.250	1.250 Review	1.250 as adjusted	1.250 as adjusted
Recovery Catchments	2.50	3.00	3.50	4.50	5.50	5.50 Review
Land for Wildlife	0.15	0.50	0.50	0.50	0.50 Review	0.50 as adjusted
Biological Survey	0.50	0.50	0.50	0.50 Review	0.50 as adjusted	0.50 as adjusted
Wetland Monitoring	0.25	0.292	0.305	0.33	0.33 Review	0.33 as adjusted
Monitoring (Salinity Strategy M&E project)	0	0.10	0.10	0.10	0.10 Review	0.10
Woody plant industry development	0	3.00	5.00	10.00	15.00	20.00 Review
Threatened flora seed collection, storage and databasing	0	0.16	0.16	0.16	0.16 Review	0.16
Databasing of threatened and priority flora in saline environments	0	0.05	0.05	0.05	0.05 Review	0.05
Databasing of threatened and priority fauna in saline environments	0	0.025	0	0	0	0
Carnaby’s cockatoo ‘flagship’ project	0	0.015	0	0	0	0
TOTALS	4.65	8.892	11.365	17.39	23.39	28.39

*The *Salinity Strategy* recommended that additional funds be granted in 2000–01. As at December 2000, these funds have not been granted; therefore it is proposed here that these funds become available in 2001–02.

Contributing across the Department’s salinity program are the Biological Survey Program and the Wetland Monitoring Program. The first of these two programs is providing the most comprehensive assessment ever of the south-west agricultural region’s biota. It is also describing the extent to which this unique biota is threatened by salinity. When complete, this survey will not only provide information upon which to base sound biodiversity management

decisions; it will also be an important resource for decision-making in revegetation, including the selection of prospective economic species. As the program is based on the survey of fixed sites (quadrats), it is also an invaluable resource for long-term monitoring. This monitoring function is greatly expanded by the Wetland Monitoring Program. This program is a re-vamped version of a long-term wetland monitoring project, and should (with the Biological Survey Program quadrats) be the basis for monitoring and evaluation of the *Salinity Strategy* in respect of biodiversity outcomes.

An important conclusion from the past five years is that it is important to have an effective mix of very targeted programs—such as the Natural Diversity Recovery Program—and other programs that are more broadly available to the rural community. The Land for Wildlife Program has been important in this regard. It also tackles the important issue of helping landholders better manage their remnants of native vegetation. The great success of the program and demands for its services challenge the Department's capacity to maintain a high quality program. Astute planning and a modest increase in resources will enable this important program to service the rural community effectively in the longer term.

Taken together, these Departmental programs are an important, integrated attack on salinity. At the same time, they are achieving much broader outcomes in terms of conservation of natural diversity and sustainable land use.

Crown Reserves Program

All remnant vegetation, especially if combined with appropriate revegetation, contributes to the control of salinity and protects nature conservation values. Remnant vegetation has many other values, including its contribution to water and soil conservation, its importance as a genetic resource for commercial and land conservation plants, and as the strategic building blocks for landscape revegetation and repair. However, the viability of remnants and their long-term value for salinity control and biodiversity conservation depend on effective management of a range of threats.

During the development of the *Salinity Action Plan*, the vital role of Crown reserves as the most significant component of remnant vegetation in the south-west agricultural region—based on extent, condition, biodiversity values, security of tenure and management for conservation—was acknowledged. It was also recognised that it was important for Government to improve significantly the management and protection of the land resource for which it is responsible, as well as encouraging protection of privately owned remnants. Therefore, the Crown Reserves Program was developed as a new, major, long-term commitment to the better management of remnant vegetation.

The Department already expends significant funds on Crown reserve protection through management of lands held under management order by the Conservation Commission. In this regard, the Department is the only agency that has expended significant resources on managing native vegetation on Crown reserves in the agricultural region. An important strategy adopted within the Crown Reserves Program has been to use salinity resources as contributory funds to obtain additional Commonwealth funding, particularly through the Natural Heritage Trust. This, and the Department's ability to develop synergies across a range of programs, has led to significant value-adding among the range of activities that improve the protection and management of remnant vegetation.

Of the \$3.65 million allocated to the Crown Reserves Program, all but \$210,000 has been expended through the Department's Regional Services Division, the group responsible for on-ground management of reserves. The carryover funds (3%) have resulted from delays to several projects, and this small amount has already been committed in the 2000-01 financial year.

Nearly 60% (\$1.9 million) of funds were allocated to rehabilitating degraded areas on reserves. In total, 384 sites totalling nearly 850 hectares were rehabilitated.

The second largest expenditure of funds (\$540,146), representing 16% of total expenditure, was on the purchase of nine parcels of land totalling 3,064 hectares.

Weed control over 7,200 hectares, and construction and maintenance of firebreaks, were also carried out (27 kilometres of fire access tracks constructed and 1,200 kilometres maintained). These two work activities were each allocated about 6% (\$200,000) of total funding. Remaining funds were expended across a wide range of activities, including planting seedlings and rabbit control.

During the life of the program to 30 June 2000 management activities were undertaken on some 360 Crown reserves (including some unallocated Crown land). While most of these have been conservation reserves, work has also been undertaken on a variety of other reserve types including water reserves and road reserves.

Improved management of Crown reserves in the agricultural region has resulted in improved water use and better long-term protection of nature, land and water conservation values. It has also demonstrated that Government cares for the land it is responsible for, and that this land is important. Other benefits are discussed more fully in the Crown Reserves Program chapter.

There have also been problems, the most serious of which has been the lack of infrastructure and other resources, causing a lag in program delivery. It is expected that this delay will be fully overcome in 2000-01.

Recommendation 1

The objectives and delivery of the Crown Reserves Program should be maintained. However, as the initial focus on rehabilitation works declines, the program should be expanded as elaborated in the following points.

Recommendation 2

Groups of Crown reserves of high biodiversity and salinity control value should be identified for concerted planning and management action (for example, Dongolocking and Wallatin Creek). This will entail development of selection criteria and their integration with other criteria (for example, those related to selecting recovery catchments and threatened ecological communities).

Recommendation 3

Guidelines should be developed and implemented for utilising some of the resources under the Crown Reserves Program on freehold and leasehold land where this contributes significantly to the protection of biodiversity values in Crown lands.

Recommendation 4

Some funds within the Crown Reserves Program should continue to be used to purchase land for addition to the conservation reserve system. Only land that is a high priority for conservation should be considered for purchase, and, as at present, the contribution of proposed purchases to salinity management should continue to be one of the criteria used in ranking purchases.

Recommendation 5

There should be greater collaboration with community groups over specific projects. Additionally, a geographical information system (GIS), bibliographic and other databases should be developed and implemented so that regional, community and other groups can be provided with biodiversity information for strategic planning.

Recommendation 6

Increased resources should be allocated to staff and staff support to meet the increased planning and liaison involved in implementing these recommendations.

Recommendation 7

Provided there is sufficient increased funding to the Natural Diversity Recovery Program, the above changes should be funded through a shift in emphasis and funds within the Crown Reserves Program, rather than additional funds being provided. However, this should be reviewed within three years.

Recommendation 8

Operational and strategic issues identified in the Problems/Difficulties section should be resolved. These include the need for:

- improved infrastructure and resources for delivery, including increased staff;
- standard notification procedures for local authorities, Aboriginal and landcare groups;
- standard reporting formats at all levels, and improved strategic planning and coordination;
- standard cost-sharing principles;
- training, recruitment and research to increase technical capacity to deliver outputs;
- development and implementation of a communications plan for the salinity program; and
- the appointment of a senior corporate officer to manage the Department's salinity program.

Recommendation 9

There should be resolution about the degree to which special projects, such as management of drainage and delivery of information into the Rapid Catchment Appraisal process, should be funded from the Crown Reserves Program, or another special allocation of funds.

Recommendation 10

There should be a conscious effort to maintain the broader benefits of the program (see Benefits/Highlights section).

Natural Diversity Recovery Program

Under the *Salinity Action Plan* the Government decided to apply intensive resources and management to protect valuable public assets threatened by salinity. Areas where these resources are focussed are called recovery catchments, and include natural diversity recovery catchments for the protection of natural, biophysical diversity.

The initial focus of the Natural Diversity Recovery Program was on catchments that contain wetlands of high biodiversity value, but protection of natural biodiversity throughout the agricultural region is also viewed as an important part of the program.

Three natural diversity recovery catchments were identified in the *Salinity Action Plan*: Toolibin Lake and Lake Warden, which are both listed under the Ramsar Convention as Wetlands of International Importance; and the Lake Muir-Unicup Wetland Complex.¹ A fourth, the Lake Bryde Wetland Complex, was identified by the Department early in 1999 and subsequently endorsed by the National Parks and Nature Conservation Authority and the State Salinity Council. The Salinity Council endorsed a fifth catchment, the Buntine-Marchagee Natural Diversity Recovery Catchment, during the preparation of this Review.

The selection of recovery catchments was based on a set of criteria developed by the Department. The results of the biological survey of the south-west agricultural region (see Biological Survey Program) are making an increasingly important contribution to these criteria. Once areas have been selected as recovery catchments, investment in recovery will continue for as long as it takes to achieve the stated recovery goals. The intention is that as these goals are achieved, then resources will be withdrawn or reduced and re-allocated to a new recovery catchment.

Management goals, recovery objectives and criteria, expenditure and outcomes are detailed for each recovery catchment in the Natural Diversity Recovery Program chapter. Total expenditure on natural diversity recovery catchments has been \$3.434 million. More than 85% of expenditure is accounted for by six categories of activity:

- planning and implementation of engineering works on reserves and private property \$944,770 (29%)
- revegetation and related fencing (552,350 seedlings on 338 ha) \$677,630 (19.5%)
- monitoring/research combined with biological survey \$624,667 (18%)
- purchase of 265 ha of strategic lands \$361,307 (10.5%)
- management of recovery and related committees \$255,443 (7.5%)
- fencing of remnant vegetation on private property (749 ha) \$202,010 (6%)

Taking Toolibin Lake as an example, some recovery criteria have been met, others not. The nature of salinity development means that at large scales it cannot be stopped, then rolled back, in short periods of time. The broad conservation values of the lake have been maintained in the face of severe pressure from salinity, although there have been damaging losses in the vegetation of the lake floor.

There have been other, highly significant outcomes from the recovery process:

- the information being collected through recovery catchments is vital to developing the State's knowledge about salinity, its development, and its control;
- work in recovery catchments contributes to the development and implementation of new technical solutions for salinity management;
- long-term liaison and partnerships between various agencies and private interests have been developed;
- the high resource input and long-term commitment required to combat serious natural resource management issues have been demonstrated, but equally apparent are the potential gains in achieving sustainable land use and conservation of natural resources, irrespective of the ultimate outcomes in relation to salinity.

¹ Lake Muir was added to the Ramsar list in 2001.

Another significant outcome from the recovery process at Muir-Unicup is that farmers are now raising social issues at recovery meetings. There is a shift in emphasis from concern about salt and water management to concern for maintaining the local community. This shows that groups established through recovery catchment activities may provide a useful vehicle for tackling other community issues.

The Review found a need for improvements, including better infrastructure and resources, better selection of species for revegetation and better information sharing. However, despite some concerns from communities outside recovery catchments who felt excluded, the Review found targeted government investment was a cornerstone of any serious attempt to conserve natural diversity in the agricultural region. An important aspect of targeting expenditure will be the development of effective environmental management systems that include risk assessment as a mechanism for establishing priorities. In the case of natural diversity recovery catchments, the Department will need to determine which potential recovery catchments are just too expensive to recover in relation to the values at risk.

Recommendation 11

The Natural Diversity Recovery Program should be expanded to cover areas that, while not necessarily containing wetlands, are of significant importance to biodiversity conservation and whose management will contribute to achieving positive downstream effects. Note that there is some capacity to achieve this through implementing the recommendations made under the Crown Reserves Program.

Recommendation 12

The Natural Diversity Recovery Program should be expanded to include the most important areas threatened by salinity identified through the Biological Survey Program. In doing this, it is also recommended that an effective environmental management system be developed that better integrates risk, costs and values than current procedures.

Recommendation 13

The Natural Diversity Recovery Program should be explicitly recognised for its importance in researching and developing solutions to salinity. Their role as living experiments that protect key public assets as well as contributing to research and development should be maintained and expanded. Works in recovery catchments will, if properly managed, underpin the achievement of both natural diversity conservation and sustainable land use objectives. This also underlines the program's role in maintaining the type of long-term monitoring required to develop and document effective practice in natural resource management.

Recommendation 14

The Natural Diversity Recovery Program should be funded to implement effectively recommendations 11 to 13 inclusive. An additional \$3.0 million (as recommended in the *Salinity Strategy*), scaled up over four years, should be allocated to natural diversity recovery catchments. It should be noted that this amount only substitutes for that which was to be sought from the Commonwealth Government under the *Salinity Action Plan*.

Recommendations 11, 12 and 14 are consistent with the *Salinity Strategy* recommendation that the number of natural diversity recovery catchments be expanded. However, Recommendation 14 is an extremely modest step given the extreme risk to biodiversity values throughout the agricultural region. Consequently, it is recommended that:

Recommendation 15

The adequacy of funding for this program should be reviewed in three years (February 2004). This will allow time to fully digest the outcomes of the biological survey, implement additional recovery catchments, and assess whether one or more earlier recovery catchments are in a position where they may be wound down.

Recommendation 16

At an operational level, the issues highlighted in the Problems/Difficulties section should be tackled by the Department, and action should be taken to maintain the positive outcomes listed within the highlights section and in the specific catchment accounts. This includes, but is not restricted to, developing and implementing:

- improved monitoring and GIS-based information systems;
- guidelines for species selection in revegetation;
- guidelines for cost-sharing and strategies to maximise adoption of actions sympathetic to conservation across the agricultural region;
- improved public access to documents and reports generated through the recovery process that will help other groups to implement salinity management;
- improved information exchange between officers involved with recovery works, both within the Department and with other officers managing Water and Rivers Commission (WRC) and Agriculture WA recovery catchments;
- maintaining the very effective inter-agency links and collaboration that have evolved at the recovery project level, while noting the need to broaden this beyond the project level (see previous point); and
- improved evaluation of proposed recovery catchments in terms of salinity hazard, values at risk, and costs to recover. In this regard it may be more fruitful, in some cases, to prevent areas higher in the landscape becoming saline than trying to implement expensive engineering in the valleys.

It is also recommended that these actions be tackled in consultation with other organisations involved in delivering highly targeted programs.

Land for Wildlife Program

As noted in the section on Crown Reserves, all remnant vegetation, whether on public or private land, contributes to the control of salinity and protects nature conservation values. While the Crown Reserves Program focuses on protecting these values in reserves, Land for Wildlife helps private landholders protect and manage their remnant vegetation.

Launched in February 1997, Land for Wildlife (LfW) is funded by the Department (through the *Salinity Action Plan*) and Environment Australia (through the Bushcare Program of the Natural Heritage Trust). Other State Government agencies provide support for landholders conserving native vegetation through the Remnant Vegetation Protection Scheme, and general advice and a range of covenanting schemes.

LfW is implemented by two full-time officers and part-time officers (3.2 FTEs) throughout the south-west. In general, they provide advice and information to guide private landholders and local government in the management of wildlife habitat values using sound ecological principles.

Salinity funds allocated to the LfW Program consist of \$75,000 in 1996–97 and \$150,000 per annum thereafter. These amounts were bolstered by \$100,000 from recovery catchment funds in 1998–99 and 1999–2000 as well as supplementary funds from the Department and grant funds from the Bushcare Program under the Natural Heritage Trust. The latter funds expire on 30 September 2001.

As at 1 September 2000, 683 applications for registration with LfW had been received, 509 of these properties had been assessed, and 80,083 hectares were being managed for nature conservation under the scheme.

In a readership survey of the LfW newsletter *Western Wildlife*, 74% of respondents said that they had used information gained from LfW to help manage their land, and 79% said they now have a better appreciation of their bushland. Nineteen workshops, field days, etc., have been specifically organised by LfW since August 1996, with 674 attendees.

The improved management of more than 80,000 hectares at a cost of \$9.17 per hectare is cost effective. However, the Review found some problems arising from a lack of ability to service the increasing demand from landholders.

Recommendation 17

LfW should receive additional, ongoing funding of \$200,000 per year to enable the Scheme to service areas where salinity is a significant issue, but there is as yet no LfW presence. This recommendation supports that made in the *Salinity Strategy*.

Recommendation 18

Natural Heritage Trust funding for LfW will cease on 31 May 2001. This will result in the loss of \$113,000 of Commonwealth funding. It is recommended that this be replaced with \$150,000 from State funds, an amount that will cover the loss of the Commonwealth funds plus a small amount for increasing costs. It is stressed that the Program will not be viable unless recommendations 17 and 18 occur. This money is required from the beginning of 2001–02 if the current LfW officers are to be maintained.

Recommendation 19

By December 2001 the Department's Wildlife Branch, in consultation with other stakeholders, should provide the Director of Nature Conservation with a strategic document that outlines how LfW should develop so that it is effectively integrated with other programs targeting private remnant vegetation, and is able to deliver effective management advice on an on-going basis.

Recommendation 20

LfW data should be GIS based and compatible with other GIS developments proposed for the Natural Diversity Recovery and Crown Reserves Programs.

Biological Survey Program

During the development of the *Salinity Action Plan* it was recognised that the natural biodiversity of the south-west agricultural region is generally poorly documented. Consequently, it was essential to survey the biological resources of the area to provide a basis for better management in the face of increasing salinity. Funding of \$500,000 per year was provided for the Department to undertake this work.

Preliminary results from the survey were incorporated into the 1998 Draft Plan and the subsequent *Salinity Strategy*. These reviews led to some modification of the Biological Survey Program; for example, it was proposed that the results of the Department's Biological Survey be combined with those of the SS2020 project to help define biodiversity conservation priorities.

For the purposes of the survey, the south-west agricultural region was divided into three zones: Northern, Central and Southern bands. Subsequently, a fourth area has been added comprising the Dandaragan Plateau and the section of the third band lying to the east of Ravensthorpe. While not directly part of the Biological Survey Program, the work of the Wetland Monitoring Program also provided important information.

The original budget of \$500,000 per year was to provide 120 terrestrial zoology quadrats for the entire study area. In 1997 alone, 100 terrestrial zoology quadrats were established, and it was recognised that the original estimate of 120 quadrats in total would be inadequate to deliver the expected outcomes. Consequently, in 1998 funding was increased to \$700,000 per year to ensure a more effective coverage and outcomes from the Program, which is now based on 300 quadrats.

Additionally, many more species were found during the survey than had been expected. For example, it had been anticipated (based on prior records) that some 130 taxa of spiders would be collected. However, about 600 taxa have been collected.

Given that the selection of areas for the Natural Diversity Recovery Program was dependent on an effective Biological Survey Program, it was decided to slow the selection of natural diversity recovery catchments—where start-up and development were, in any case, slower than expected—and allocate some resources across to the Biological Survey Program.

Therefore, the total budget for the Biological Survey Program for the Review period has been \$1.956 million. This was expended by June 2000.

The Department's Biological Survey Program is recognised as the leading Australian study of the effects of salinity on biodiversity. While it has generated results of immense value, such as identifying 450 species of endemic plants that are threatened, in the long-term, with extinction as a consequence of increasing salinity, it is important to be realistic about what has been achieved given the magnitude of the task. Following the WA Museum surveys in the wheatbelt during the 1970s, there was a tendency to assume the wheatbelt was 'known'. The current program has shown just how wrong this assumption was, and despite the vast gains under the current program, it has still sampled only a small percentage of a highly variable landscape of mega-biodiversity.

Recommendation 21

The current funding of \$500,000 to the Biological Survey Program should be maintained to deliver three related streams of work, namely:

- completion and delivery of the current surveys, including development and management of information systems that service the full array of clients;
- further biophysical surveys to complete the skeletal picture becoming available through current work, and to tackle specific issues; and
- delivery of natural diversity information to community groups and other clients.

Wetland Monitoring Program

Water depth, salinity and pH in a large number of wetlands south-west of a line from Geraldton to Esperance have been monitored by the Department and one of its predecessors since the late 1970s. However, this program was on the verge of collapse in 1996.

The principal objective of wetland monitoring undertaken by the Department under the *Salinity Action Plan* and *Salinity Strategy* is to determine long-term trends in natural diversity within wetlands, and provide a sound basis for corrective action.

The annual budget for the Wetland Monitoring Program has been \$250,000 per year in 1997–98, 1998–99 and 1999–00. An additional amount of \$19,000 was allocated in 1996–97 for urgent maintenance of the depth gauge network used in wetland monitoring. The program is implemented by a team of Departmental scientists and technical staff, and consultants are hired as required.

Regular monitoring is now being undertaken at 100 wetlands across the south-west agricultural area. Water level data from all but a few of the 100 wetlands and 51 additional wetlands monitored in the past have been secured by the installation and ‘survey to gauges’ of Department of Land Administration (DOLA) bench and reference marks. These survey marks now form part of the State geodetic network.

A new database, SWALMP (South West Athalassic Lake Monitoring Program), has been constructed to store and manage all data from this wetland monitoring. Progress has been made in preparing salinity data for trends analysis.

Outcomes in the following areas are detailed in the Wetland Monitoring Program chapter:

- physico-chemical monitoring of surface waters;
- flora monitoring;
- shallow groundwater monitoring; and
- fauna monitoring.

The Wetland Monitoring Program is not only essential to meet the specific objectives established for it under the *Salinity Action Plan* and *Salinity Strategy*; it also makes a vital contribution to a range of salinity management programs.

Recommendation 22

The fauna monitoring program should be expanded by an additional \$30,000 per annum commencing 2001–02 given that the current budget is not viable without substantial field and laboratory input by Dr Halse, and his input cannot continue indefinitely.

Recommendation 23

The overall program (physico-chemical monitoring of surface waters, flora monitoring, shallow groundwater monitoring, and fauna monitoring) should be maintained with an additional increment of \$50,000 per year (starting with \$12,000 in 2001–2002, \$25,000 in 2002–2003 rising to \$50,000 in 2003–2004) to cover inflation and other cost increases. It should be noted that, if additional funds are not provided, then sampling frequencies will have to be reduced to less than desirable levels.

Recommendation 24

Following completion of installation and development of the bore monitoring network, consideration should be given to whether some greater efficiencies might result from adding ongoing bore monitoring and its budget to the physico-chemical monitoring program.

Recommendation 25

Scientists involved in the program should advise the Director of Nature Conservation on means of presenting findings on trends so as to inform decision-making on salinity projects. While the monitoring program is only in its early stages, and there has been little repeat monitoring, it is important that analyses of trends are made available as soon as practicable for policy development and management.

Recommendation 26

The importance of maintaining a core of cross-disciplinary staff in the biological sciences to deliver effective long-term monitoring and value-adding to information should be explicitly recognised. Specifically, it is recommended that a long-term staff succession plan be prepared under the direction of the Department's Science Director, and that its implementation be negotiated with the program purchaser.

Oil Mallee Program

Under the *Salinity Action Plan* development of new vegetation systems—including commercial woody perennials—was highlighted as a priority area for salinity management. The development of further commercial crops, especially for the low rainfall areas, was seen as an important priority.

Apart from resources generated by the internal redistribution of funds and assets within the Department, none of the tree crop programs was provided with new funds under the *Salinity Action Plan* as it was proposed to seek Commonwealth funds for such research and development programs. The Department did, however, have funding committed to ongoing research and development of the oil mallee project, in partnership with the Oil Mallee Company and Oil Mallee Association.

The Oil Mallee Program recognises that initial public investment is essential to develop new plant industries. The development of oil mallees in Western Australia began with research and small trial plantings by Allan Barton at Murdoch University, then expanded to broadscale planting by the Department. A growers' representative group, the Oil Mallee Association, was formed in 1995. This group assumed control of the project in 1997, and sponsored the formation of the Oil Mallee Company to conduct harvest, processing and market development.

In 1999, the Company and Western Power Corporation (WPC) jointly investigated the feasibility of integrated processing of oil mallees. This investigation showed that integrated processing of mallee feedstocks to concurrently produce three products (eucalyptus oil, activated carbon and electricity) should be commercially viable. WPC is planning to construct a \$5 million demonstration plant to operationally test integrated processing.

Up until June 2000 investment in the Oil Mallee Program—excluding the proposed Integrated Mallee Processing Project—has been \$19.1 million. This has come from a range of sources, but does not include Salinity Action Plan funds.

The Oil Mallee Program has been highly effective in attracting farmers into revegetation and in the establishment of large plantings. Up to and including the winter of 2000, the program had involved 900 growers and the planting of 17 million seedlings (equivalent to 6,800 hectares).

With support from the Natural Heritage Trust Bushcare Program (1999 and 2000 planting years) farmers have been involved in plantings totalling 7.9 million mallees and 2.4 million trees planted for biodiversity objectives. In addition, 260 hectares of remnant native vegetation have been protected—by fencing and by buffering against recharge—as part of the Oil Mallee Program.

However, while farmers have shown great interest in mallees, many have limited their involvement and are waiting for the new crop to develop commercially.

The program is currently the only comprehensive program of its kind in the low rainfall zone. If successful, it will provide a model for a range of other industries based on native species.

Recommendation 27

There should be a co-ordinated State and Commonwealth commitment to systematic development of this major project. Funds of the order of \$2 to 3 million per year are required to maintain its momentum. Major items for development are:

- genetic improvement and seed production;
- definition of yield potential and harvest management regimes; and
- development of harvest and materials handling systems.

Public investment in these areas could be secured against future industry earnings.

Recommendation 28

The Department should retain its role as the main channel for State and Commonwealth Government agency support.

Development of Tree and Shrub Crops—Low/Medium Rainfall Programs

The development of commercial perennial crops, especially for the low rainfall zone (<400mm annual rainfall), was identified as an important priority under both the *Salinity Action Plan* and *Salinity Strategy*. However, there is currently no rigorous method for identifying and selecting woody plants for commercial development.

To begin this work, the Department designed and now leads a joint project with Agriculture WA and the Natural Heritage Trust Farm Forestry Program, to develop a search procedure and begin the development of ‘best bet’ species. This project is generally known as the Search Project. No new funds for the project were allocated under the *Salinity Action Plan* as it was anticipated that such work, particularly given its national values, would be supported by Commonwealth funds.

The *Salinity Strategy* confirms the need for new industries based on woody plants, and \$1.05 million per year, rising from a base of \$750,000, were proposed as new funds from State resources. To date Government has not committed these funds. Instead, Commonwealth Farm Forestry funds and State resources, particularly from the Department, support this project.

A project manager and 1.5 contract staff have been appointed.

By 30 June 2000, \$77,000 had been expended on developing a procedure to identify systematically the most prospective perennial species and products. The projected expenditure to 30 September of \$575,000 was not reached due to delays in commissioning pre-feasibility investigations. Demonstration planting accounted for a further \$208,000 to 30 June 2000 and \$270,000 to 30 September 2000.

The Search Project has achieved a national profile even before it has produced any results. For example, groups in CSIRO and eastern states agencies have sought collaboration, and the Rural Industries Research and Development Corporation listed compatibility with the objectives of the Search project as a selection criterion for new proposals. A Co-operative Research Centre proposal (CRC for Plant Based Management of Salinity) has also incorporated the Search concept into its proposal.

Although the commercial development of woody plants is addressed by the *Salinity Strategy*, the level of funding proposed is inadequate to achieve the developments necessary for salinity management. Under the *Salinity Strategy* \$1.05 million (including \$50,000 for seed collection) is proposed for allocation to the development of new industries based on native plants. While this is a significant improvement on the current situation, the reality is that development of a single new industry—and several are required—will cost in the order of \$20 million over 10 years.

Consequently, to develop the 10 best commercial prospects, of which it would be expected that at least two would develop into full industries, will cost an estimated \$20 million per year for 10 years.

Recommendation 29

The Department should strengthen its leadership role and infrastructure support for the Search Project and related developments.

Recommendation 30

Additional funding of \$20 million per year (scaled up over five years, with a total expenditure of \$200 million over 15 years) should be sought for research and development of new industries based on native plants. The intellectual property developed in this work should be used to enhance the competitive position of new enterprises committed to strategic, rapid industry development.

Maritime Pine Program

The development of an industry based on maritime pine (*Pinus pinaster*) is one of the key elements for revegetation in the medium rainfall zone (400 to 600mm annual rainfall).

None of the programs aimed at developing new industries based on woody plants was provided with new funds under the *Salinity Action Plan*. As part of the plan the Department did, however, undertake to redistribute existing funds to support the development of the Maritime Pine Program, with the following broad aims:

- to establish a new commercial industry in rural areas that has multiple benefits to the State; and
- to improve recharge control in the medium rainfall zone by providing a commercially viable option for increasing water use.

In 1996 the Government announced the potential to establish 500,000 hectares of maritime pine over 30 years. The current plan is to establish 150,000 hectares over 10 years.

All seedlings are produced at the Department's Plant Propagation Centre at Manjimup, where some \$12 million was spent in 1999–2000 on expanding the nursery facilities to accommodate cuttings production and an expanded program. The Manjimup Plant Propagation Centre can now produce an average of 8.5 million pine seedlings per year specifically for the Maritime Pine Program. The nursery can also potentially produce 500,000 seedlings per year for biodiversity plantings.

As at July 2000 there are some 255 individual sharefarmers with maritime pine established on their properties. A total of 11,757 hectares had been planted.

In 1999–2000 expenditure, excluding funds allocated to the Propagation Centre upgrade, was some \$6.152 million and the expenditure budget for 2000–01 is set at \$7.520 million. Previously funding was raised through the sale of Departmental assets. For 2000–01, \$4.520 million was to be borrowed. In future, funding is most likely to be sourced from investors or from the Government as a community service program.

This program now lies within the Forest Products Commission, and not within the Department of Conservation and Land Management. While the program has been included in this Review to complete reporting of the Department's activities against the *Salinity Action Plan* to 30 June 2000, recommendations concerning the future of the program are now the province of the Commission.

Nevertheless, an industry based on maritime pine remains one of the key elements of an effective revegetation package in the medium rainfall zone. It is essential that the commercial drivers for large-scale revegetation are developed as a matter of priority, and that the State capitalises on the potential synergies between the various projects aimed at developing such new industries. Continued support for the program as endorsed under both the *Salinity Action Plan* and *Salinity Strategy* is recommended.

Concluding remarks and strategic recommendations

This chapter takes a broader view than the others, and considers the Department's programs and role in the context of salinity management in general.

Despite the valuable outputs from work to date, it is also clear from the Review that we must do better in key areas to achieve the goals of the *Salinity Action Plan* and *Salinity Strategy*. While the programs reviewed all contribute to the achievement of sustainable land use and conservation of natural diversity, outside one or two recovery catchments there is little direct evidence that salinity is being slowed or reversed. This is not peculiar to the Department's activities; it applies to all current activities—private and government—carried out under the salinity management banner.

The reasons for this include:

- broad scale adoption of integrated salinity management practices has not occurred, largely because there are no economically viable solutions for either recharge control or discharge management;
- solutions are very slow to take positive effect;
- with the exception of some recovery catchments and some specific projects, there are no rigorous goals or accepted environmental management frameworks being used to define problems, generate management priorities, and set performance indicators;
- we are learning the science of salinity as we tackle it;
- more strong leaders and visionary personalities are required; and
- it is difficult for community and other groups to remain, over extended periods, active and fully engaged in salinity management.

Salinity management outcomes will be improved by:

- developing effective natural resource management goals and environmental management frameworks;
- developing technical solutions to ameliorate recharge and discharge;
- encouraging an appropriate culture;
- enacting effective legislation and regulation; and
- maintaining and developing partnerships.

Recommendation 31

Funding to salinity programs managed by the Department should be expanded as outlined in Table 1 (see also page 7). These amounts take into consideration recommendations made in the *Salinity Strategy* as well as in this document (see individual chapters for details).

Recommendation 32

The Department should develop goals and an environmental management system suitable for effective delivery of sustainable land use and conservation of natural diversity. The product should also be used to help develop both a model for managing natural resource management issues and a mechanism to rank programs and activities for salinity management.

Recommendation 33

Additional funding of \$20 million per year (scaled up over five years, with a total expenditure of \$200 million over 15 years) should be sought for research and development of new industries based on native plants. At the same time, the position of Government on ownership of intellectual property and on-ground resource development needs to be clarified. This is required to guarantee adequate return to the State on investment while still ensuring that substantial and focussed commercial development occurs. Government should use public intellectual property to give exclusive commercial advantage that carries with it an obligation to meet social and environmental bottom lines.

Recommendation 34

The Department should contribute strongly to the development of new, sustainable agronomic systems and industries that are sympathetic to conservation. Recommendation 33 is an important component of the Department's contribution; however, it is also crucial that the Department contribute to the development of new industries based on environmentally sound treatment of saline discharge. Recovery catchments and a reconstructed Crown Reserves Program should be the key mechanisms for implementing this recommendation.

Recommendation 35

The Department should assist and encourage the research and development of:

- socio-cultural frameworks that effectively describe the functioning of rural-urban systems in terms of natural resource decision-making and adoption of new innovations;
- methods for developing and maintaining robust and resilient rural communities; and
- links between quality of life at the individual level and natural resource management, particularly conservation of natural diversity.

Recommendation 36

The Department should expand its capacity to develop and maintain partnerships and collaborative projects by:

- providing additional resources (internal re-allocation) to support partnership building;
- training staff in building and maintaining partnerships and collaborative projects;
- where practicable and appropriate, encouraging staff to participate in community groups involved in natural resource management; and
- participating in regional groups and, in particular, helping them and government better define the roles and functions of these groups.

Recommendation 37

The Department should encourage and assist the development of effective legislation and regulation, particularly with respect to land clearing and drainage. This should be undertaken in conjunction with a review of the broader array of mechanisms—such as tradeable quotas, targeted tax rebates and cross-compliance—that may be applied to improve natural resource management in Western Australia.

Recommendation 38

A senior officer should be appointed to manage the complexity of the salinity management program and to provide an organisational focus for natural resource management within the Department. This officer would need support from one junior officer (level 3 or 4) skilled in databasing and spreadsheet operations to manage collation and analysis of data and to assist with administration and information management.

Recommendation 39

The Director of Nature Conservation should review budgets annually. Adjustments between programs managed by the Department should be made as appropriate and as endorsed by the Executive Director.

Recommendation 40

The total program managed by the Department should be reviewed in detail during the 2005–06 financial year. In the case of specific programs, earlier reviews are desirable—review years are provided in Table 1 (page 7). The earlier reviews are for those programs whose funding has been stable for three consecutive financial years.

INTRODUCTION

Background

W.E. Wood (1924) was one of the first to connect land clearing and agricultural land use with the development of salinity. However, it was not until the 1970s that the probable severity of salinity began to be recognised. Apart from concerns about loss of farmland, some in the rural community also became aware of the potentially profound impacts on biodiversity. In this regard community interest during the mid-1970s in conserving a threatened wetland, Toolibin Lake, is noteworthy.

During the early 1980s the modern form of Australian landcare began. This received considerable momentum with the launch of the National Soil Conservation Program in 1983. A coalition between the National Farmers Federation and the Australian Conservation Foundation further consolidated landcare as a key approach and the Federal Government declared the 1990s as the Decade of Landcare.

As the 1990s progressed, the threat salinity poses to a range of private and public assets became increasingly clear. A series of reports by Select Committees and others (Anon 1988, Anon 1991, Anon 1995) outlined some of the issues. There was also a range of actions by government agencies to address salinity, including many inter-agency endeavours, as well as individual and collective action by landholders.

During 1995 the State Government decided a more comprehensive review and plan of action were required, and 1996 saw the first thorough, cross-agency review of salinity. This was followed by a much more consolidated attack on salinity.

Brief history of the State Salinity Action Plan, Situation Statement and State Salinity Strategy

Following Ministerial instructions, Agriculture Western Australia, the Department of Conservation and Land Management, the Department of Environmental Protection (DEP) and the Water and Rivers Commission (WRC) met in January 1996 to begin development of a State Salinity Action Plan. Although the initial intent was to produce one consolidated document, it was realised this would be too large. Ultimately two documents—*Salinity; a Situation Statement for Western Australia*² and the *Western Australian Salinity Action Plan*³—were produced and released in November 1996 (Agriculture Western Australia *et al.* 1996a, 1996b).

In its own words (page 1), the *Situation Statement* “provides the background material upon which the *Salinity Action Plan* for Government and community action is built by:

- describing the causes, effects and implications of salinity;
- outlining options and practices for controlling and adapting to salinity.”

While our understanding of salinity and its causes, effects and implications has improved, and sections of the document are now out of date, the *Situation Statement* still provides the most accessible summary of the technical aspects of salinity.

² Referred to in the remainder of the document as the *Situation Statement*.

³ Referred to in the remainder of the document as the *Salinity Action Plan*.

Taking the *Situation Statement* as its background, the *Salinity Action Plan* aimed to (paraphrased from page 1):

- describe the causes of salinity and its threat to natural resources;
- set objectives for management of salinity;
- outline solutions that are currently available and how they can be improved with further technological development and improved planning and management;
- propose the implementation of viable land management practices as quickly as possible; and
- outline the overall approach to government coordination, monitoring of the plan and proposed funding of the actions.

A Cabinet Standing Committee, chaired by the Deputy Premier, was established with overall accountability for the *Salinity Action Plan*. A Salinity Council was also appointed by Government to report to the Committee on matters of policy and performance of the *Salinity Action Plan*.

The *Salinity Action Plan* was written by four Government agencies with little opportunity for wider consultation. While this was a consequence of delivering the documents within the required timeline, the lack of public consultation concerned the Salinity Council. Consequently, Council was keen to produce a new document based on public consultation to achieve broad ownership of the plan.

In March 1998 a re-written plan (State Salinity Council 1998⁴) was released for public comment. Subsequently, a new set of documents was released in April 2000. While collectively called *Natural Resource Management in Western Australia: Salinity* (State Salinity Council 2000⁵), this publication consists of three documents:

- The Salinity Strategy (2000);
- Salinity Actions (2000); and
- Salinity: A Guide for Land Managers.

The general thrust of these documents is consistent with the *Salinity Action Plan* and *Situation Statement*. However, there has been a tendency to ignore the *Situation Statement*, which is unfortunate, because it contains information that significantly adds to the plan. Some omissions for which the *Salinity Action Plan* has been criticised are covered in the *Situation Statement*.

Purpose of this Review

Under the *Salinity Action Plan* and continued under the *Salinity Strategy*, the Department received significant funds to better protect biodiversity from increasing salinity. This recognised the:

- high risk that salinity poses to the State's unique biodiversity;
- comparatively small amount of funds directed at conservation; and
- important contribution biodiversity can make, in various ways, to tackling salinity.

The *Salinity Strategy* was publicly released in April 2000, thus superseding the *Salinity Action Plan*. Consequently, with the end of the 1999–2000 financial year, it was opportune for the Department to evaluate its activities and accomplishments under the original plan.

⁴ Referred to in the remainder of the document as the 1998 Draft Plan.

⁵ Referred to collectively in the remainder of the document as the *Salinity Strategy* unless otherwise stated.

The Terms of Reference for this Review are that it will:

- review the Department of Conservation and Land Management's programs under the *State Salinity Action Plan* and its successor, the *Salinity Strategy*; and
- make recommendations for the future of the Department's programs under the *Salinity Strategy*.

As all new funds allocated to the Department under the *Salinity Action Plan* and *Salinity Strategy* are for salinity activities relating to biodiversity, these are the primary focus of this Review. Additionally, Departmental programs to develop new industries based on commercial woody revegetation are also dealt with. However, other actions listed in the salinity documents are not covered. In nearly all cases where programs are reviewed, only new funds or external funds are accounted for—normal recurrent expenditure by the Department is not described.

Goals, strategies, and funding

In this section, the overall goals, strategies and funding of the *Salinity Action Plan* and *Salinity Strategy* are summarised. Goals for specific programs conducted by the Department are given with the respective program chapters.

Goals and strategies

The aims stated in the original *Salinity Action Plan* (page 5) were to:

- reduce further deterioration of agricultural land and where possible recover or rehabilitate existing salt-affected land;
- protect and restore key water resources to ensure salinity levels are kept at a level that permits safe, potable water supplies in perpetuity;
- protect and restore high-value wetlands, and maintain natural (biological and physical) diversity within the agricultural areas of Western Australia; and
- protect designated infrastructure affected by salinity.

It should be noted that the aims provided in the Executive Summary of the *Salinity Action Plan* differ slightly from those in the main body of the text.

In the *Salinity Strategy* the general intent of these aims is retained. In this later document the goals are, with respect to the south-west agricultural region of Western Australia:

- to reduce the rate of degradation of agricultural and public land, and where practical recover, rehabilitate or manage salt-affected land;
- to protect and restore key water resources to ensure salinity levels are kept to a level that permits safe, potable water supplies in perpetuity;
- to protect and restore high value wetlands and natural vegetation, and maintain natural (biological and physical) diversity within the region;
- to provide communities with the capacity to address salinity issues and to manage the changes brought about by salinity; and
- to protect infrastructure affected by salinity.

To achieve its aims the *Salinity Action Plan* based actions on two fundamental principles (page 5):

- developing and implementing solutions that reduce net recharge and control saline groundwater; and
- taking an integrated approach to the planning and implementation of solutions at the catchment scale.

By 2000, these fundamental principles had become:

- salinity needs to be addressed by treating the causes of the problem, focussing on managing recharge and rising watertables;
- developing practical and environmentally sound methods that mitigate the impact of salinity by managing the discharge; and
- the strategy needs to be implemented in a partnership approach between all stakeholders at the regional and catchment scale.

In summary, apart from a more explicit focus on communities and partnerships, there are no significant changes in the broad goals across the two key salinity documents, particularly with respect to conservation of natural diversity.

In the *Salinity Action Plan* five categories of water management practices are described that are essential to salinity control. These are:

- introducing perennial species, both native and exotic, to increase water use;
- improving water use of annual crops and pastures;
- collection, re-use and/or disposal of surface water;
- drainage or pumping, re-use and/or disposal of groundwater; and
- protection and management of remnant vegetation.

To ensure these practices are effectively applied, the *Salinity Action Plan* goes on to describe the technology development required, challenges to business management, and implementation from the level of the individual to a range of catchment approaches.

Under the *Salinity Strategy*, the original five practices are again stated, albeit in slightly different form. However, greater emphasis is given to revegetation with native species and productive use of saline lands and saline water. Note, however, that these were not ignored during discussions in 1996. They are all listed in the Appendix of management practices in the *Situation Statement*, rather than in the *Salinity Action Plan*. The *Salinity Strategy* also introduces the importance of social impact management.

Finally, the *Salinity Strategy* considers in greater detail community and regional approaches to natural resource management. These serve to pick up more recent trends, but build on, rather than amend, the earlier work of the *Salinity Action Plan*.

Achievable goals

In tackling difficult natural resource management issues, such as salinity, where solutions are complex and progress difficult, it is very important to be clear about what is achievable, and at what scale.

The *Situation Statement* (page 15) recognises this issue, and points out that there are, conceptually, three approaches to salinity management:

- substantial recovery—reverse the salinisation process and recover damaged land and water resources;
- contain and control—bring the process under control so that further damage is contained; and
- live with it—adapt to the consequences of salinity and minimise the losses.

It was recognised that the State's salinity management would include a mix of all three, with the emphasis on recovery and containment. More recent, bleaker views of the development of salinity and our ability to manage it have led to greater focus on the 'live with it' option.

This stresses the need to clearly elaborate the goals of management in relation to salinity. For nature conservation, this process is outlined in the following extract from a paper that has been submitted for publication (Wallace).

Nature conservation goals are generally stated in broad terms in planning documents written for landscapes within southern Australia. Statements such as ‘maintaining and enhancing current biodiversity in natural ecosystems’, and ‘maintaining ecosystem processes and opportunities for current and future generations’ are common. As a starting point such broad goals are useful. However, in many fragmented landscapes population decline and losses continue. These losses will continue wherever natural habitats are inadequate to support viable populations of native biota, or where specific threats—for example, introduced plants and animals—overwhelm native populations.

In Western Australia, community-based catchment groups are an important focus for on-ground action and increasingly include biodiversity conservation objectives with their landcare work. These groups frequently include the concepts of ‘maintaining and enhancing natural biodiversity’ as one of their goals. While admirable, throughout much of agricultural Western Australia such a goal is not achievable at the catchment or sub-catchment scale. It is particularly important to provide these and similar groups with goal options that allow them to choose goals that inform, guide management action and unambiguously describe outcomes to which they may aspire. The following six options (based on Wallace 1998) outline the broad nature conservation goals available to most groups in fragmented landscapes.

1 Take no positive management action. That is, do nothing.

While technically this is not a goal, it is listed here because it is important for groups to decide, after considering all options, whether they do wish to include a nature conservation goal in their planning. Sometimes the decision will be to exclude such a goal, and it is preferable that this be made explicit.

2 Ensure that the current threats to nature conservation do not get worse.

That is, take action only to the extent needed to ensure that new threats to nature conservation are prevented. At their simplest, actions to achieve this goal include:

- preventing the introduction of new environmental weeds and diseases;
- stopping further destruction of natural habitat; and
- preventing the introduction of environmentally damaging animals.

In Western Australia it is difficult to achieve this goal given the high interest in testing new production systems based on exotic animals (particularly in aquaculture) and exotic perennial plants. Indeed, this goal has not yet been achieved at any regional level in Australia.

3 Slow the inevitable decline of biodiversity values in agricultural landscapes.

It is widely accepted that species loss from agricultural areas is continuing. While actions listed under (2) will help ensure that the rate of decline is not dramatically increased, they will not slow the rate of decline. To slow the rate of decline will involve a wide range of general enhancement techniques that include revegetation and improved remnant management. Actions described by Hussey and Wallace (1993) are required to “slow the inevitable decline”, although much of the information in that book would also lead towards the following goals.

4 Take positive steps to conserve specific elements of the biota, generally threatened species or communities.

At landscape scales, the shift from goal (3) to (4) is a quantum change. It requires much greater resources, and these must be committed over decades. In Western Australia at least, achieving this goal at landscape and broader scales has rarely been attempted without at least some government resources.

5 Take positive steps to conserve all natural populations in an area.

In fragmented landscapes this goal is difficult to achieve unless large areas of natural habitat remain.

6 Reconstruct landscapes and their natural biota.

This goal entails achieving (5) and then reintroducing those elements of the biota that have become locally extinct. Reintroductions are generally beyond the resources of most land managers. In Western Australia, reintroductions have generally been restricted to mammal and some bird species, in conjunction with control of the introduced fox, a major predator of small native animals. However, reintroduction of threatened plants is being used increasingly.

These goals may be variously combined and are not strictly in order of increasing difficulty, although this is generally the case as one moves from (1) to (6). Also, each goal normally includes the actions listed in previous goals and is increasingly more resource demanding. In fragmented landscapes, goals (4), (5) and (6) are particularly difficult to achieve and require a significant commitment of resources over long periods. The value of testing management objectives against these options is that this set of goals:

- emphasises what is achievable. For example, although the goals of community groups are often couched in terms of goals (4) or (5), this is rarely the reality. An examination of proposed management actions usually reveals that, at best, managers are slowing species decline, and so are generally meeting only goal (3). While goal (3) is worthy, particularly where resources are small, it is a very different outcome from (4), (5) or (6).
- highlights the size and duration of the resource commitment to achieve a specific goal. The probability of achieving a particular goal also decreases as one moves from (1) through to (6).
- makes it unlikely that groups will over-reach in developing objectives and thus suffer disillusionment when failure occurs.

An example of how these six goals can be developed into a range of useful goals to guide nature conservation is shown in Table 2. This table summarises goals being developed for the management of nature reserves in the wheatbelt of Western Australia.

The above discussion and the range of goal types in Table 2 emphasise the need to be clear about the nature conservation goals for management in relation to particular areas of management.

Funding

Upon release of the *Salinity Action Plan* in November 1996, the State Government allocated, over time, \$10 million per year of new funds including \$4.65 million per year to biodiversity-related programs managed by the Department. Funding provided to the Department is shown in Table 3.

The expenditure of the funds shown in Table 3 is explained separately for each salinity program within the relevant chapter of this report.

Table 2: The overall conservation goal is to conserve indigenous plants and animals in natural ecosystems. Table shows how this broad goal is dealt with in various landscape types

Landscape salinity risk	Management landscape type	Specific nature conservation goal
Management area lies within landscape units at very low risk from salinity.	Large (> 5,000 ha) nature reserve and adjoining lands.	To conserve all existing taxa of native species in natural or near natural ecosystems. (Minimum time scale of 50 years and 60% probability of success.)
	Large (> 30,000 ha) managed landscape of which a minimum of 20% or 6,000 ha of natural or semi-natural habitat exists and operates as a non-fragmented unit. Management of threatened communities often occurs within this category.	To conserve all existing taxa of native species (or threatened community) in natural or near natural ecosystems. (Minimum time scale of 50 years and 60% probability of success.)
	Small, managed landscape incorporating a threatened species.	To conserve the threatened species, or if this is not practicable, then manage the genetic material of the species to maintain it in perpetuity.
	All other areas.	To prevent or minimise the introduction of new threats and to slow the rate of decline.
Management area lies within a landscape, or includes landscape units, highly threatened by salinity.	Catchment that includes significant threatened community(ies) or species that it is feasible to manage so as to protect from the worst effects of salinity.	To conserve the threatened community(ies) or species. (Minimum time scale of 50 years and 70% probability of success.)
	All other areas.	To prevent or minimise the introduction of new threats and to slow the rate of decline; and/or To identify unique taxonomic elements that will be lost and conserve representative sample of genotypes.

Table 3: Funding provided through the *Salinity Action Plan*

Program	Budget 1996–97	Budget 1997–98	Budget 1998–99	Budget 1999–2000	TOTALS
Crown Reserves Program	0	1.15	1.25	1.25	3.65
Recovery Catchments	0.080	0.385	2.50	2.50	5.465
Land for Wildlife	0.070	0.15	0.15	0.15	0.52
Biological Survey	0.056	0.500	0.500	0.500	1.556
Monitoring	0.019	0.250	0.250	0.250	0.769
TOTALS	0.225	2.435	4.65	4.65	11.96

NOTE: Development of commercial woody plants is not shown in this table, as they received no new funds through the *Salinity Action Plan*.

Structure of the Review Report

This Review contains eight chapters devoted to programs managed by the Department under the *Salinity Action Plan*. These are the:

- Crown Reserves Program;
- Natural Diversity Recovery Program;
- Land for Wildlife Program;
- Biological Survey Program;
- Wetland Monitoring Program;
- Oil Mallee Program;
- Development of Tree and Shrub Crops—Low/Medium Rainfall Programs; and
- Maritime Pine Program.

The first five of these received funding through the *Salinity Action Plan*. The Department has had a major role in, or managed, the remaining programs, all of which are discussed in the *Salinity Action Plan*, but were not funded through it. (However, the Maritime Pine Program received additional funding through the redistribution of existing Departmental resources, in accordance with commitments in the *Salinity Action Plan*.) The Maritime Pine Program ceased to be managed by the Department with the creation of the Forest Products Commission in November 2000.

Each program chapter includes sections dealing with:

- objectives and program rationale;
- implementation methods;
- outputs and outcomes from the program; and
- recommendations for the future of the program.

At the end of the Review is a concluding chapter. Apart from general comments on the combined Departmental programs, this chapter does not aim to summarise the Review. Rather, it discusses important, broader issues relating to salinity management that are not picked up by the specific program chapters. This chapter was added once it was realised that there are a number of critical issues that, while germane to the Department's programs, would not be effectively covered in descriptions of specialist programs.

The preceding chapter, the Executive Summary, provides an overview of the programs and conclusions on broader aspects of salinity management. It contains all the recommendations together with a summary of program highlights and benefits. While providing an overview of the document, the reader should refer to specific program chapters for a detailed account of activities, expenditure, outputs, outcomes and recommendations.

CROWN RESERVES PROGRAM

Background and rationale

Remnant vegetation occupies 2.8 million of the 20.8 million hectares of privately owned land in the south-west agricultural region.⁶ It occurs mainly as small areas and is often degraded. A further 4.5 million hectares of native vegetation occurs in State forests, national parks, nature reserves and other Crown lands. State forest and national parks in the region are generally large (at least in relative terms compared to remnant vegetation on private land) and concentrated in the south-western and coastal parts of the region (Map 1). In contrast, the remaining reserves are generally small and are mostly scattered throughout the main cereal-growing part of the region (see Map 1, Table 4 and Figure 1 on page 35).

Table 4: Public and private lands in the south-west agricultural region

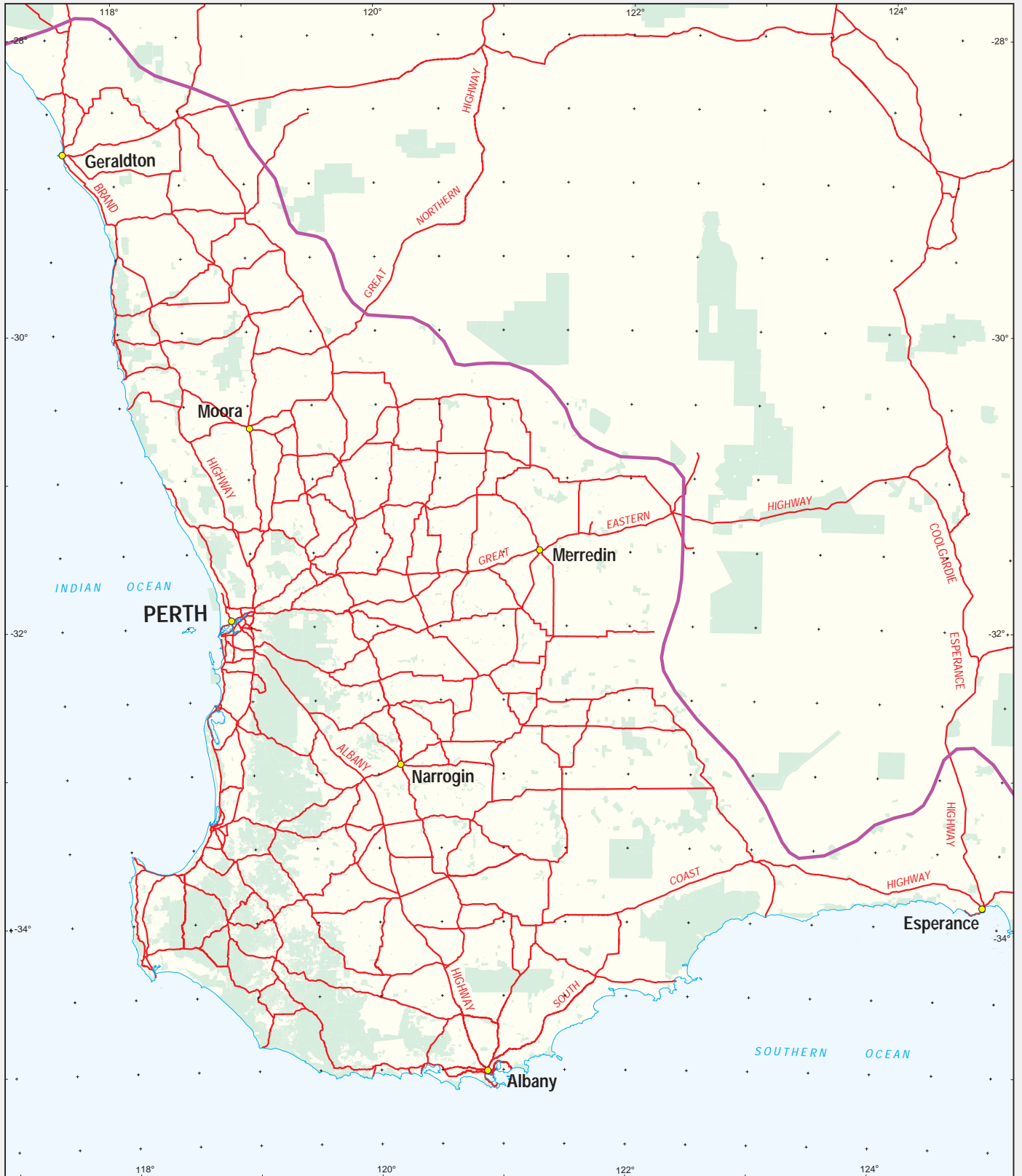
Land use	Area (millions of hectares)	Percentage of area within the south-west agricultural region
Cleared land (private property)	18.0	71%
Private remnant vegetation	2.8	11%
Sub-total: area of private land	20.8	82%
Public land in State forest and associated parks and reserves within the main forest belt including coastal parks between Augusta and Denmark.	2.35	9.5%
Other reserves and unallocated Crown land	2.15	8.5%
Sub-total: area of Crown land	4.5	18%
TOTAL	25.3	100%

Remnant areas of native vegetation are vital for biodiversity conservation, and particularly valued for salinity control where:

- individual remnants or reserves are large enough to affect recharge at a catchment or sub-catchment scale; or
- smaller remnants or reserves occur on high recharge zones (deep sands and around rocky outcrops) or discharge zones (for example, drainage lines, swamps and lakes).

Remnant vegetation has many other values including its contribution to water and soil conservation (Wallace 1994). It is also an important genetic resource for commercial and land conservation plants, and provides the strategic building blocks for landscape revegetation and repair. This role is underlined by the cost of revegetation, which may range from about \$800 (direct seeding with bought seed) to \$3,000 (specialist planting with seedlings) per hectare depending on site characteristics and project aims. Taking \$1,000 per hectare as a median

⁶ The account in the introductory paragraphs is adapted from a number of sources including information in the 1998 Draft Plan (pages 14 and 15).



Map 1
Lands and waters managed by the
Department of Conservation and Land Management
in the south-west agricultural region

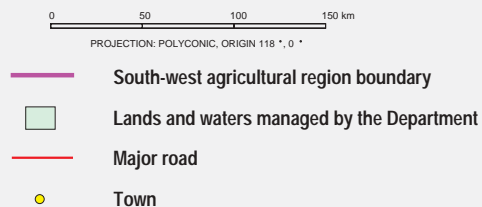


figure for revegetation costs, the replacement value of existing remnant vegetation in the south-west agricultural region is \$7.3 billion.

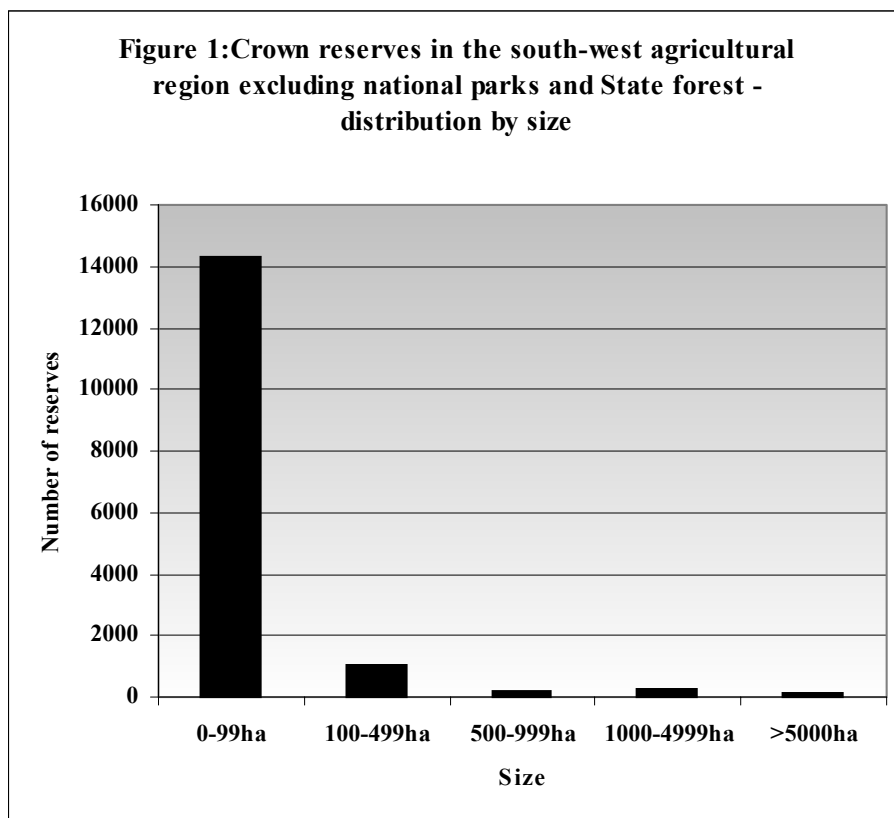
All remnant vegetation, especially if combined with appropriate revegetation, contributes to the control of salinity and protects nature conservation values. Thus remnants of native vegetation significantly contribute to achieving sustainable land use and biodiversity conservation.

However, the viability of remnants and their long-term value for salinity control and biodiversity conservation depend on effective management of a range of threats. These threats include salinity, weeds, feral animals, and inappropriate disturbance events such as too frequent or too infrequent fires (see Table 5).

Table 5: Threats to the long-term viability and value of native vegetation remnants

Threats	Examples of impacts
Impacts of introduced plants and animals	Rabbit and stock grazing, and its direct impact on water use values and the regeneration of native plants. Plant examples include bridal creeper and annual veldt grass.
Impacts of problem native species	Parrot and spring beetle damage to remnant vegetation and associated revegetation.
Detrimental regimes of physical disturbance events, such as fire, cyclone, drought	Too frequent fires, reducing the water use and regeneration ability of particular plants.
Altered biogeochemical processes, for example, disrupted water and nutrient cycles	Salinity, waterlogging and eutrophication all affect the viability of remnant vegetation.
An unsympathetic culture in rural and urban communities	Lack of understanding of remnant values leads to them not being accorded a high priority for management.
Inappropriate use of pesticides	Herbicide drift frequently kills native plants.
Impacts of disease	<i>Phytophthora</i> and other diseases severely affect the viability of native vegetation in some areas.
Competing land uses	Gravel mining, rubbish dumping and inappropriate recreation degrade remnant vegetation.
Insufficient resources to maintain viable populations	In highly cleared agricultural areas there is simply not enough native vegetation to support viable populations of some native plants and animals, irrespective of whether the above threats are controlled.

Recognising the value of remnant vegetation, the State Government has funded a range of activities and programs to better protect and manage these important lands. During the development of the *Salinity Action Plan*, the vital role of Crown reserves as the most significant component of remnant vegetation in the south-west agricultural region—based on extent, condition, biodiversity values, security of tenure and management for conservation—was acknowledged. It was also recognised that it was important for Government to



significantly improve the management and protection of the land resource for which it is responsible, as well as encouraging protection of privately owned remnants.

Therefore, the Crown Reserves Program was developed as a new, major long-term commitment to the better management of remnant vegetation.

Objectives

The Crown Reserves Program has two inter-related goals. These are:

- to contribute to the protection and restoration of high-value wetlands and natural vegetation, and maintain natural (biological and physical) diversity within the region; and
- to improve the management and protection of native vegetation remnants so that their long-term contribution to salinity control is maintained and, where practicable, improved.

The first of these goals is taken, with minor adjustments, from the *Salinity Strategy* (page 10). The second goal recognises that protection of remnant vegetation is one of the key mechanisms for combating salinity. Thus the Crown Reserves Program contributes to all goals in the *Salinity Action Plan*, and all *Salinity Strategy* goals apart from that dealing with community capacity. However, some of the projects within the Program involving community groups are contributing to the development of community capacity, and this will be an increasing trend if the recommendations at the end of the chapter are implemented.

The Crown Reserves Program has been implemented by developing activities to counteract the threats listed in Table 5. These activities, and their contribution to salinity control, are summarised in Appendix 1.

There are two other important points. Firstly, the Department already expends significant funds on Crown reserve protection through management of lands held under management order by the Conservation Commission. In this regard, the Department is the only agency that has expended significant resources on managing native vegetation on Crown reserves in the agricultural region. Secondly, an important strategy adopted within the Crown Reserves Program has been to use salinity resources as contributory funds to obtain additional Commonwealth funding, particularly through the Natural Heritage Trust (NHT). This, and the Department's ability to develop synergies across a range of programs, has led to significant value-adding among the range of activities that improve the protection and management of remnant vegetation.

Implementation methods

Procedures

The Crown Reserves Program has generally been implemented through the Department's Regional Services Division. With operational centres throughout the south-west, this group provides the most cost-effective mechanism for delivering on-ground activities and outcomes.

Before the beginning of each financial year the Department's six administrative regions (see Map 2) with land in the south-west agricultural region submit draft programs to the Director of Nature Conservation. Following discussion between the Director and regional staff, programs are then endorsed and funds allocated for expenditure.

Funds under the Crown Reserves Program must be expended in ways that have a significant, positive effect on:

- salinity control; and
- conservation of natural biodiversity.

These two points reflect the goals for the program described in the preceding section.

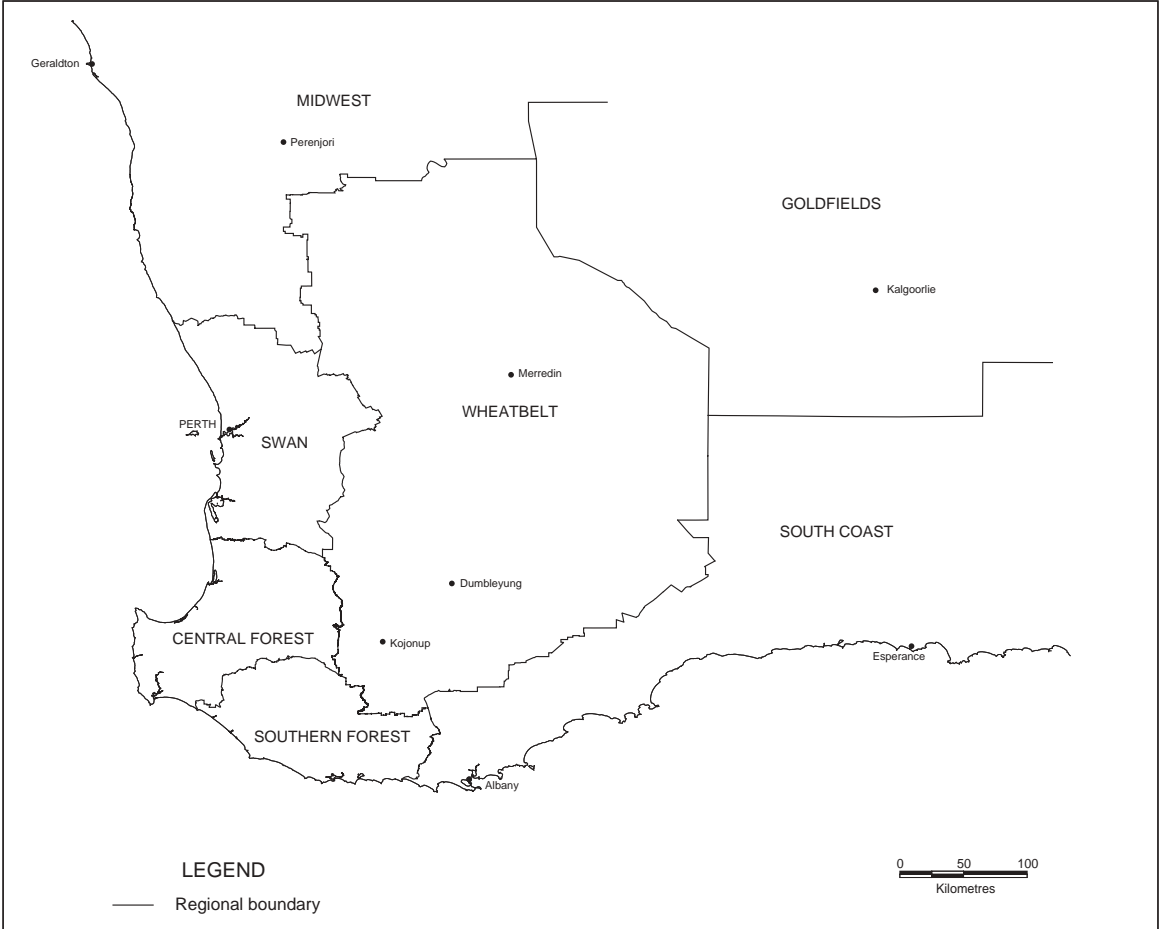
Guidelines and criteria

Allocation of funds between regions

At the outset of the program two strategies for allocating funds between regions were considered. These were to either:

- invite regions to submit projects for funding, and for these to be ranked and funds allocated accordingly; or
- partition funds between regions on the basis of agreed guidelines.

It was agreed to adopt the latter method in the first years of the program. However, it was anticipated that a mixture of the two approaches would be taken in the longer term.



Map 2
Department of Conservation and Land Management
regional boundaries in the south-west

Seven criteria for developing regional guidelines were considered:

- a) Relative area in salinity hazard zones (see Figure 2.2 in the *Situation Statement*). The extreme hazard zone for salinity lies largely below 400 mm annual rainfall. However, the map is generalised, and it was decided that it would not be a useful tool by itself for allocating funds.
- b) Degree of clearing in catchments and regions. More highly cleared localities are generally, but not always, at greater salinity risk than more vegetated areas. Exceptions include areas such as parts of the Wellington Catchment.
- c) Availability of tree crops. Tree crops (*Eucalyptus globulus*, *Pinus pinaster* and *P. radiata*) are available in higher rainfall zones and there is significant commercial funding of revegetation in these areas. Therefore regions without such profitable, recharge control measures are a higher priority for salinity action.
- d) Biological values at risk. The most obvious zone in this regard is the transitional rainfall zone lying from Kalbarri in the north through the wheatbelt and into the southern sandplains. Within this zone biodiversity values are at most risk in highly cleared areas. However, throughout the south-west there are local sites of high diversity. Their significance will be of greater importance when allocating priorities within, rather than between, regions.
- e) Size of Crown reserves. Larger Crown reserves, such as Lake Magenta Nature Reserve and Fitzgerald River National Park, are generally of lower priority for management works. These areas are sufficiently large that works within them will have less impact on salinity than is the case with smaller reserves. (However, it should be noted that salinity is having an impact on parts of Lake Magenta Nature Reserve, and this may necessitate works on freehold land in partnership with landowners.) Conversely, works on smaller Crown reserves (certainly less than 5–6,000 ha) will have a more significant, positive effect on the reserves themselves and on their catchments. This criterion is more useful for distinguishing between projects rather than between regions.
- f) Intensity of pressures from human use. Areas with high people pressures will have higher levels of degradation (for example, illegal green firewood gathering and gravel mining). However, while acknowledged as an issue, it is difficult to use this to compare regions.
- g) Areas currently in good condition but at significant risk in the future. However, it was decided that this point is more relevant in comparing particular projects, rather than regions.

Given points (b) and (e) in particular, it was agreed that priorities for funding should target regions with high numbers of small to medium sized reserves within highly cleared landscapes. It was expected that the application of salinity funds in these areas would have more immediate impact and achieve greater cost-effectiveness. To quantify these factors three estimates (Table 6) were used:

1. Numbers of nature reserves by region. High numbers within a region generally reflect high fragmentation of the conservation estate, and correlate with numbers of Crown reserves in total.
2. Area of cleared land within each region.
3. Area of cleared land plus private property remnant vegetation (estimates total area of agricultural/pastoral land within a region). This correlates with predicted levels of salinity at equilibrium. That is, regions with large areas of cleared land and remnant vegetation on private property are those that have the highest salinity hazards (see Figure 2.2 in the *Situation Statement*).

Allocations derived by this means are also consistent with criteria (a), (c) and (d).

Guidelines and priority works for Crown reserve funds

At the outset of the program the Director of Nature Conservation made it clear (1997) that, while some new personnel would be needed to implement the program, appointments must be kept to an absolute minimum. Throughout the program, an aim has been to maximise on-ground outcomes.

Therefore, funding has been focussed on direct management of Crown reserves. Initial priorities (in order) were:

Rehabilitation/revegetation of tracks, gravel pits, cleared areas: Works in this category were a priority given the obvious links between recharge control and improved biodiversity conservation values achieved. Where practicable, the focus was on catchments where maximum advantage from increased water use is attained and where revegetation will thrive. For example, dieback-infected areas may be a low priority unless appropriate species are available for revegetation.

Additional officers/running costs/administration: While funding to this area was tightly controlled, some resources were required to support the program so that it could be implemented without jeopardising existing Departmental programs. This item is listed as second priority given that the program could not have been effectively implemented without additional corporate resources.

Management of processes that damage transpiration tissues and thus decrease water use in remnants: Reducing herbivory by exotic and pest herbivores was a high priority. The aim of management actions was to significantly reduce damage to transpiration tissues and thus have a positive impact on plant water use.

Management of annual weeds, or other weeds detrimentally affecting water use by woody vegetation: It was seen as important to tackle those weeds that have a detrimental effect on water use, particularly by perennial plants.

Table 6: Figures used to calculate percentage allocation of funds in 1997–98

Departmental Region	Area (ha) of cleared land* (% in brackets)	Number of nature reserves (% in brackets)	Area (ha) of private property*(% in brackets)	% Crown funds allocated to Regions
Midwest	3602025 (20.02)	146 (13.00)	4263526 (20.54)	20%
South Coast	2486144 (13.82)	149 (13.6)	3022975 (14.56)	14%
Southern Forest	470619 (2.62)	48 (4.40)	561925 (2.71)	4%
Central Forest	750438 (4.17)	53 (4.80)	989194 (4.77)	4%
Swan	1317331 (7.32)	113 (10.30)	1539001 (7.41)	8%
Wheatbelt	9361556 (52.04)	589 (53.60)	10381185 (50.01)	50%

* These data are based on information held by Agriculture WA. Note that these land areas are for the agricultural region. They do not include, for example, freehold lands lying outside the agricultural zone within Departmental regions. The private property figure includes remnant vegetation on private property (often highly modified) as well as cleared land.

Maintenance of firebreaks for remnant protection: While initially few funds were expended in this area, it was acknowledged that too frequent or extensive fires will decrease water use, and that firebreaks are important in this context. Concerns expressed by some local communities were also taken into consideration. As the program evolved, it was also decided that some highly strategic fire access track construction was permissible.

Land purchases: While a secondary focus for attention, it was recognised that selected purchases of privately owned remnants will have an important strategic role in achieving the program's objectives, particularly where they:

- contribute significantly to achieving salinity goals (for example, protect important recharge or discharge zones, or contribute significantly to vegetated areas of catchments);
- accord with nature conservation priorities;
- adjoin, and add significantly to, current conservation reserves, thus greatly enhancing their viability and allowing more cost-effective protection and management; and
- contribute to an agreed catchment group program.

It was also acknowledged that, in special cases, the purchase and revegetation of cleared areas would be strategically important in achieving program objectives.

Other guidelines discussed and agreed during the early part of the program were that, in general, funds should:

- not be allocated to large areas such as Dragon Rocks Nature Reserve, Stirling Range National Park, etc.;
- concentrate on achievements within small and medium-sized reserves;
- be directed to catchments where there will be greatest hydrological benefits;
- achieve nature conservation goals; and

- take advantage of catchments where local groups have works programs, and contribute to them.

The importance of some of these program activities in delivering broader objectives for salinity management was recognised at the outset. For example, the value of land purchases in not only allowing the better protection and management of remnant vegetation, but also contributing to:

- rationalisation of land use to reflect land capability and Government policy (such as land clearing controls); and
- making local funds available, at the individual level, for improving farming practice and viability.

While these points were not developed into criteria for guiding land purchases, they were recognised as important additional reasons for maintaining the land purchase sub-program.

These guidelines for expenditure have been maintained throughout the program except that the range of work activities has been expanded. The range of current activities is described in Appendix 1.

Outputs and outcomes

Expenditure, outputs and activities

Expenditure

Total expenditure under the Crown Reserves Program between 1 July 1997 and 30 June 2000 is summarised below:

Expenditure through regional operations	3,323,729
Contingency	150,000
Drainage consultancies	60,000
<u>Carryover of committed funds to 2000–01</u>	<u>116,271</u>
TOTAL	3,650,000

Of the \$3.65 million allocated to the Crown Reserves Program, all but \$210,000 has been expended through the Department's Regional Services Division, the group responsible for on-ground management of reserves. The carryover funds (3%) have resulted from delays to several projects, and this small amount has already been committed in the 2000–01 financial year.

Details of the \$3.32 million expended by regional operations are contained in Appendix 2. Key factors that affect interpretation of this information are:

- data were not originally collated in this format—therefore some outputs and allocations are estimates;
- expenditure and related on-ground results may occur in different financial years—for example, seed collection and purchase of fencing materials are often in the financial year before implementation on the ground;
- in some cases work activities will involve the same piece of land for several years in a row. For example, weed control may be essential on the same area for many years—therefore care must be taken when interpreting accumulated figures over the life of the project;

- the same work activity may incorporate different actions—for example, rehabilitation works may or may not include some rubbish removal or burial, and may or may not include planting of seedlings.

Despite these factors, Appendix 2 provides a very good picture of expenditure against the range of activities undertaken and outputs delivered.

Outputs and outcomes

By far the largest work activity was rehabilitating degraded areas on reserves. Nearly 60% (\$1.9 million) of funds were allocated to this activity. In total, 384 sites totalling nearly 850 hectares were rehabilitated. This represents a cost per hectare of \$2,265. Given the extensive ripping and shaping required for old quarries and the high cost of treating small, scattered work sites, this is a cost-effective result taking the \$1–2,000 cost per hectare for tree planting as a benchmark. However, it must be noted that some of the areas rehabilitated will require follow-up works, such as weed control and planting where natural regeneration is ineffective.

Outcomes from rehabilitation work have included:

- improved recharge control by increasing the vegetated area of Crown reserves;
- decreased costs, in the longer term, for reserve management given that quarries and other degraded areas on reserves often attract further degradation, such as rubbish dumping including environmental weeds; and
- a range of other indirect benefits detailed in the Benefits/Highlights section below.

The second largest expenditure of funds (\$540,146), representing 16% of total expenditure, was on the purchase of nine parcels of land totalling 3,064 hectares. This is a significant addition to the conservation estate and outcomes include:

- significantly improved, long-term protection of the water use values of the areas purchased;
- significantly improved, long-term protection of the conservation values of the areas purchased;
- improved viability, in most cases, of adjoining or nearby Crown reserves—it is proposed to improve the connection and buffering of groups of reserves in the landscape, and these purchases will contribute significantly to this process;
- assistance with the necessary process of rationalising land use in the agricultural region by, in the case of the purchases, bringing tenure and land use into appropriate alignment to the mutual benefit of sellers and the State.

As judged by expenditure, the two next largest outputs were weed control, and construction and maintenance of firebreaks. These two work activities were each allocated about 6% (\$200,000) of total funding.

Over the three-year period weed control was undertaken on some 190 sites totalling 7,200 hectares. However, note that these figures are accumulated across years—in some cases the same site was treated more than once. Nevertheless, the accumulated figures best represent the effort that has gone into weed control, a very important activity, particularly where annual weeds compete with native perennial plants and thus detrimentally affect water use and conservation values.

The 27 kilometres of fire access tracks constructed and 1,200 km (an accumulated figure) maintained are an important contribution to local fire control. Their contribution to maintaining water use, particularly in the <450 mm annual rainfall zone, is the reduced probability of wildfires burning an excessive area of vegetation types that regenerate slowly.

Remaining funds were expended across a wide range of activities. Other, specific outputs include:

- 28,600 seedlings planted on 53.5 hectares of private lands to improve the viability and values of Crown reserves;
- rabbit control over 95 sites representing about 12,500 hectares—note that these are accumulated figures across years, and include some repeated sites;
- the removal (including burial) of rubbish from 171 sites;
- involvement of more than 20 community groups and 1,800 individuals during the program; and
- other outputs as shown in Appendix 4.

Taken together, the outputs from the program represent an impressive array of activities and on-ground outcomes. During the life of the program to 30 June 2000 management activities have been undertaken on some 360 Crown reserves (including some unallocated Crown land). While most of these have been conservation reserves, work has also been undertaken on a variety of other reserve types including water reserves and road reserves. The most notable of the latter activities has been the completion of planning for a combined Departmental/local authority project in the Esperance District to rehabilitate old gravel pits on road reserves that contain significant vegetation for conservation. On-ground works will begin in the 2000–01 financial year.

In summary, the program has delivered a range of important outputs leading to improved management of Crown reserves in the agricultural region. Important outcomes have included:

- improved water use through improved management;
- better long-term protection of nature, land and water conservation values;
- proof that Government cares for the land it is responsible for, and that this land is important—a very important message from Government that needs to be constantly reinforced—it is not a ‘one-off’ message.

While much of the work undertaken will have long-lasting impacts, land management is a continuous process. Effort must be maintained to continue delivering the range of benefits realised under the Crown Reserves Program.

Problems/Difficulties

Lack of infrastructure and other resources: The rapid escalation in natural resource management activity with the Natural Heritage Trust, *Salinity Action Plan*, regional natural resource management initiatives, and heightened interest in land degradation generally has overtaxed the resources available to deliver natural resource management programs. This has occurred because:

1. Australia-wide, there are too few experienced officers working in natural resource management. This was compounded by a decline in recruitment among natural resource management agencies during the late 1980s and early 1990s. While landcare did develop a small group of professionals, their skills were largely in facilitation, coordination, planning and awareness raising. Thus there was no pool of staff to draw on and allow a rapid scaling-up of efforts, particularly in the biodiversity conservation area. In this regard the Department was partially protected by its graduate recruitment program and its ability to attract some experienced officers from the agricultural disciplines.
2. The availability of offices, technology systems and other infrastructure to support a rapid expansion of activities has, in some cases, placed a strain on delivering works. Within the Department this is most notable at Narrogin, the major inland centre for delivery of biodiversity programs.

3. It is difficult to attract, and hold, experienced young staff inland. Such staff are essential to deliver effective on-ground outcomes in natural resource management. This problem occurs across all organisations, including community landcare groups struggling to appoint and retain coordinators.
4. There is an inevitable time-lag between starting a program, including appointment of staff, on the one hand, and delivering effective outcomes on the other. Building an effective team takes time. However, the politics of natural resource management demands rapid results.
5. Natural resource management problems are complex and their resolution is long-term. Outside the *Salinity Strategy*, many current programs are based on short projects and therefore short-term employment contracts.

Existing capacity within the Department has helped speed delivery of the Crown Reserves Program in comparison with others that have not had similar levels of available infrastructure. However, the program has still been affected by each of the above problems. Effective delivery of natural resource management programs will not occur unless these issues are redressed.

Thus while the aim of maximising on-ground outcomes through the Crown Reserves Program was appropriate, this inevitably strained resources for planning, supervision and implementation. In retrospect, the proportion of resources allocated to these functions and related support was under-done. While some adjustments have been made as the program developed, this is still an important issue. In general, a modest increase in staff investment and related infrastructure would have allowed more strategic application of the program and greater opportunities for interacting with community groups during projects. This issue is dealt with below.

A marked effect of this resource issue has been the lag in program delivery. It is expected that the delay in full delivery will be fully overcome in 2000–01.

Community concerns with rehabilitation: Rehabilitation programs in some cases attracted negative comment from community members. While concerns occasionally related to loss of public access to specific sites, most arose where works—particularly gravel pit rehabilitation—entailed the removal of some living vegetation. Longer-term results will justify this approach, but in the short-term the community concerns are understandable. Generally these concerns were allayed by field trips and discussions with interested individuals. Also, in the wheatbelt, notifications of proposed works were sent for information and comment to land conservation district committees as well as local authorities after the first two years of the project. It was found that notification to local authorities alone was not sufficient to inform local communities.

Notifications to Aboriginal groups: While not a major issue, works were sometimes slowed by the lead times necessary for effective consultation with Aboriginal groups.

Strategic planning, coordination and reporting of program delivery: Although there has been regular reporting of program outcomes, a consistent format has not been developed. While understandable during the development of a new program, it is important that reporting formats are now settled. It has also been suggested that a GIS may provide the best platform for documenting outputs. Documentation of expenditure at the corporate level also needs to be improved. These issues reflect that there is considerable capacity to better coordinate and manage the program, including sharing of ideas and experiences between all groups involved. At the same time, as the emphasis of the program changes away from the early focus on rehabilitation, it is very important that strategic planning is used to provide a planning framework and identify priorities for action. To achieve this level of coordination and

strategic management would require the appointment of a senior officer at corporate level to manage the salinity program.

Lack of technical capacity: Operational personnel have raised a series of technical matters that might be resolved by a combination of training, recruitment and investigations. These matters include:

- contract supervision and management;
- use of herbicides;
- lack of knowledge concerning appropriate herbicides in mixed plantings; and
- the need for more resources for hydrological advice despite good support from Agriculture WA officers in the field.

Weather effects: Major cyclonic rainfall events have occurred several times during the program. This has caused major disruption to rehabilitation programs in some areas. While planning can overcome some issues, such broad scale disruption inevitably results in some carryover of funds and work.

Education and awareness: There has been relatively good coverage of the program in the rural press and radio. *Golden West Network* also covered one story. To expand education and awareness programs would be at the cost of on-ground works. However, it is important to maintain the current level of rural media information and better inform urban audiences. To achieve this a communications plan is required. This report (or a summary) should also be circulated to key stakeholders.

Benefits and highlights

Cost-effective outputs: Taken together, the outputs and outcomes listed in Appendix 2 and described in the sections above on expenditure, outcomes and outputs represent a significant improvement in management of Crown reserves. Given that remnants of native vegetation in Crown reserves are the largest resource of perennial vegetation in the agricultural region, and are the most important conservation resource, this is an important contribution to natural resource management.

Involvement of Aboriginal groups: In a number of cases Aboriginal groups were contracted to assist with implementing on-ground works including weed control, tree planting, seed collection and rubbish removal. Not only did this achieve the outcomes of the program; it put money into local communities and provided employment opportunities. In one instance an Aboriginal was supported through part (six months) of a TAFE landcare trainee course while working on landcare projects.

Involvement of community and other groups: There has been a range of projects involving other groups in work on Crown reserves under the program. Examples of these projects include:

- joint work between the Hyden Progress Association, Shire of Kondinin and the Department to clean-up and rehabilitate areas associated with adjoining nature and local authority reserves at Hyden;
- use by Greening Australia (WA) of sites revegetated under the Crown Reserves Program to show community groups examples of successful direct seeding techniques;
- the planned rehabilitation of old gravel and limestone pits located within the Esperance Shire, some as old as 20-30 years. This joint project between the Department and the Esperance Shire developed following discussions between the Minister for the Environment and Council in March 1999. Under the project, old pits have been assessed in relation to their location, the surrounding biological values, degree of weed infestation,

significance as a wildlife corridor, and potential value in relation to local groundwater control. Current and more recently established pits remain the responsibility of Council. Joint inspections of priority pits for rehabilitation have occurred, and works will begin during 2000–01 under the Crown Reserves Program;

- volunteer support from the Friends of Wyalkatchem group (weed control at Korrelocking Nature Reserve);
- in 1998–99 the Shire of Bruce Rock included the Department’s nature reserve rehabilitation work within the Shire’s achievements for the Keep Australia Beautiful ‘Tidy Towns Competition’.

Contracting of local businesses and expenditure in local areas: Throughout the program to date there has been significant use of regionally based contractors. These contractors have ranged from those with earthmoving machinery involved in rehabilitation works, to Aboriginal and other groups contracted to plant trees and collect rubbish.

Meeting community concerns: Funding through the Crown Reserves Program has enabled specific community concerns to be addressed to the advantage of both the program and the community. For example, following extensive frosting of crops in 1998, there was considerable community concern that widespread burning of heavy stubbles would present a significant wildfire risk where crops adjoined Crown reserves. At the same time program managers were concerned that, if wildfires were too large, water use would decline (particularly in the central and eastern wheatbelt where regeneration rates are slow) and biodiversity values would be damaged. These risks and community concerns were eased by firebreak maintenance on some particularly vulnerable reserves.

Demonstrating someone cares for Crown land: Past experience (anecdotal) has shown that reserves that are never managed and for whom no-one is clearly responsible are subject to greater abuse from quarrying, illegal timber removal and other degrading activities. An important aspect of the Crown Reserves Program is that it demonstrates that someone does care for Crown reserves, and that they are important. This is a very important message from Government that needs to be constantly reinforced—it is not a ‘one-off’ message. Given that degradation attracts further neglect—for example, gravel pits are used for dumping weeds and other rubbish—the rehabilitation component of the program will also decrease the likelihood of further damaging use. This is one of the reasons rehabilitation of quarries was an early activity under the program.

Research and development: Operational personnel have taken the opportunity to trial techniques, particularly in revegetation, along with implementation of on-ground actions. This includes testing of smoked water and direct seeding trials.

Use as contributory funds into NHT and synergy with other programs: An important added value of the salinity programs has been their use to leverage other funds, and the synergy that has developed between programs. In particular, funds have been used as contributory funds into the Meta Project.⁷ In the case of the Crown Reserves Program, this has involved a partnership with Recovery Catchment Program funds to access capacity building positions and additional funds for on-ground works under the Meta Project.

Advantage has also been gained through synergies with other management programs. For example, a number of species of threatened flora have been translocated in conjunction with gravel pit rehabilitation.

⁷ Natural Heritage Trust Project No. 973855, full title ‘State Agency Contributions to Land Conservation and Biodiversity Revegetation’.

Of great value has been the sharing of expertise, ideas, technical knowledge and equipment between the Meta Project, recovery catchment projects, Land for Wildlife and other programs. The benefits from this will increase as the programs have now completed their start-up phase, and staff have developed valuable experience and knowledge. However, keeping programs running and maintaining the core of experienced staff that have developed are important issues.

Delivery of technical capacity and demonstrated on-ground results for natural resource management: If natural resource management is to achieve targets of sustainability and biodiversity conservation, it is absolutely imperative that the technical capacity, synergies and the flow of demonstrated on-ground results from the group of projects described above is maintained.

Recommendations for future program

The Crown Reserves Program has significantly improved the protection and management of Crown reserves. However, even when combined with on-going agency expenditure, it is not sufficient to fully deliver the Program's objectives throughout the south-west agricultural region. This is simply an acknowledgment that all the threats listed in Table 5 cannot be managed everywhere, all of the time, with the current allocation of resources.

Therefore, although the broad approach of the Program in its first years was appropriate to demonstrate that Government values native vegetation remnants and is serious about their management, there is now scope to selectively apply some of the funds. The most obvious mechanism for doing this is to target groups of reserves that should be managed as a unit. This is similar to the Natural Diversity Recovery Program, but differs in that it is targeted to groups of reserves rather than specific biological communities, and it will often involve areas high in the landscape. Such an approach has a number of advantages, including that it will:

- generally involve the upper, topographical parts of the landscape—these areas are recognised as important to salinity control, but have been difficult to involve in landcare and related activities;
- provide an opportunity to work with catchment and other community groups to better protect biodiversity and other land use values—current projects at Dongolocking and Wallatin Creek provide models for developing this interaction; and
- have a higher probability of achieving Crown Reserves Program objectives, although in more restricted areas.

This approach involves funding of some works on freehold and leasehold lands to better protect remnant vegetation. Mechanisms for doing this effectively while maintaining equity across the program (for example, cost-sharing arrangements) would need to be better developed. Whether works on freehold and leasehold lands would be considered outside target areas is also a consideration. Note also that this recommendation links with recommendations made under the Natural Diversity Recovery Program.

As part of this targeting approach, and also within the remainder of the Crown Reserves Program, there is an opportunity to expand the number of projects that involve community groups. While this would entail greater staff resources to ensure effective liaison and implementation, the benefits for all stakeholders justify the expenditure. Examples of the types of projects that could be used as models for this work include the combined agency-community programs at Hyden involving rehabilitation and tree planting.

Currently some funds from the Crown Reserves Program are used to tackle specific issues, such as drainage. The degree to which this should occur from within this program, or as a separate allocation, needs to be decided.

In a similar vein, depending on how the NHT evolves, the Crown Reserves Program could be used to deliver some technical support to community groups planning management of biodiversity in native vegetation remnants. Currently, there is a request to contribute biodiversity information to the Rapid Catchment Appraisal process managed by Agriculture WA. To deliver information on a catchment basis effectively it is essential to construct effective GIS and bibliographic databases to efficiently deliver area-based information. Such information would also assist regional and other community groups to compile accurate information on the biodiversity characteristics of their areas.

Individually, each of the above changes in approach requires an increase in staff resources and their support.

In summary, the following recommendations are made:

Recommendation 1

The objectives and delivery of the Crown Reserves Program should be maintained. However, as the initial focus on rehabilitation works declines, the program should be expanded as elaborated in the following points.

Recommendation 2

Groups of Crown reserves of high biodiversity and salinity control value should be identified for concerted planning and management action (for example Dongolocking and Wallatin Creek). This will entail development of selection criteria and their integration with other criteria (for example, those related to selecting recovery catchments and threatened ecological communities).

Recommendation 3

Guidelines should be developed and implemented for utilising some of the resources under the Crown Reserves Program on freehold and leasehold land where this contributes significantly to the protection of biodiversity values in Crown lands.

Recommendation 4

Some funds within the Crown Reserves Program should continue to be used to purchase land for addition to the conservation reserve system. Only land that is a high priority for conservation should be considered for purchase, and, as at present, the contribution of proposed purchases to salinity management should continue to be one of the criteria used in ranking purchases.

Recommendation 5

There should be greater collaboration with community groups over specific projects. Additionally, GIS, bibliographic and other databases should be developed and implemented so that regional, community and other groups can be provided with biodiversity information for strategic planning.

Recommendation 6

Increased resources should be allocated to staff and staff support to meet the increased planning and liaison involved in implementing these recommendations.

Recommendation 7

Provided there is sufficient increased funding to the Natural Diversity Recovery Program, the above changes should be funded through a shift in emphasis and funds within the Crown Reserves Program, rather than additional funds being provided. However, this should be reviewed within three years.

Recommendation 8

Operational and strategic issues identified in the Problems/Difficulties section should be resolved. These include the need for:

- improved infrastructure and resources for delivery, including increased staff;
- standard notification procedures for local authorities, Aboriginal and landcare groups;
- standard reporting formats at all levels, and improved strategic planning and coordination;
- standard cost-sharing principles;
- training, recruitment and research to increase technical capacity to deliver outputs;
- development and implementation of a communications plan for the salinity program; and
- the appointment of a senior corporate officer to manage the Department's salinity program.

Recommendation 9

There should be resolution about the degree to which special projects, such as management of drainage and delivery of information into the Rapid Catchment Appraisal process, should be funded from the Crown Reserves Program, or another special allocation of funds.

Recommendation 10

There should be a conscious effort to maintain the broader benefits of the program (see Benefits/Highlights section).

Appendix I

Crown reserve expenditure under the Salinity Action Plan—issues, activities, and contribution to salinity control

(those marked with an asterisk have not been implemented to date under the Crown Reserves Program)

Issue	Work activities	Contribution to salinity control
Lack of ecological resources to support viable populations	Expansion of conservation estate through land purchases. Current efforts in this area are generally focussed on purchasing lands that enhance long-term viability of existing reserves and remnant systems.	<ul style="list-style-type: none"> • Increased protection of recharge and discharge zones. • Increased viability of remnant vegetation, thus better guarantee of long-term water use. • Increased funds for private action (purchase funds effectively go into the community).
	Biological surveys to identify Crown reserves that should be incorporated into the conservation estate, used for seed orchards, revegetated, or accorded better protection for salinity control.	<ul style="list-style-type: none"> • Greatly improved allocation and use of Crown land to meet salinity control objectives.
	Creating buffers, corridors, etc. for remnant vegetation. Involves use of Crown Reserves money for works on private property to protect Crown lands. May include land conservation plantings and prospective commercial (regional native species only) plantings.	<ul style="list-style-type: none"> • Increased water use. • Increased viability of remnant vegetation, thus better guarantee of long-term water use.
	Rehabilitation of degraded areas on conservation lands including: <ul style="list-style-type: none"> • Rehabilitation of historic quarries; • Revegetate disturbed parts of recreation sites in conjunction with other works funded under recreation program; and • Revegetation of cleared areas. 	<ul style="list-style-type: none"> • Increased water use. • Increased viability of remnant vegetation, thus better guarantee of long-term water use.

Issues	Work activities	Contribution to salinity control
	Fencing of remnant vegetation on private property. (Would only be implemented as part of a Government-endorsed landscape plan.)	Improve condition of vegetation and regeneration, thus increase water use and viability of remnant.
Detrimental regimes of physical disturbance events, such as fire, cyclone, drought, flooding	Construction and maintenance of fire-access tracks.	Access for management, including weed control, feral animal control and fire control.
	Prescribed burning.	Protection of remnant against catastrophic wildfire and consequent short-term decrease in water use.
Impacts of introduced plants and animals	Weed control.	Control of annual weeds, such as bridal creeper, that displace perennial native plants that have a higher water use.
	*Research and development of new control methods.	As above.
	Rabbit control	Decreased grazing by rabbits leads to improved condition of vegetation and regeneration, thus increased water use.
	Pig control.	As above.
Impacts of problem native species	*Control of plague locusts.	Prevention of grazing damage to vegetation, thus preventing loss of water use.
	*Research and development of control methods, e.g. parrot control.	As above, also, improved condition of vegetation.
Impacts of disease	Develop and implement <i>Phytophthora</i> management plans for the agricultural region.	Prevent loss of plants, and thus maintain water use.
	*Investigate and recommend control methods for <i>Armillaria</i> and other diseases.	As above.
Inappropriate use of pesticides	*Promote incorporation of best practice on pesticide container labels that include protection of remnant vegetation.	Minimises pesticide drift causing defoliation and death of remnant vegetation with consequent decline in water use.

Issue	Work activities	Contribution to salinity control
Altered biogeochemical processes, for example, disrupted water and nutrient cycles leading to salinity and eutrophication respectively	Contribute to the development of improved drainage assessment, practice, and policy (e.g. development of MOU).	Better integration of drainage and other salinity control practices.
	Engineering works on reserves to protect public asset values.	Depending on works, decrease recharge, lower groundwater, etc.
	*Engineering works on private property to protect Crown reserve values.	Depending on works, decrease recharge, lower groundwater, etc.
	Input to catchment planning.	Better integration of drainage and other salinity control practices.
	*Monitoring and research/investigations	Results allow improved, and more cost-effective technologies to be developed.
Cultural change	Explain to land managers the value of remnant vegetation (including Crown reserves) to them, and provide management advice. Preparation of interpretive material, media releases, etc.	Improved protection of remnant vegetation, maintenance of water use.
Competing land uses	*Develop a statistically valid method for monitoring degrading usage of Crown reserves.	Better protection of Crown reserves through improved focus of management.
	Removal of rubbish.	Increased water use.
Other activities to support the above activities.	Various.	Infrastructure available to support effective implementation.

APPENDIX 2

Crown Reserves Program

Work activities, outputs, and expenditure, 1 July 1996 to 30 June 2000

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Work activities	Outputs	Statistics (areas in ha)	Expenditure
Expansion of conservation estate through land purchases. Current efforts in this area are generally focussed on purchasing lands that enhance long-term viability of existing reserves and remnant systems	No. of land parcels inspected.	49	\$540,146
	No. of land parcels purchased.	9	
	Total area of land purchased.	3064	
Biological surveys to identify lands that should be incorporated into the conservation estate, used for seed orchards, revegetated, or accorded better protection for salinity control	No. of areas surveyed.	118	\$87,327
	No. of recommendations completed (at regional level).	48	
Creating buffers, corridors, etc. for remnant vegetation. Involves use of Crown Reserves money for works on private property to protect Crown lands	Buffers		\$35,166
	a. No. of sites	4	
	b. No. of seedlings	11640	
	c. area of buffers.	9	
	Corridors		
	a. No. of sites	2	
	b. No. of seedlings	11500	
	c. Area of corridors.	37	
	Land conservation plantings		
	a. No. of sites	4	
	b. No. of seedlings	5460	
	c. Area planted.	7.5	

Work activities	Outputs	Statistics (areas in ha)	Expenditure
	Commercially prospective species		\$5,245
	a. No. of sites	0	
	b. No. of seedlings	0	
	c. Area planted.	0	
Rehabilitation of degraded areas on Crown lands including: <ul style="list-style-type: none"> rehabilitation of historic quarries revegetate disturbed parts of recreation sites in conjunction with other works funded under recreation program revegetation of cleared areas 	No. of sites rehabilitated.	384	\$1,914,493
	Area rehabilitated.	844.75	
	No. of reserves involved (note, individual reserves may be recorded more than once).	211	
Fencing of remnant vegetation on private property. (Note: normally done under Remnant Vegetation Protection Scheme or NHT. Only to be funded from Crown Reserves Program where part of a landscape plan endorsed by the Director, Nature Conservation)	Km of fencing.	9.9	\$50,450
	No. of remnants.	5	
	Area of remnants.	0	
	No. of landholders involved.	0	
Construction and maintenance of fire-access tracks	Length (km) constructed.	27.2	\$208,758
	Length (km) maintained.	1206.4	
	No. of reserves on which construction work undertaken.	3	
	No. of reserves on which maintenance work undertaken.	60	
Prescribed burning	Area treated.	51	\$11,859
	No. of reserves treated.	2	
Weed control on Crown lands	No. of sites treated.	190	\$210,059
	Area treated.	7222.3	
	No. of reserves treated (note, individual reserves may be recorded once).	152	

Work activities	Outputs	Statistics (areas in ha)	Expenditure
Research and development of improved control methods (e.g. parrot control)	No work undertaken in this activity.		\$0
Rabbit control	No. of sites treated.	95	\$27,702
	Area treated.	12786.2	
	No. reserves treated (note, individual reserves may be recorded more than once).	75	
Pig control	No. sites treated.	7	\$6,491
	Area treated.	701	
	No. reserves treated (note, individual reserves may be recorded more than once).	7	
Control of plague locusts	Area treated.	0	\$874
Develop and implement <i>Phytophthora</i> management plan	Plan status in preparation (insert No. of, or 0)	23	\$36,871
	Plan status completed and being implemented (insert No. of, or 0).	35	
Investigate and recommend control methods for <i>Armillaria</i> and other diseases	No work undertaken in this activity.		\$0
Promote incorporation of best practice on pesticide container labels that include protection of remnant vegetation	New labels on pesticide containers.		
Contribute to the development of improved drainage assessment, practice, and policy (e.g. development of MOU)	No work undertaken in this activity.		\$0
Engineering works on reserves to protect public asset values	Projects are described in documentation collected during the Review.		\$18,704
	No. of sites.	15	
	Length of structure; or	10	
	Area treated.	0	

Work activities	Outputs	Statistics (areas in ha)	Expenditure
Engineering works on private property to protect Crown reserve values	No work undertaken in this activity.		\$0
	No. of sites.	0	
	Length of structure; or	0	
	Area treated	0	
Input to catchment planning	No. of groups assisted.	14	\$2,767
Explain to land managers the value of remnant vegetation (including Crown reserves) and how to manage them	No. of groups dealt with;	44	\$60,173
	No. of people dealt with.	3603	
Preparation of interpretive material and use of other media	No. of interpretive items.	84	
	No. of media releases.	18	
Develop statistically valid method for monitoring degrading usage of Crown reserves	No work undertaken in this activity.		\$0
Removal of rubbish	No. of sites treated.	171	\$96,049
	No. of reserves treated (only record individual reserves once).	89	
TOTAL			\$3,323,729

NATURAL DIVERSITY RECOVERY PROGRAM

Background and rationale

Under the *Salinity Action Plan* the importance of protecting a range of high-value public assets was recognised. Such assets include potable water, key wetlands for natural diversity, and infrastructure in towns. Consequently, the Government decided to apply intensive resources and management to protect valuable public assets threatened by salinity. Areas where these resources are focussed are called recovery catchments, and three types have been defined (terminology of the *Salinity Strategy* is used):

- natural diversity recovery catchments for the protection of natural, biophysical diversity;
- water resource recovery catchments for the protection of potable water resources; and
- rural towns program for the protection of rural towns.

This section reviews the Natural Diversity Recovery Program, a program for which the Department is the lead agency. Building on early work, particularly at Toolibin (Northern Arthur River Wetland Rehabilitation Committee 1987, Toolibin Lake Recovery Team and Technical Advisory Group 1994), it was recognised that key wetlands and catchments for the conservation of natural biological and physical diversity (or natural diversity) would only be conserved if significant resources were applied.

While the program was initially designed to focus on catchments that contain wetlands of high biodiversity value, improving protection of natural biodiversity throughout the agricultural region is also viewed as an important part of the program. Indeed, the language used to describe the program has evolved since the *Salinity Action Plan* from a focus on wetlands to centre on broader biodiversity values.

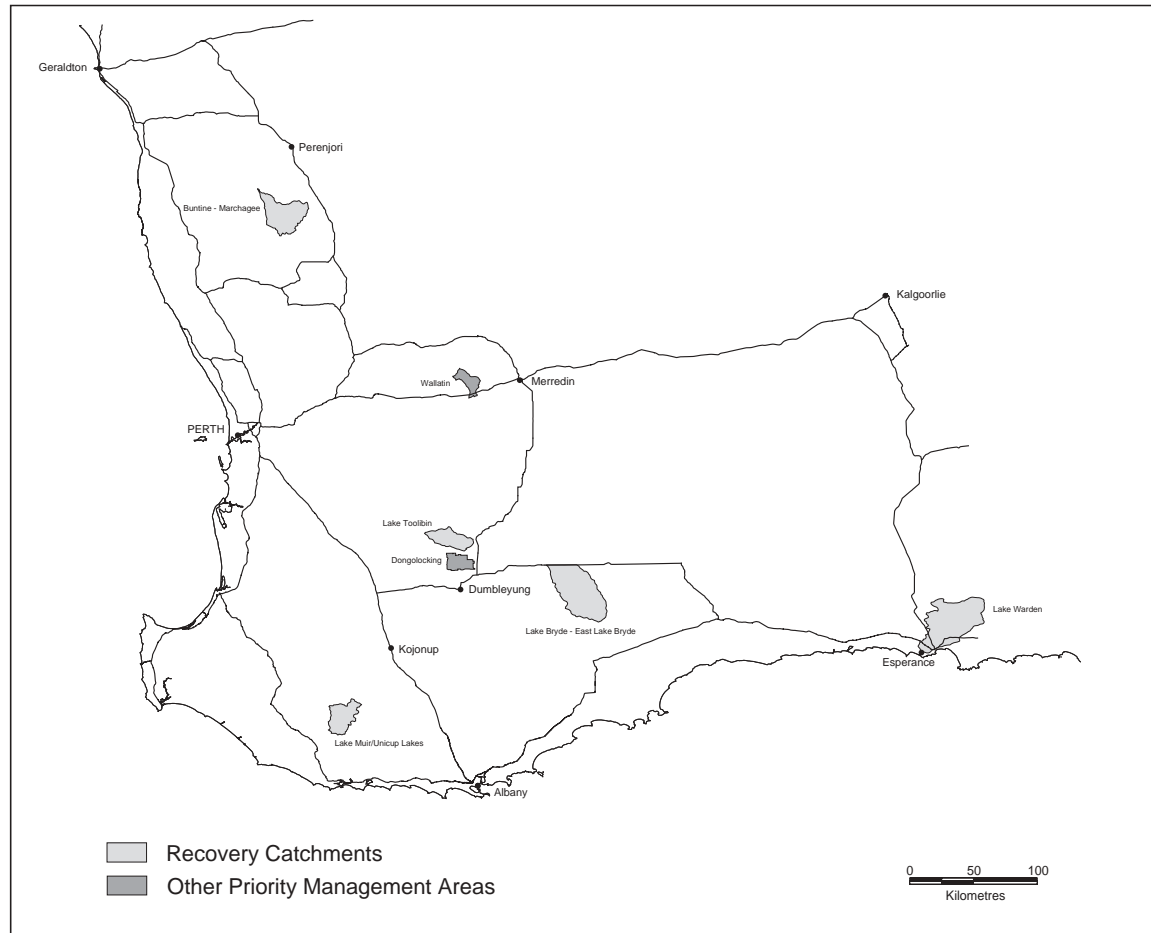
Three natural diversity recovery catchments were identified in the *Salinity Action Plan*. These were:

- Toolibin Lake;
- Lake Muir-Unicup Wetland Complex; and
- Lake Warden.

A fourth, the Lake Bryde Wetland Complex, was identified by the Department early in 1999 and subsequently endorsed by the National Parks and Nature Conservation Authority and the State Salinity Council. The Salinity Council endorsed a fifth catchment, the Buntine-Marchagee Natural Diversity Recovery Catchment, during the preparation of this Review.

Early work in each catchment has focussed on documentation and planning; however, on-ground work is now under way in all of the first four areas identified. The location of each recovery catchment is shown on Map 3.

Under the *Salinity Strategy*, the program for natural diversity recovery catchments is maintained unchanged except that it introduced the term 'natural diversity recovery catchments'.



Map 3
 Natural Diversity Recovery Catchments
 and other priority management areas

Objectives

The objective stated in the *Salinity Action Plan* is that (page 23):

the Government will develop and implement a coordinated Wetlands and Natural Diversity Recovery Program targeting at least six key catchments over the next 10 years to ensure that critical and regionally significant natural areas, particularly wetlands, are protected in perpetuity.

The plan then goes on to state that (page 24)

The Department of Conservation and Land Management will:

- implement the Toolibin Lake Recovery Plan;
- complete its management plan for the Muir-Uncup wetland reserves by 1997 and work with the local community to coordinate action in the whole catchment area;
- complete its management plan for the Lake Warden wetland reserves by 1997 and work with the existing catchment groups to coordinate action over their catchment areas;
- give priority to locating commercial woody perennial plantings in areas which also generate significant nature conservation benefits, such as Toolibin Lake.

Given the need to document the biodiversity of the south-west agricultural zone and the degree to which it is threatened by salinity, and the need for much better data to select recovery catchments, provide ecological advice for catchment management, and develop the resource base of species for use in land conservation and for commercial development, a program of biological survey and related activities was also proposed. This is dealt with in the section on the Biological Survey Program.

While not specifically mentioned as an objective in the plan, the importance of using work in recovery catchments to devise and test methods for combating salinity throughout the agricultural region has long been recognised. In the Toolibin Lake Recovery Plan (Toolibin Lake Recovery Team and Toolibin Lake Technical Advisory Group 1994), three of the principal goals specifically recognise this point. These are that work at Toolibin will aim to:

- demonstrate that, within a large catchment, it is possible to stabilise hydrological trends that if unchecked threaten land, water and biodiversity resources;
- demonstrate to other land managers in Australia methods of protecting their biodiversity, land, and water resources;
- develop mechanisms which lead to community ownership of Western Australia's natural resources, including management problems and their solution.

The principle of using work in recovery catchments not only to protect a key public asset, but also research and develop solutions for much wider application, is very important. In this regard the Research and Development Priorities listed (pages 29–31) in the 1998 Draft Plan are particularly relevant and will be referred to below.

Unless specifically stated otherwise, the term 'recovery catchment' below refers to natural diversity recovery catchments.

Implementation methods

Procedures

As with the Crown Reserves Program, the Natural Diversity Recovery Program is largely implemented through the Department's Regional Services Division. With operational centres throughout the south-west, this group provides the most cost-effective mechanism for delivering on-ground activities and outcomes.

Before the beginning of each financial year, those Departmental regions with recovery catchments submit draft programs, with budgets, to the Director of Nature Conservation. Following discussion between the Director and regional staff, amended budgets are then endorsed and funds allocated for expenditure.

Guidelines and criteria

The first three recovery catchments identified in the State Salinity Action Plan were effectively self-selecting. Two—Toolibin Lake and Lake Warden—are listed under the Ramsar Convention as Wetlands of International Importance. These listings involve international commitments by the Federal and State Governments to protect the values of these wetlands. The biodiversity values of the third recovery catchment, the Lake Muir-Unicup⁸ complex of wetlands, have long been recognised in broad terms. While their value for waterbirds is well documented, their extraordinary diversity of plants has only been confirmed in recent years (Gibson and Keighery 2000).

One of the key outputs from the Biological Survey Program (see page 109 this report) is to identify prospective recovery catchments. However, it was recognised that:

- in the first few years of the salinity program and before the biological survey information became available, it was important to select, and begin management, of more recovery catchments if areas of sufficient value could be identified. Criteria for selecting recovery catchments were therefore needed;
- while biological values would be the primary criterion for identifying recovery catchments, other criteria—such as local community support—were also very important. Again, the need for a list of criteria for selecting recovery catchments was seen.

Consequently, the Department developed a set of criteria for identifying recovery catchments (Appendix 3). These criteria were used to evaluate the Lake Bryde Wetlands Complex as a recovery catchment. The National Parks and Nature Conservation Authority and the State Salinity Council, through their endorsement of the Lake Bryde Wetlands Complex Recovery Catchment, have subsequently accepted the application of these criteria. More recently the criteria have been applied to the Buntine-Marchagee Catchment.

Once areas have been selected as recovery catchments, investment in recovery will continue for as long as it takes to achieve the stated recovery goals. The intention is that as these goals are achieved, resources will be withdrawn or reduced and re-allocated to a new recovery catchment.

⁸ Lake Muir was listed under the Ramsar Convention as a Wetland of International Importance on 5 January 2001, and formally announced on 2 February 2001.

Outputs and outcomes

Expenditure, outputs and activities

Each of the recovery catchments is a major project in its own right. Therefore, they are considered separately below.

Toolibin Lake

Toolibin Lake has a long history of management intervention. The need to protect the lake from salinity was recognised by the local community and State Government in the mid-1970s. Actions to protect the lake began with the purchase in 1977 of native vegetation on private property threatened by land clearing (it had been bulldozed, but not burnt). Work to protect the Lake was focussed by the release of the Toolibin Lake Recovery Plan in 1994 (Toolibin Lake Recovery Team and Toolibin Lake Technical Advisory Group 1994). For details on the Lake and the history of its management, interested readers should refer to the Recovery Plan and the major review of works undertaken in 1998 (Smith and Wallace 1998).

Goals of management: in the case of Toolibin, there are five principal goals of management:

1. To conserve Toolibin Lake and its associated wildlife as a freshwater habitat.
2. To improve land use decision making and practice within the Toolibin Catchment so that land management:
 - is sustainable, productive and profitable in the long term (more than 100 years);
 - reduces the current area of degraded land;
 - and favours conservation of local wildlife.
3. To demonstrate that, within a large catchment, it is possible to stabilise hydrological trends that if unchecked threaten land, water and biodiversity resources.
4. To demonstrate to other land managers in Australia methods of protecting their biodiversity, land, and water resources.
5. To develop mechanisms which lead to community ownership of Western Australia's natural resources including management problems and their solution.

The strategies identified to achieve these goals are given in Appendix 4.

Recovery objectives and criteria: The recovery objective identified for management is:

To ensure the long-term maintenance of Toolibin Lake and its environs as a healthy and resilient freshwater ecosystem suitable for the continued visitation and breeding success by the presently high numbers and species of waterbirds.

Recovery criteria are listed below under Outcomes along with progress.

Expenditure, outputs and activities: These are summarised in Appendix 5. Expenditure at Toolibin reflects the focus during the past six years on getting emergency engineering actions into place to protect the lake. These actions have cost, from salinity funds, \$851,084 for planning and implementation of groundwater pumping. This represents about half the salinity funds expended at Toolibin during the period of this Review. Monitoring, land purchase and revegetation have also been significant items of expenditure, and will take up an increasing amount over coming years. Engineering works have predominated given the precarious status of the lake and consequent need to implement emergency actions to combat rising groundwater and increasingly saline surface flows.

Outcomes: It is important to evaluate work to date against the recovery criteria (outlined in Toolibin Lake Recovery Team and Toolibin Lake Technical Advisory Group 1994). Table 7 summarises progress against recovery criteria.

In summary, some recovery criteria have been met, others not. The nature of salinity development means that at large scales it cannot be stopped, then rolled back, in short periods of time. While the continued deterioration of the lake floor vegetation in some areas is of concern, the actual recovery of the vegetation at one site on the lake floor is extremely encouraging, as is the regeneration of seedlings in large patches on parts of the lake floor. The capacity to divert highly saline flows and thus protect the lake floor from high salt loads is also a major victory for the lake and recovery process. This protects the quality of surface water entering the lake, at least within the next 10 to 20 years. With the planned completion of the full groundwater pumping program under the lake in 2001, it is predicted that much of the lake floor will be protected from rising groundwater within three years.

Thus a key outcome is that the broad conservation values of the lake have been maintained in the face of severe pressure from salinity, although there have been damaging losses in the vegetation of the lake floor. The success of the diversion channel and separator together with the first signs of success from groundwater pumping are very encouraging. These are tangible signs that management can succeed. However, it has also become clear that the commitment to pumping groundwater to protect the lake must be undertaken over very long time periods (in excess of 50 years). Consequently, the commercial use of groundwater will be an important focus for future work along with major works within the broader catchment.

There have been several other, highly significant outcomes from the recovery process:

- The information being collected at Toolibin is vital to developing the State's knowledge about salinity, its development, and its control. Toolibin represents the best combination of developing a better understanding of the biophysical processes of salinity (research priority 2⁹) in conjunction with implementing and testing solutions in actual situations to protect public assets.
- Work at Toolibin contributes to the development and implementation of new technical solutions for salinity management, including (for example) research of economic, woody perennial options (research priority 1), funding of resource building for an integrated oil mallee industry, research of alley farming (research priority 1), research and development of groundwater pumping (research priority 8), feasibility studies for salt harvesting and aquaculture, and monitoring of surface drainage systems. It is planned that Toolibin will continue to be used as a site for driving technical solutions, including commercial options, for managing salinity.
- A feature of work at Toolibin has been the liaison and partnerships between various agencies and private interests (including local farmers and community groups) over a long period of time. These relationships have not been without their difficulties, but they have delivered valuable outcomes for the State and have solved some problems for local landholders. In particular, the work has been an emphatic demonstration of the ability of agencies to work together constructively over long time periods. Positive outcomes at Toolibin have been absolutely dependent on the positive interactions between a range of stakeholders, both private and public. There are very important lessons in this for natural resource management in general (research priority 3).

The high resource input and long-term commitment required to combat serious natural resource management issues have been demonstrated at Toolibin. However, equally apparent is the potential gain in achieving sustainable land use and conservation of natural resources, irrespective of the ultimate outcomes in relation to salinity.

⁹ Research priorities are those listed in pp 29–31 of *Western Australian Salinity Action Plan, Draft update, 1998*

Table 7: Progress against recovery criteria at Toolibin Lake

Recovery criterion	Current progress (1997–2000)
<p><i>Biological criteria</i></p> <p>No further deterioration is observed in the health of the vegetation of the lake or the reserves</p>	<p>Further deterioration has occurred over much of the lake vegetation, less so within the reserves. However, there are also areas on the lake floor where the vegetation has improved in condition, and this improvement is considered to be due to recovery activities.</p>
<p>Successful tree and shrub regeneration in the lake and reserves is established in all vegetation associations</p>	<p>There has been extensive seedling establishment over several hectares of the lake floor.</p>
<p>Based upon available data, the lake supports sufficient species richness and numbers of invertebrates to assure waterbird food resources</p>	<p>The lake has not filled or partially filled since 1996. Based on data at that time, this criterion is considered to have been met.</p>
<p>The numbers and species of waterbird visitation (41 species) and breeding success (24 species) that currently occurs is maintained or improved</p>	<p>The lake has not filled or partially filled since 1996. Based on data at that time, and the ability to control in-flow salinity, this criterion is considered to have been met.</p>
<p><i>Physical criteria</i></p> <p>The minimum depth to the water table beneath the lake and Toolibin Flats in spring, when the lake is dry, should be 1.5 metres</p>	<p>In general terms the water table has been stable or dropping near groundwater pumps, and slowly rising or stable away from groundwater pumps.</p>
<p>The maximum salinity of lake water when the lake is full should be 1,000 mg/litre Total Dissolved Salts (TDS)</p>	<p>While the lake has not filled since 1996, the construction of the diversion channel and separator gate has enabled managers to divert water around the lake that does not meet this criterion. Therefore, the criterion has been met.</p>
<p>The maximum salinity of inflow to the lake, measured at the Water Authority gauging station 609,009 on the Northern Arthur River, should be 1,000 mg/litre TDS during the winter months when the lake is full</p>	<p>Criterion met by creation of diversion and separator gates.</p>
<p>The lake bed dries periodically by evaporation, on average once every three years</p>	<p>Lake has been dry during period. Criterion needs to be reviewed.</p>
<p>The levels of nutrients within the lake should not cause excessive growths of algae or other aquatic plants, or cause deleterious reductions in dissolved oxygen concentration in the water. Total phosphorus levels in the water should not exceed 100mg/litre unless long-term monitoring indicates that this criterion may be modified</p>	<p>No lake filling during the period. However, by-passing of early flows may assist in meeting this criterion.</p>

Lake Muir-Unicup Wetland Complex

The Lake Muir-Unicup Wetland Complex first gained heightened attention in the 1970s when peat mining threatened the area's conservation values, and in 1980 the Department began to monitor the wetlands regularly. A Draft Perup/Muir/Unicup reserves management plan was prepared in 1995, and the area was established as a natural diversity recovery catchment in the *Salinity Action Plan*. Rare peat and other wetlands in the catchment are important as waterbird breeding habitat. This, and the high richness of flora within the reserves, makes the catchment very important for nature conservation. However, the wetlands are variously threatened by increasing salinity in the catchment combined with increasing run-off and inundation of lower-lying areas.

Goals of management: There are two management goals at Muir-Unicup:

- to conserve the Muir-Unicup wetland complex and the associated biota; and
- to improve land use decision making within the catchments so that land management:
 - is sustainable, productive and profitable in the long term;
 - reduces the current area of degraded land;
 - favours conservation of the native biota; and
 - maintains the human community structure.

Recovery goals and criteria: The recovery goal is to:

Maintain and restore the natural environment, and to protect, care for, and promote the study of indigenous flora and fauna, and to preserve any feature of archaeological, historic or scientific interest.

Recovery criteria are listed below under *Outcomes* along with progress to date.

Expenditure, outputs and activities: These are summarised in Appendix 6. The two most dominant activities have been revegetation (\$315,145) and land purchase (\$265,000). The land purchase is a critical section of catchment for one wetland, and this area is currently being revegetated.

Outcomes: It is important to assess recovery work against the recovery criteria. Outcomes are summarised in Table 8.

Table 8: Progress against recovery criteria at Lake Muir–Unicup wetland complex

Recovery criteria	Current progress (1998-2000)
<p><i>Biological criteria</i></p> <p>Reduce spread of dieback in reserves in the long-term and maintain floristic communities in the long term</p>	Dieback assessment study proposed for affected reserves.
No further deterioration is observed in the condition or cover of <i>Baumea</i> rushes in wetlands and recovery is observed in known degraded wetlands	Proposed historical land cover monitoring study for past changes in wetlands vegetation.
<p>Biological diversity indicators/species composition of invertebrate communities in wetlands are:</p> <ul style="list-style-type: none"> • maintained for healthy wetlands; • show a return to species compositions of healthy wetlands for degraded wetlands 	Aquatic macroinvertebrate baseline study finalised and microinvertebrate study of wetlands in progress.
Declared Rare and priority flora and fauna are protected from threats	Maintain current program of feral animal control.
Reduce encroachment of weeds in reserves	Proposed weed control program.
<p><i>Physical criteria</i></p> <p>Reduce groundwater recharge affecting inflows to threatened wetlands</p>	Revegetation of recharge areas in progress (Yarnup Swamp), saline scald adjacent to Red Lake reserve revegetated.
Restore wetting-drying cycle to appropriate wetlands, these currently permanent waterbodies resulting from land clearing	Obtain historical anecdotal evidence on wetland water levels, consider possible short-term engineering solutions to dry out wetlands.
Minimise further increases in average salinity of key (target) wetlands	Groundwater monitoring studies in progress for key wetlands (Yarnup sub-catchment, Byenup Lagoon) to determine sources of salinity.
Minimise increases in salinity of major streams, improving water quality where appropriate	Stream monitoring in progress to estimate salt loads, gauging station commissioned, proposed catchment water balance modeling.

Another significant outcome from the recovery process at Muir-Unicup is that farmers are now raising social issues at recovery meetings. There is a shift in emphasis from concern about salt and water management to maintaining the local community. This shows that the group established through recovery catchment activities is providing a useful vehicle for tackling other community issues.

Lake Warden Recovery Catchment

The Lake Warden Recovery Catchment Project has resulted from landholders taking an interest in addressing the problem of salinity throughout the catchment, which started in the late 1980s. At that time, flood events and rising watertables brought a change in landcare focus from wind erosion to salinity and waterlogging. The Lake Warden Wetland System provided a flagship for farmers to work together as a catchment community to address a problem that affected both agricultural production and catchment biodiversity values.

The Esperance Land Conservation District Committee and landcare groups from the catchment obtained funding through the Natural Heritage Trust in 1997 to help protect biodiversity values on farms and within the Lake Warden Wetlands. This project was referred to as the Lake Warden System Phase 1 NHT Project and was community-driven and administered. The size of the project and extreme climatic events placed pressure on the community's ability to manage the project effectively. The community acknowledged the need for a catchment coordinator and greater integrated catchment planning at a landscape level.

An opportunity arose for such a position to be appointed with recognition of the natural diversity values at risk from salinity through the *Salinity Action Plan*. Under this plan the area was declared a natural diversity recovery catchment, with the Department to be the lead agency. A Recovery Catchment Officer was appointed early in February 1999 to implement the project under the guidance of a recovery team.

Three planning documents have been developed to assist in the project:

- the Esperance Lakes Nature Reserve Management Plan (a statutory plan under the Conservation and Land Management Act);
- Draft Lake Warden Catchment Recovery Plan; and
- Recovery Farm Kits.

The Esperance Lakes Nature Reserve Management Plan (1999–2009) focuses on lands managed by the Department. The management plan acknowledges the need for catchment management for the future well-being of the Lake Warden System and recommends that a Strategic Catchment Plan be written.

Goals of management: The Lake Warden Catchment Recovery Plan aims to provide for the maintenance and enhancement of natural diversity and prosperity of the community for the Lake Warden Catchment. The objective of the Recovery Plan is to:

Protect and enhance the Lake Warden Wetland System through sustainable catchment management implemented at a farm level.

Recovery goals and criteria: The catchment objectives are outlined in Table 9. However, the recovery plan is yet to be completed, and this will contain more specific recovery goals and criteria.

Expenditure, outputs and activities: The recovery process is an integrated approach involving:

- maintaining and enhancing natural systems; and
- increasing water use throughout the landscape.

Revegetation (\$167,058), fencing of remnant vegetation on private property (\$157,310) and a range of planning activities have been the focus of activity to date (see Appendix 7).

Eighty-three per cent of the catchment is farmland and farmers are the key stakeholders across the catchment. The Lake Warden Catchment recovery project involves applying catchment scale strategies as outlined in the Lake Warden Catchment Recovery Plan. At a farm scale, the Recovery Farm Kits are used to guide implementation.

Farm-specific maps and Farm Kit information are designed to assist farmers with decision-making and farm planning. Farmers can use the Farm Kit information to:

- plan on-farm nature conservation programs;
- diversify farming production with high water use farming systems;
- increase their understanding of landscape processes; and

- apply for financial assistance from various funding bodies.

Table 9 summarises outcomes achieved against the objectives set out in the Esperance Lakes Nature Reserve Management Plan (which focuses on the nature reserves rather than the recovery catchment as a whole—a recovery plan is being prepared). The summary outcomes include some of the project highlights.

Highlights of the recovery catchment project to date have been:

- fencing 720 hectares of native vegetation remnants on private land;
- three hundred hectares of revegetation using maritime pine (includes 20 hectares of *Pinus radiata*) and preparation (purchase of fencing materials, seedlings, equipment, etc.) for a major revegetation program in the 2000 planting season;
- the collation of valuable baseline datasets for the catchment. These have been collated and applied for both conservation and agricultural production using integrated catchment management principles. The community has been instrumental in the collection of information and development of catchment strategies aimed to meet the recovery plan's objectives; and
- the high level of community involvement, and open communication and trust between stakeholders. Community input has been married with information technology to support decision-making.

The three main issues that need to be addressed in the catchment planning process are:

1. Providing farmers with economically viable, high water use options to increase rate of adoption and thus achieve the catchment water use objective. Current options are not sufficiently economic to gain broad adoption by landholders.
2. Completing the recovery plan. It is proposed to use an internal project officer to develop the plan with assistance from the Recovery Catchment Officer.
3. The development of a standardised planning framework for recovery catchments. This would guide the drafting of recovery plans.

Lake Bryde Wetland Complex

The Lake Bryde Wetland Complex was endorsed as a natural diversity recovery catchment in March 1999 by the National Parks and Nature Conservation Authority and subsequently by the State Salinity Council. The Minister for the Environment announced the new recovery catchment in a media release dated 13 April 1999.

The Lake Bryde complex consists of a chain of freshwater and naturally saline lakes in the headwaters of the Lockhart catchment, a sub-catchment of the Swan-Avon basin. The catchment is approximately 110,770 hectares of which 30% is in reserves. A threatened ecological community—unwooded freshwater swamps of the southern wheatbelt dominated by lignum and samphire species—occurs on the floor of two lakes in the wetland complex. Other parts of the complex carry representative samples of naturally saline and brackish wetland systems. This array of wetland features and their associated native flora and fauna make the area very important for nature conservation.

Table 9: Progress against objectives in the nature reserve management plan at Lake Warden Recovery Catchment (recovery plan in preparation)

Recovery criterion	Current progress—1997–2000
<p>Land Use Catchments and hydrology The objective is to ensure that water quality and quantity are managed so as to maintain a healthy aquatic system</p>	<ul style="list-style-type: none"> • A Draft Catchment Recovery Plan has been developed for the Lake Warden Catchment. • Recovery Farm Kits were developed and distributed to about 120 farmers and cover over 200 property locations to assist in implementing catchment strategies. • Thirteen groundwater observation bores have been installed around the Lake Warden Wetlands. • Ribbons of Blue water quality data collected over the past three years have been input into a database.
<p>Land tenure The objective is to ensure that the gazetted purposes, vesting and tenure of the reserves reflects their values and use</p>	<ul style="list-style-type: none"> • The Esperance Lakes Nature Reserve estate has been expanded in cooperation with the Esperance Shire. • The Esperance Shire and Planning Commission has facilitated sustainable development through the development of the Limited Rural Strategy in consultation with the Department.
<p>Conservation Vegetation and flora The objective is to protect and conserve native plant species and communities</p>	<ul style="list-style-type: none"> • Vegetation condition assessment has been completed for native vegetation outside of Departmental reserves throughout the Lake Warden catchment. • Airborne remote sensing is being used to assist in monitoring vegetation condition on the Lake Warden Wetlands. • Salinity revegetation trials have been implemented throughout the catchment in an attempt to maximise conservation values from degraded saline land. • Permanent flora transects have been established.
<p>Plant diseases The objective is to prevent introducing plant diseases into disease-free areas and to minimise their spread where they are already present</p>	<ul style="list-style-type: none"> • Dieback sampling has been conducted throughout the reserves. • Strategic track closures and rehabilitation have been implemented to minimise the spread of disease.
<p>Recreation Nature appreciation The objective is to enhance the experience and knowledge of visitors to the reserves by providing opportunities to experience, learn about and appreciate their natural values</p>	<ul style="list-style-type: none"> • Interpretation has been designed for the Esperance Lakes to help create community awareness of the project. The signs will be in place in 2000–2001. • More than 100 people participated in a Lake Warden Catchment tour, which covered the Lake Warden Wetlands during the State Landcare Conference in 1999. • Community canoe days have been organised by the Department. • The Department has participated in school activities on the wetlands. • Festival of the Wind held an event, <i>Breakfast with the birds</i>, on the wetlands with guest speakers from the Department.
<p>Bushwalking The objective is to provide bushwalking opportunities from which the reserves' natural attractions can be experienced and do not adversely affect the conservation and landscape values</p>	<ul style="list-style-type: none"> • Construction of the Woody Lake walk trail began in 1999–2000. • Two bird hides have been constructed on the Lakes.

An Interim Recovery Plan for the threatened ecological community at the lake has been prepared. Survey and planning work, including a comprehensive salinity risk assessment, are now under way as a precursor to preparation of a full recovery plan. A recovery team has been formed, including members of the local community, to guide management.

Most of the \$250,457 spent in the catchment to date has been on survey and other assessments related to planning (Appendix 8). On-ground works will begin in 2000–01.

Buntine–Marchagee

A fifth natural diversity recovery catchment, Buntine-Marchagee, was approved in October 2000. No funds have been expended in this catchment to date during the period of this Review (January 1997 to 30 June 2000).

Summary of recovery catchment expenditure and outputs

Total expenditure on natural diversity recovery catchments has been \$3.434 million (see Appendix 9). More than 85% of expenditure is accounted for by six categories of activity:

Planning and implementation of engineering works on reserves and private property	\$944,770 (29%)
Revegetation and related fencing (552,350 seedlings on 338 hectares)	\$677,630 (19.5%)
Monitoring/research combined with biological survey	\$624,667 (18%)
Purchase of 265 hectares of strategic lands	\$361,307 (10.5%)
Management of recovery and related committees	\$255,443 (7.5%)
Fencing of remnant vegetation on private property (749 hectares)	\$202,010 (6%)

These outputs are not surprising given that:

- the most active catchment in implementation is Toolibin, the oldest recovery catchment, and here engineering actions constitute the initial priority;
- revegetation to reduce recharge is a high priority in all catchments; and
- while monitoring, research and biological survey would be expected to be much higher during the early, planning phase, some of the relevant data has come from other programs—for example, the Biological Survey Program.

Note that, in addition to the funds expended at 30 June 2000, a further \$830,000 is held in regional accounts against commitments in progress, but not completed. An issue encountered in recovery catchments has been that many projects take two years to plan and implement; however, funds must be held against the projects at the outset to meet contractual arrangements through the life of the project. This has necessarily resulted in funds being carried over between financial years. Given that vital projects with two and, on occasion, three-year planning and implementation horizons will continue to be developed, there is no mechanism for avoiding carryover amounts.

In addition to the above outputs, it was recognised early that, while recovery catchments were selected and planning began, there would be a delay before the program was fully running. It was also recognised that, in order to identify effectively areas of high priority for biodiversity conservation, it was imperative to significantly accelerate and intensify the biological survey

program. Similarly, there was an opportunity to expand the Land for Wildlife program to appoint officers into areas close to recovery catchments, and in the short term to develop other programs that would make an important contribution to salinity management. Thus in the first years of the program, short term allocations were made to:

Biological survey	\$400,000
Land for Wildlife	\$200,000
Voluntary Covenants Program	\$200,000
Bushcare Facilitator support	\$50,000

Carryover funds of \$551,000 have since been re-allocated to other smaller salinity projects in the agricultural region and will be completely expended by the close of 2000–01. With the Lake Bryde Wetland Complex and Buntine–Marchagee Catchment beginning, the opportunity to support these other projects will disappear, and the program will become significantly under-resourced.

Problems/Difficulties

Lack of infrastructure and other resources: See comments on this issue in the Crown Reserves Program chapter.

Need for skilled operatives in recovery catchments: Experience to date has shown that staff working in recovery catchments need to be highly skilled, knowledgeable and competent. Skills required include, but are not restricted to:

- ability to understand, plan and implement ecosystem management at landscape scales;
- hands-on management skills;
- capacity to operate effectively within rural socio-political systems; and
- technical and business management (including contracting) skills.

Recovery catchment officers are managing projects that, within the projects' life span, are multi-million dollar projects. It is essential that the best available personnel are selected for these positions, and that this be achieved through a process of competitive selection.

Notifications to Aboriginal groups: To date the Department has effectively negotiated with Native Title claimants. However, in at least one case, the time taken by the process delayed specific works for a considerable period.

Cost-sharing arrangements: To date the four existing recovery catchments have tended to independently develop cost-sharing arrangements to achieve their specific on-ground objectives. The three initial recovery catchments differ markedly in land use, socio-cultural context and biophysical systems. Consequently, it is probable that there will always be differences between such diverse recovery catchments in terms of their cost-sharing arrangements. However, there is a need for increased collaboration concerning cost-sharing arrangements to ensure:

- equity across the agricultural region; and
- best practice in the Department's natural resource management.

Species selection: During the inspection of recovery catchments it was found that species selection for revegetation could be improved considerably with better guidelines. For example, in some cases recovery money was used to support the planting of species that have potential to become invasive weeds or to hybridise with local provenances. In the particular area where this occurred it was in response to landholders who would not contemplate other alternatives, and whose land is strategically placed in relation to important wetlands.

Sharing of information and development of collaborative processes: A comment that occurred across the board in discussions with operational groups was the need for better interaction and sharing of information between regions, and between regions and policy, planning and research groups. Taken together, these comments included the need for better guidelines for strategy formulation and for activities/output/budget documentation.

Need to tackle wider range of threats in recovery catchments: As the recovery catchment process matures, the need to address a greater range of threats than those dealt with in recovery criteria is becoming apparent. For example, other threats that interact with recovery objectives—such as *Phytophthora* (dieback) and other diseases—need to be addressed through recovery management. Taking a broader view, there is also a need to tackle the cultural threats (for example, lack of empathy with natural resource issues) to recovery and other salinity management activities. In this regard recovery catchments must be used as one means for developing community understanding of salinity and other natural resource management issues.

Community concern at being left out: When strategically important areas become the focus for government resources, it is inevitable that communities that do not receive this attention are sometimes envious. There is no easy solution to this problem. If money is spread out across the agricultural region, rather than targeted, complaints of inequity will be less (but will not cease). While the diffuse expenditure of money will help develop a more sympathetic culture to natural resource management, it will achieve little in terms of on-ground results. Ultimately the mix of funding—targeted versus diffuse—will be a political decision. In any case, recovery programs are deliberately targeted to high-value community assets, and other programs address the needs of the whole community. It should be noted, however, that the gains from targeted funding have a much greater probability of delivering valuable outcomes for the whole community in the longer term. This underlines the importance of better delivering the lessons and information from recovery catchments to the broader community. For example, it is essential to place reports and feasibility studies in the public domain as quickly as practicable, probably through the Web.

Monitoring and information: One of the strengths of the recovery program is that it provides the capacity to monitor the effectiveness of various management actions over long periods. This is essential to achieve improved natural resource management and sustainable land use systems. However, achieving the necessary level of monitoring, including documentation, requires improved monitoring and information systems throughout the recovery catchments. It is important that a consistent GIS system is used to capture information throughout the Department.

Adoption of revegetation: As the recovery programs proceed it has become clear that adoption of revegetation by landholders is very uneven and often much less than had been anticipated. This is due to a range of factors including:

- land capable of growing cereals will be preferred for that purpose—this will not change unless agricultural lands become available through other activities (for example, installation of grade banks) or commercial species (at the least, highly commercially prospective) are available that out-compete returns from cropping; and
- if 5% (figure based on anecdotal information) of landholders are prepared to revegetate to meet nature conservation objectives, it is comparatively easy to find projects among a few thousand farmers. However, once this 5% is applied to a target area of 50 to 100 landholders, then uptake is low compared with recovery objectives. In some places the 5% may be 10%, but even this is much too low in target areas to achieve desired planting levels.

These and related issues need to be discussed among agencies involved in recovery programs with the view to clarifying the most effective mechanisms for cost-sharing and adoption.

Accurate assessment of salinity hazard and effects of recovery actions: To establish recovery objectives and criteria accurately it is essential to have good information and models upon which to base salinity hazard and the projected effects of various management strategies. Unfortunately, information is expensive to collect, and the available models are useful, but not accurate. However, as the program proceeds it is important to build more accurate assessment of salinity hazard and the efficacy of treatments into the evaluation of potential recovery catchments. It is probable that the cost of engineering works required to save some important areas will exceed their value. This issue is currently being addressed at Lake Bryde, where the recovery plan will assess whether it is realistic to conserve the lake floor community *in situ*, or whether it is more important to focus on other, salinity-threatened (but more readily recovered) areas in the wetland complex.

Benefits and highlights

Cost-effective outputs: Given that over the three-year period of the program start-up activities—such as planning and appointment of personnel—have predominated, the outputs (see summary above) are solid and cost effective. For example, the establishment cost of \$1.21 per seedling is a satisfactory result given that this includes a significant component of fencing, and also includes the costs of collecting seed and other materials for future years.

Research and development: The delivery of research and development outcomes through the recovery program, particularly at Toolibin Lake, the oldest recovery catchment, has been very useful to the State as a whole. As they mature, it is expected that other recovery catchments will also drive important research and development programs. At present the recovery catchments (all three types) are the best available means for testing and driving long-term solutions to salinity at catchment scales. It is unlikely that any other program will take up this role in the short to medium term. This vital role is, in its own right, a significant justification for the program.

Inter-agency partnerships: The recovery programs are providing important lessons in creating and maintaining long-term partnerships for integrated land management. Collaboration of agencies for more than 20 years in research, and six years in implementation, at Toolibin Lake demonstrates emphatically that State agencies can effectively integrate their work to deliver on-ground works. This underlines the importance for those seeking institutional reform to examine such cases to determine exactly what has allowed such effective interaction. For those who have been involved in successful collaborative projects it is clear that the capacities, personalities and goals of participants are more important than institutional arrangements.

Partnerships with community groups and private enterprise: As with agency partnerships, the partnerships with community groups and private enterprise have been integral to many successful projects. A valuable lesson from Toolibin and other similar projects is that there will be many occasions when engaging landholders at a one-to-one level, or in very small groups with an immediate interest in an issue, is crucial to the success of a particular project. There are limitations on what can be achieved through group processes. Of note is the evolution of the Lake Muir-Unicup group from a recovery group into one that is picking up broader socio-cultural issues in the catchment. This demonstrates that groups formed with a comparatively narrow focus may evolve to become vehicles for broader community issues. Finally, it is important that the reasons for success—and failure—are documented to provide a basis for better and more innovative management of social processes.

Contracting of local businesses and expenditure in local areas: Throughout the program to date there has been significant use of regionally based contractors. These contractors have ranged from those with earthmoving machinery to Aboriginal and other groups contracted to plant trees and undertake other works.

Use as contributory funds into NHT and synergy with other programs: An important added value of the salinity programs has been their use to leverage other funds, and the synergy that has developed between programs. In particular, recovery funds have been used as contributory funds into the Meta Project¹⁰ to leverage additional funds for on-ground management (approved for the 2000–01 NHT year).

As with the Crown Reserves Program, sharing of expertise, ideas, technical knowledge and equipment between the Meta Project, recovery projects, Land for Wildlife and other programs continues to be very productive. Such benefits will increase as the programs reach maturity (a three to five year process). However, keeping programs running and maintaining the core of experienced staff that have developed are important issues.

Delivery of technical capacity and demonstrated on-ground results for natural resource management: As noted under the analysis of the Crown Reserves Program, if natural resource management is to achieve targets of sustainability and biodiversity conservation, it is absolutely imperative that the technical capacity and the flow of demonstrated on-ground results from the group of projects described above is maintained. In the case of recovery catchments, the ability to develop long-term projects and associated monitoring is vital to establish the basis for future decision-making in natural resource management.

Recommendations for future program

Targeted government investment, as represented by work in recovery catchments, will be a cornerstone of any serious attempt to conserve natural diversity in the agricultural region. Alternative approaches—such as diffuse application of limited resources across the whole agricultural region—can at best only slow the rate of biodiversity decline. These comments apply with additional force in the case of areas severely threatened by salinity. For such areas recovery catchments represent the best opportunity to conserve representative samples of natural diversity.

To meet goals established under the *Salinity Action Plan* it is important to expand recovery programs beyond the initial focus on wetlands. While wetlands were to be the key focus for action, the plan intended that a broader landscape view should also be taken. This broader view is implicit, rather than explicit, in the *Salinity Strategy*. Taking this broader view, targeted investments such as those at Dongolocking¹¹ and Wallatin Creek are also important in a salinity context. This is because improved management of upland areas, such as at Dongolocking, is important to the long-term management of downstream lands.

A key aspect of recovery programs is that they cannot achieve their conservation objectives without also achieving sympathetic, economically viable, sustainable land use in surrounding lands. Thus planning and work towards conservation in recovery catchments entails directly contributing to the development of profitable land use systems in surrounding lands (see Appendix 10 for a fuller explanation of this point). This is exemplified by the contribution to

¹⁰ Natural Heritage Trust Project No. 973855, full title 'State Agency Contributions to Land Conservation and Biodiversity Revegetation'.

¹¹ Dongolocking and Wallatin Creek both include groups of reserves and private remnants that are largely high in the landscape and very important for nature conservation. In both areas strategic planning to achieve biodiversity conservation goals has been undertaken, and work is now under way to implement planning outcomes.

oil mallees at Toolibin, Maritime Pine at Lake Warden and to trials of perennial pastures at Lake Muir-Unicup. In this regard it is vital to recovery catchments, and salinity management in general, for recovery areas to drive economically viable, environmentally sound technologies to reduce recharge and manage discharge.

At the same time, the need for significant amounts of long-term targeted expenditure to achieve real success must be recognised. This also applies in a much broader way across natural resource management issues. An important aspect of targeting expenditure will be the development of effective environmental management systems that include risk assessment as a mechanism for establishing priorities (see Concluding Remarks and Strategic Recommendations for a more detailed coverage of this issue). In the case of natural diversity recovery catchments, the Department will need to determine which potential recovery catchments are just too expensive to recover in relation to the values at risk. There is also an important question as to whether some funds should be targeted to areas higher in the landscape at long-term risk from salinity. Many of these areas can probably be protected with comparatively inexpensive management works implemented in the short term.

Given the above, the following recommendations are made:

Recommendation 11

The Natural Diversity Recovery Program should be expanded to cover areas that, while not necessarily containing wetlands, are of significant importance to biodiversity conservation and whose management will contribute to achieving positive downstream effects. Note that there is some capacity to achieve this through implementing the recommendations made under the Crown Reserves Program.

Recommendation 12

The Natural Diversity Recovery Program should be expanded to include the most important areas threatened by salinity identified through the Biological Survey Program. In doing this, it is also recommended that an effective environmental management system be developed that better integrates risk, costs and values than current procedures.

Recommendation 13

The Natural Diversity Recovery Program should be explicitly recognised for its importance in researching and developing solutions to salinity. Their role as living experiments that protect key public assets as well as contributing to research and development should be maintained and expanded. Works in recovery catchments will, if properly managed, underpin the achievement of both natural diversity conservation and sustainable land use objectives. This also underlines the program's role in maintaining the type of long-term monitoring required to develop and document effective practice in natural resource management.

Recommendation 14

The Natural Diversity Recovery Program should be funded to implement effectively recommendations 11 to 13 inclusive. An additional \$3.0 million (as recommended in the *Salinity Strategy*), scaled up over four years, should be allocated to natural diversity recovery catchments. It should be noted that this amount only substitutes for that which was to be sought from the Commonwealth Government under the *Salinity Action Plan*.

Recommendations 11, 12 and 14 are consistent with the *Salinity Strategy* recommendation that the number of natural diversity recovery catchments be expanded. However, Recommendation 14 is an extremely modest step given the extreme risk to biodiversity values throughout the agricultural region. Consequently, it is recommended that:

Recommendation 15

The adequacy of funding for this program should be reviewed in three years (February 2004). This will allow time to fully digest the outcomes of the biological survey, implement additional recovery catchments, and assess whether one or more earlier recovery catchments are in a position where they may be wound down.

Recommendation 16

At an operational level, the issues highlighted in the Problems/Difficulties section should be tackled by the Department, and action should be taken to maintain the positive outcomes listed within the highlights section and in the specific catchment accounts. This includes, but is not restricted to, developing and implementing:

- improved monitoring and GIS-based information systems;
- guidelines for species selection in revegetation;
- guidelines for cost-sharing and strategies to maximise adoption of actions sympathetic to conservation across the agricultural region;
- improved public access to documents and reports generated through the recovery process that will help other groups to implement salinity management;
- improved information exchange between officers involved with recovery works, both within the Department and with other officers managing Water and Rivers Commission (WRC) and Agriculture WA recovery catchments;
- maintaining the very effective inter-agency links and collaboration that have evolved at the recovery project level, while noting the need to broaden this beyond the project level (see previous point); and
- improved evaluation of proposed recovery catchments in terms of salinity hazard, values at risk, and costs to recover. In this regard it may be more fruitful, in some cases, to prevent areas higher in the landscape becoming saline than trying to implement expensive engineering in the valleys.

It is also recommended that these actions be tackled in consultation with other organisations involved in delivering highly targeted programs.

APPENDIX 3

Criteria for selecting recovery catchments

Criterion	Comment
Biodiversity values at risk	<p>This is the primary criterion for selecting recovery catchments for natural diversity. Recovery catchments will contain very high nature conservation values at risk. Assessment of catchments will involve the following attributes:</p> <ul style="list-style-type: none"> ▪ how representative the catchment biota is of important natural communities; ▪ presence of threatened communities and species; ▪ species and community richness; ▪ whether the catchment provides an important biological corridor (e.g. that connecting Lake Magenta Nature Reserve and Fitzgerald River National Park), or other significant ecological service; and ▪ international or national significance of the area (e.g. Ramsar Convention, Directory of Important Wetlands in Australia).
Biogeographic representation	<p>It is desirable to have recovery catchments that represent a range of situations. For example, as many IBRA regions as practicable will be represented, consistent with other criteria.</p>
Opportunities for R&D or demonstration sites	<p>R&D or demonstration sites, particularly those with State or national or international significance, might include special management techniques for:</p> <ul style="list-style-type: none"> ▪ nature conservation; ▪ farm economics; ▪ cultural change or improved social interaction; and ▪ landcare.
Tenure of land at risk	<p>While conservation lands that are the focus of recovery catchments for natural diversity should be vested with the NPNCA, other land tenures may be considered for selection as recovery catchments if they are sufficiently important for nature conservation and threatened by salinity.</p>
Representation of hazard	<p>The greater the hazard to an important site, the greater the urgency for action. However, recovery catchments will be selected that represent a range of hazard situations including those that are threatened in the longer term by salinity, but are at present in good condition.</p>
Potential for success	<p>In the main, catchments will be selected that are likely to lead to success. This will involve, for example, taking into consideration:</p> <ul style="list-style-type: none"> ▪ ‘physics’ of pressure (e.g. is hydrological pressure overwhelming?); ▪ area of catchment (bigger catchments are generally more difficult to recover); ▪ degree of threat; ▪ level of landcare community support, knowledge and enthusiasm; ▪ potential to use prospective commercial species in revegetation; and ▪ current area and distribution of remnant vegetation (the more the better).
Socio-political considerations	<p>There will be demands from a plethora of socio-political stakeholder groups ranging from catchment groups to Federal agencies and politicians. The demands from these groups will need to be taken into consideration.</p>

APPENDIX 4

Recovery Strategies—Toolibin Lake

While all the strategies listed are important, the first four are crucial and therefore have the highest priority. The strategies for achieving the Recovery Objective are:

- To control groundwater levels beneath Toolibin and ensure that they do not threaten the freshwater status of the Lake or its environs.
- To control surface water inflows to Toolibin and ensure that they do not threaten the freshwater status of the lake.
- To maintain or enhance the natural vegetation in and around the lake.
- To achieve sustainable agriculture and increased water use on agricultural lands in the catchment by:
 - developing and implementing commercial revegetation schemes based on woody, native vegetation;
 - developing and implementing revegetation, which improves current agricultural production (cereal and stock). For example, by effective implementation of alley farming, shelterbelts, and rehabilitation and pastoral use of areas with surface salinity;
 - encouraging changes in farm practice which better utilise water where it falls. This may include improving soil structure to enhance plant growth (and thus water use).
- To develop consultative mechanisms, models and decision-making systems with the community to ensure that potentially divisive land conservation issues, such as drainage and disposal of effluent from groundwater pumping, can be effectively resolved.
- To implement monitoring and research which allows the achievement of strategies to be evaluated.
- Given that the Australian community contributes to the recovery of the lake, it is recognised that the following strategies must also be pursued although they do not directly relate to the recovery objective.
- To improve knowledge of hydrological, farming and natural systems so that information generated through the Toolibin Catchment can be successfully applied elsewhere.
- To educate the local, State, and National communities concerning the recovery outcomes so that people are better informed concerning land use and land conservation.
- To extend the information and lessons from Toolibin to other land managers.

APPENDIX 5
Toolibin Lake Recovery Catchment Program
Work activities, outputs, and expenditure, 1 July 1996 to 30 June 2000

Work activities	Outputs	Statistics	Expenditure
Expansion of conservation estate through land purchases. Current efforts in this area are generally focussed on purchasing lands that enhance long-term viability of existing reserves and remnant systems	No. of land parcels inspected.	1	\$95,310
	No. of land parcels purchased.	1	
	Total area of land purchased.	137	
Biological surveys to identify lands that should be incorporated into the conservation estate, used for seed orchards, revegetated, or accorded better protection for salinity control	No. of areas surveyed.	0	\$0
	No. of recommendations completed (at regional level).	0	
Biological surveys (e.g. vegetation and floristics, mammal surveys) as a basis for monitoring and planning	State project name, objectives and progress (please state in a separate Word document) and insert expenditure amount.		\$89,484
Creating buffers, corridors, etc., for remnant vegetation. Involves use of funds for works on private property to protect recovery values	Buffers		\$0
	a. No. of sites	0	
	b. No. of seedlings	0	
	c. Area of buffers.	0	
	Corridors		
	a. No. of sites	0	
	b. No. of seedlings	0	
	c. Area of corridors.	0	
	Land conservation plantings		\$7,671
	a. No. of sites	5	
b. No. of seedlings	25,000		
Creating buffers, corridors, etc. for remnant vegetation. Involves use of funds for works on private property to protect recovery values	c. Area planted.	0	\$82,196
	Commercially prospective species		
	a. No. of sites	14	
	b. No. of seedlings	227,000	
Fencing of revegetation plantings on private property	c. Area planted.	12	\$0
	Km of fencing	0	
	No. of landholders involved.	0	

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Work activities	Outputs	Statistics	Expenditure
Rehabilitation of degraded areas on Crown lands including:			
Rehabilitation of historic quarries	No. of sites rehabilitated.	6	\$65,912
Revegetate disturbed parts of recreation sites in conjunction with other works funded under recreation program	Area rehabilitated.	73	
Revegetation of cleared areas	No. of reserves involved (note, individual reserves should only be recorded once).	3	
Fencing of remnant vegetation on private property	Km of fencing.	0	\$0
	No. of remnants.	0	
	Area of remnants.	0	
	No. of landholders involved.	0	
Coverage of private remnants by conservation covenants	No. of sites covered.	0	\$0
	Area of sites covered.	0	
Construction and maintenance of fire-access tracks	Length (km) constructed.	0	\$0
	Length (km) maintained.	0	
	No. of reserves on which construction work undertaken.	0	
	No. of reserves on which maintenance work undertaken.	0	
Prescribed burning	Area treated.	0	\$0
	No. of reserves treated.	0	
Weed control on Crown lands	No. of sites treated.	3	\$4,119
	Area treated.	40	
	No. of reserves treated (note, individual reserves should only be recorded once).	2	
Rabbit control	No. of sites treated.	0	\$0
	Area treated.	0	
	No. of reserves treated (note, individual reserves should only be recorded once).	0	

Work activities	Outputs	Statistics	Expenditure
Pig control	No. of sites treated.	0	\$0
	Area treated.	0	
	No. of reserves treated (note, individual reserves should only be recorded once).	0	
Control of plague locusts	Area treated.	0	\$0
Develop and implement <i>Phytophthora</i> management plan	Plan status in preparation (insert No. of, or 0)	0	\$0
	Plan status completed and being implemented (insert No. of, or 0).	0	
Investigate and recommend control methods for <i>Armillaria</i> and other diseases	Projects documented separately.		\$0
Planning of engineering works	Projects documented separately.		\$199,822
Engineering works on Crown lands to protect recovery catchment values	Description of work (please describe in a separate Word document).		\$651,262
	No. of sites treated.	34	
	Length of structure; or	2	
	Area treated.	800	
Engineering works on private property to protect recovery catchment values	Description of work (please describe in a separate Word document).		\$68,386
	No. of sites treated.	3	
	Length of structure; or	0	
	Area treated	0	
	If appropriate, number of de-watering bores.	0	
Monitoring and research/investigations (other than listed for particular project areas above).	Projects documented separately.		\$157,744

Work activities	Outputs	Statistics	Expenditure
Management of recovery and related committees	Management of recovery team, technical advisory group, relevant catchment groups (no statistics required). Insert expenditure amount.		\$583
Communication and interpretation of recovery catchment and results	No. of groups dealt with.	12	\$28,607
	No. of people dealt with.	30	
	No. of interpretive items.	3	
	No. of media releases.	0	
Removal of rubbish	No. of sites treated.	0	\$0
	No. of reserves treated (only record individual reserves once).	0	
TOTAL (not including infrastructure)			\$1,451,096
Infrastructure Costs			\$191,735
GRAND TOTAL			\$1,642,831

APPENDIX 6

Lake Muir/Unicup Complex Recovery Catchment Program

Work activities, outputs, and expenditure, 1 July 1996 to 30 June 2000

Work activities	Outputs	Statistics	Expenditure
Expansion of conservation estate through land purchases. Current efforts in this area are generally focussed on purchasing lands that enhance long-term viability of existing reserves and remnant systems	No. of land parcels inspected.	2	\$265,000
	No. of land parcels purchased.	2	
	Total area of land purchased.	128	
Biological surveys to identify lands that should be incorporated into the conservation estate, used for seed orchards, revegetated, or accorded better protection for salinity control	No. of areas surveyed.	0	\$0
	No. of recommendations completed (at regional level).	0	
Biological surveys (e.g. vegetation and floristics, mammal surveys) as a basis for monitoring and planning	State project name, objectives and progress (please state in a separate Word document) and insert expenditure amount.		\$6,000
Creating buffers, corridors, etc. for remnant vegetation. Involves use of funds for works on private property to protect recovery values	Buffers		\$0
	a. No. of sites	0	
	b. No. of seedlings	0	
	c. Area of buffers.	0	
	Corridors		
	a. No. of sites	0	
	b. No. of seedlings	0	
	c. Area of corridors.	0	
	Land conservation plantings		
	a. No. of sites	65	\$315,145
b. No. of seedlings	300350		
c. Area planted.	326		
Creating buffers, corridors, etc. for remnant vegetation. Involves use of funds for works on private property to protect recovery values	Commercially prospective species		\$0
	a. No. of sites	0	
	b. No. of seedlings	0	
Fencing of revegetation plantings on private property	c. Area planted.	0	\$101,360
	Km of fencing	25	
	No. of landholders involved.	15	

Work activities	Outputs	Statistics	Expenditure
Rehabilitation of degraded areas on Crown lands including:			
Rehabilitation of historic quarries	No. of sites rehabilitated.	0	
Revegetate disturbed parts of recreation sites in conjunction with other works funded under recreation program	Area rehabilitated.	0	\$0
Revegetation of cleared areas	No. of reserves involved (note, individual reserves should only be recorded once).	0	
Fencing of remnant vegetation on private property	Km of fencing.	10	\$44,700
	No. of remnants.	9	
	Area of remnants.	29	
	No. of landholders involved.	5	
Coverage of private remnants by conservation covenants	No. of sites covered.	0	\$0
	Area of sites covered.	0	
Construction and maintenance of fire-access tracks	Length (km) constructed.	0	\$0
	Length (km) maintained.	0	
	No. of reserves on which construction work undertaken.	0	
	No. of reserves on which maintenance work undertaken.	0	
Prescribed burning	Area treated.	0	\$0
	No. of reserves treated.	0	
Weed control on Crown lands	No. of sites treated.	0	\$0
	Area treated.	0	
	No. of reserves treated (note, individual reserves should only be recorded once).	0	
Rabbit control	No. of sites treated.	6	\$3,000
	Area treated.	10	
	No. of reserves treated (note, individual reserves should only be recorded once).	0	

Work activities	Outputs	Statistics	Expenditure
Pig control	No. of sites treated.	0	\$0
	Area treated.	0	
	No. reserves treated (note, individual reserves should only be recorded once).	0	
Control of plague locusts	Area treated.	0	\$0
Develop and implement <i>Phytophthora</i> management plan	Plan status in preparation (insert No. of, or 0	0	\$0
	Plan status completed and being implemented (insert No. of, or 0).	0	
Investigate and recommend control methods for <i>Armillaria</i> and other diseases.	Projects documented separately.		\$0
Planning of engineering works	Projects documented separately.		\$0
Engineering works on Crown lands to protect recovery catchment values	Description of work (please describe in a separate Word document).		\$0
	No. of sites treated.	0	
	Length of structure; or	0	
	Area treated.	0	
Engineering works on private property to protect recovery catchment values	Description of work (please describe in a separate Word document).		\$3,500
	No. of sites treated.	2	
	Length of structure; or	2.5	
	Area treated	0	
	If appropriate, number of de-watering bores.	0	
Monitoring and research/investigations (other than listed for particular project areas above)	Projects documented separately.		\$87,500
Management of recovery and related committees	Management of recovery team, technical advisory group, relevant catchment groups (no statistics required). Insert expenditure amount.		\$153,000

Communication and interpretation of recovery catchment and results	No. of groups dealt with.	3	\$6,000
	No. of people dealt with.	56	
	No. of interpretive items.	38	
	No. of media releases.	10	
Removal of rubbish	No. of sites treated.	0	\$0
	No. of reserves treated (only record individual reserves once).	0	
TOTAL (not including infrastructure)			\$985,205
Infrastructure costs			\$0
GRAND TOTAL			\$985,205

APPENDIX 7

Lake Warden Recovery Catchment Program

Work activities, outputs, and expenditure, 1 July 1996 to 30 June 2000

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Work activities	Outputs	Statistics	Expenditure
Expansion of conservation estate through land purchases. Current efforts in this area are generally focussed on purchasing lands that enhance long-term viability of existing reserves and remnant systems	No. of land parcels inspected.	3	\$997
	No. of land parcels purchased.	0	
	Total area of land purchased.	0	
Biological surveys to identify lands that should be incorporated into the conservation estate, used for seed orchards, revegetated, or accorded better protection for salinity control	No. of areas surveyed.	0	\$0
	No. of recommendations completed (at regional level).	0	
Biological surveys (e.g. vegetation and floristics, mammal surveys) as a basis for monitoring and planning	Projects documented separately.		\$16,595
Creating buffers, corridors, etc. for remnant vegetation. Involves use of funds for works on private property to protect recovery values	Buffers		\$167,058
	a. No. of sites	0	
	b. No. of seedlings	0	
	c. Area of buffers.	0	
	Corridors		
	a. No. of sites	0	
	b. No. of seedlings	0	
	c. Area of corridors.	0	
	Land conservation plantings		\$0
	a. No. of sites	0	
	b. No. of seedlings	0	
	c. Area planted.	0	
	Commercially prospective species		\$4,200
	a. No. of sites	0	
	b. No. of seedlings	0	
c. Area planted.	0		
Fencing of revegetation plantings on private property	Km of fencing	0	\$0
	No. of landholders involved.	0	

Work activities	Outputs	Statistics	Expenditure
Rehabilitation of degraded areas on Crown lands including:			
Rehabilitation of historic quarries	No. of sites rehabilitated.	1	
Revegetate disturbed parts of recreation sites in conjunction with other works funded under recreation program	Area rehabilitated.	1	\$9,000
Revegetation of cleared areas	No. of reserves involved (note, individual reserves should only be recorded once).	1	
Fencing of remnant vegetation on private property	Km of fencing.	55	\$157,310
	No. of remnants.	15	
	Area of remnants.	720	
	No. of landholders involved.	14	
Coverage of private remnants by conservation covenants	No. of sites covered.	0	\$0
	Area of sites covered.	0	
Construction and maintenance of fire-access tracks	Length (km) constructed.	0	\$0
	Length (km) maintained.	0	
	No. of reserves on which construction work undertaken.	0	
	No. of reserves on which maintenance work undertaken.	0	
Prescribed burning	Area treated.	0	\$0
	No. of reserves treated.	0	
Weed control on Crown lands	No. sites treated.	0	\$0
	Area treated.	0	
	No. reserves treated (note, individual reserves should only be recorded once).	0	
Rabbit control	No. sites treated.	0	\$0
	Area treated.	0	
	No. reserves treated (note, individual reserves should only be recorded once).	0	

Work activities	Outputs	Statistics	Expenditure
Pig control	No. of sites treated.	0	\$0
	Area treated.	0	
	No. of reserves treated (note, individual reserves should only be recorded once).	0	
Control of plague locusts	Area treated.	0	\$0
Develop and implement <i>Phytophthora</i> management plan	Plan status in preparation (insert No. of, or 0	0	\$0
	Plan status completed and being implemented (insert No. of, or 0).	0	
Investigate and recommend control methods for <i>Armillaria</i> and other diseases	Projects documented separately.		\$0
Planning of engineering works	Projects documented separately.		\$21,800
Engineering works on Crown lands to protect recovery catchment values	Description of work (please describe in a separate Word document).		\$0
	No. of sites treated.	0	
	Length of structure; or	0	
	Area treated.	0	
Engineering works on private property to protect recovery catchment values	Description of work (please describe in a separate Word document).		\$0
	No. of sites treated.	0	
	Length of structure; or	0	
	Area treated	0	
	If appropriate, number of de-watering bores.	0	
Monitoring and research/investigations (other than listed for particular project areas above)	Projects documented separately.		\$63,800
Management of recovery and related committees	Management of recovery team, technical advisory group, relevant catchment groups (no statistics required). Insert expenditure amount.		\$60,947

Work activities	Outputs	Statistics	Expenditure
Communication and interpretation of recovery catchment and results	No. of groups dealt with.	25	\$54,511
	No. of people dealt with.	375	
	No. of interpretive items.	41	
	No. of media releases.	9	
Removal of rubbish	No. of sites treated.	0	\$0
	No. of reserves treated (only record individual reserves once).	0	
TOTAL (not including infrastructure)			\$556,218
Infrastructure costs			\$0
GRAND TOTAL			\$556,218

APPENDIX 8

Lake Bryde Recovery Catchment Program

Work activities, outputs, and expenditure, 1 July 1996 to 30 June 2000

Work activities	Outputs	Statistics	Expenditure
Expansion of conservation estate through land purchases. Current efforts in this area are generally focussed on purchasing lands that enhance long-term viability of existing reserves and remnant systems	No. of land parcels inspected.	0	\$0
	No. of land parcels purchased.	0	
	Total area of land purchased.	0	
Biological surveys to identify lands that should be incorporated into the conservation estate, used for seed orchards, revegetated, or accorded better protection for salinity control	No. of areas surveyed.	0	\$0
	No. of recommendations completed (at regional level).	0	
Biological surveys (e.g. vegetation and floristics, mammal surveys) as a basis for monitoring and planning	Projects documented separately.		\$59,414
Creating buffers, corridors, etc. for remnant vegetation. Involves use of funds for works on private property to protect recovery values	Buffers		\$0
	a. No. of sites	0	
	b. No. of seedlings	0	
	c. Area of buffers.	0	
	Corridors		
	a. No. of sites	0	
	b. No. seedlings	0	
	c. Area of corridors.	0	
	Land conservation plantings		\$0
	a. No. of sites	0	
	b. No. of seedlings	0	
	c. Area planted.	0	
	Commercially prospective species		\$0
	a. No. of sites	0	
	b. No. of seedlings	0	
c. Area planted.	0		
Fencing of revegetation plantings on private property	Km of fencing	0	\$0
	No. of landholders involved.	0	

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Work activities	Outputs	Statistics	Expenditure
Rehabilitation of degraded areas on Crown lands including:			
Rehabilitation of historic quarries	No. sites rehabilitated.	0	
Revegetate disturbed parts of recreation sites in conjunction with other works funded under recreation program	Area rehabilitated.	0	\$0
Revegetation of cleared areas	No. of reserves involved (note, individual reserves should only be recorded once).	0	
Fencing of remnant vegetation on private property	Km of fencing.	0	
	No. of remnants.	0	
	Area of remnants.	0	\$0
	No. of landholders involved.	0	
Coverage of private remnants by conservation covenants	No. of sites covered.	0	\$0
	Area of sites covered.	0	
Construction and maintenance of fire-access tracks	Length (km) constructed.	0	
	Length (km) maintained.	0	
	No. of reserves on which construction work undertaken.	0	\$0
	No. of reserves on which maintenance work undertaken.	0	
Prescribed burning	Area treated.	0	\$0
	No. of reserves treated.	0	
Weed control on Crown lands	No. of sites treated.	0	
	Area treated.	0	
	No. of reserves treated (note, individual reserves should only be recorded once).	0	\$0
Rabbit control	No. of sites treated.	0	
	Area treated.	0	
	No. of reserves treated (note, individual reserves should only be recorded once).	0	\$0

Work activities	Outputs	Statistics	Expenditure
Pig control	No. of sites treated.	0	\$0
	Area treated.	0	
	No. of reserves treated (note, individual reserves should only be recorded once).	0	
Control of plague locusts	Area treated.	0	\$0
Develop and implement <i>Phytophthora</i> management plan	Plan status in preparation (insert No. of, or 0	0	\$0
	Plan status completed and being implemented (insert No. of, or 0).	0	
Investigate and recommend control methods for <i>Armillaria</i> and other diseases	Projects documented separately.	0	\$0
Planning of engineering works	Projects documented separately.	0	\$0
Engineering works on Crown lands to protect recovery catchment values	Description of work (please describe in a separate Word document).		\$0
	No. of sites treated.	0	
	Length of structure; or	0	
	Area treated.	0	
Engineering works on private property to protect recovery catchment values	Description of work (please describe in a separate Word document).		\$0
	No. of sites treated.	0	
	Length of structure; or	0	
	Area treated	0	
	If appropriate, number of de-watering bores.	0	
Monitoring and research/investigations (other than listed for particular project areas above)	Projects documented separately.		\$144,129
Management of recovery and related committees	Management of recovery team, technical advisory group, relevant catchment groups (no statistics required). Insert expenditure amount.		\$40,913

Work activities	Outputs	Statistics	Expenditure
Communication and interpretation of recovery catchment and results	No. of groups dealt with.	6	\$6,000
	No. of people dealt with.	100	
	No. of interpretive items.	0	
	No. of media releases.	0	
Removal of rubbish	No. of sites treated.	0	\$0
	No. of reserves treated (only record individual reserves once).	0	
TOTAL (not including infrastructure)			\$250,457
Infrastructure costs			
GRAND TOTAL			\$250,457

APPENDIX 9
SUMMARY: Recovery Catchment Program
Work activities, outputs, and expenditure, 1 July 1996 to 30 June 2000

Work activities	Outputs	Statistics	Expenditure
Expansion of conservation estate through land purchases. Current efforts in this area are generally focussed on purchasing lands that enhance long-term viability of existing reserves and remnant systems	No. of land parcels inspected.	6	\$361,307
	No. of land parcels purchased.	3	
	Total area of land purchased.	265	
Biological surveys to identify lands that should be incorporated into the conservation estate, used for seed orchards, revegetated, or accorded better protection for salinity control	No. of areas surveyed.	0	\$0
	No. of recommendations completed (at regional level).	0	
Biological surveys (e.g. vegetation and floristics, mammal surveys) as a basis for monitoring and planning	Projects documented separately.		\$171,493
Creating buffers, corridors, etc. for remnant vegetation. Involves use of funds for works on private property to protect recovery values	Buffers		\$167,058
	a. No. of sites	0	
	b. No. of seedlings	0	
	c. Area of buffers.	0	
	Corridors		
	a. No. of sites	0	
	b. No. of seedlings	0	
	c. area of corridors.	0	
	Land conservation plantings		\$322,816
	a. No. of sites	70	
	b. No. of seedlings	325350	
	c. Area planted.	326	
	Commercially prospective species		\$86,396
	a. No. of sites	14	
	b. No. of seedlings	227000	
c. Area planted.	12		
Fencing of revegetation plantings on private property	Km of fencing	25	\$101,360
	No. of landholders involved.	15	

Work activities	Outputs	Statistics	Expenditure
Rehabilitation of degraded areas on Crown lands including:			
Rehabilitation of historic quarries	No. of sites rehabilitated.	7	
Revegetate disturbed parts of recreation sites in conjunction with other works funded under recreation program	Area rehabilitated.	74	\$74,912
Revegetation of cleared areas	No. of reserves involved (note, individual reserves should only be recorded once).	4	
Fencing of remnant vegetation on private property	Km of fencing.	65	\$202,010
	No. of remnants.	24	
	Area of remnants.	749	
	No. of landholders involved.	19	
Coverage of private remnants by conservation covenants	No. of sites covered.	0	\$0
	Area of sites covered.	0	
Construction and maintenance of fire-access tracks	Length (km) constructed.	0	\$0
	Length (km) maintained.	0	
	No. of reserves on which construction work undertaken.	0	
	No. of reserves on which maintenance work undertaken.	0	
Prescribed burning.	Area treated.	0	\$0
	No. of reserves treated.	0	
Weed control on Crown lands	No. of sites treated.	3	\$4,119
	Area treated.	40	
	No. of reserves treated (note, individual reserves should only be recorded once).	2	
Rabbit control	No. of sites treated.	6	\$3,000
	Area treated.	10	
	No. of reserves treated (note, individual reserves should only be recorded once).	0	

Work activities	Outputs	Statistics	Expenditure
Pig control	No. of sites treated.	0	\$0
	Area treated.	0	
	No. of reserves treated (note, individual reserves should only be recorded once).	0	
Control of plague locusts	Area treated.	0	\$0
Develop and implement <i>Phytophthora</i> management plan	Plan status in preparation (insert No. of, or 0	0	\$0
	Plan status completed and being implemented (insert No. of, or 0).	0	
Investigate and recommend control methods for <i>Armillaria</i> and other diseases	Projects documented separately.		\$0
Planning of engineering works	Projects documented separately.		\$221,622
Engineering works on Crown lands to protect recovery catchment values	Description of work (please describe in a separate Word document).		\$651,262
	No. of sites treated.	34	
	Length of structure; or	2	
	Area treated.	800	
Engineering works on private property to protect recovery catchment values	Description of work (please describe in a separate Word document).		\$71,886
	No. of sites treated.	5	
	Length of structure; or	2.5	
	Area treated	0	
	If appropriate, number of de-watering bores.	0	
Monitoring and research/investigations (other than listed for particular project areas above)	Projects documented separately.		\$453,174
Management of recovery and related committees	Management of recovery team, technical advisory group, relevant catchment groups (no statistics required). Insert expenditure amount.		\$255,443

Work activities	Outputs	Statistics	Expenditure
Communication and interpretation of recovery catchment and results	No. of groups dealt with.	46	\$95,118
	No. of people dealt with.	561	
	No. of interpretive items.	82	
	No. of media releases.	19	
Removal of rubbish	No. of sites treated.	0	\$0
	No. of reserves treated (only record individual reserves once).	0	
TOTAL (not including infrastructure)			\$3,242,976
Infrastructure Costs			\$191,735
GRAND TOTAL			\$3,434,711

APPENDIX 10

Integration of land use goals

(Extract from *Planning Nature Conservation in Agricultural Environments: A Land Manager's Perspective* by K. J. Wallace and B. C. Beecham, submitted to *Conservation Biology*.)

Integrating goals

At Dongolocking, goals for nature conservation must in some way be integrated with those of other land uses because, irrespective of the socio-cultural need to integrate planning, populations of some species are not viable within the limits of the existing reserve system. Consequently, the management of privately owned native vegetation remnants and revegetation is important. This situation is common in agricultural areas of southern Australia. Catchment and other land management groups frequently plan for a number of land use goals including sustainable agriculture and nature conservation.

The question then arises as to how to reconcile various land use goals when many of the management actions required to achieve them are potentially antagonistic. At Dongolocking the two major land uses are agriculture and nature conservation; therefore planning revolves around the interaction of these two goals.

In resolving this issue we quickly realised that any attempt to plan the landscape for agriculture, then fit the nature conservation goal to that plan would result in a diminution of the nature conservation goal. This is for two reasons.

Firstly, there are many more species and ecological processes that must be managed to achieve conservation as opposed to agricultural goals. In this sense, nature conservation goals are more demanding than agricultural goals. To plan for the latter will neglect actions necessary for nature conservation.

Secondly, while it is theoretically possible, with enormous resources, to achieve nature conservation independently of other land use goals, this will never be culturally acceptable in agricultural areas of south-west Western Australia. Thus many threats to nature conservation may only be countered by achieving sustainable agriculture in a way that is sympathetic to nature conservation. That is, achievement of sustainable, profitable agriculture is essential for effective nature conservation in agricultural environments.

Therefore, if nature conservation is a goal, it should be explicitly planned for at the outset where there are competing land uses. It is generally very difficult to retrospectively plan conservation goals into the landscape.

As we began implementing management from the nature conservation planning process we recognised that goal integration could best be achieved through integration at the action level. For example, increasing the area of woody perennials in the landscape is important to achieve the goals of both nature conservation and sustainable agriculture. Therefore, integration of the two goals may be achieved by selecting species, sites and planting designs compatible with both goals.

Thus although we began the project seeking some form of integration at the level of the goals themselves, we ultimately found that it was preferable to keep goals distinct. This ensures that goals reflect the desires of stakeholders and allows integration to be sought at the level of actions where synergies can be achieved, and potentially antagonistic actions reconciled. Failure to reconcile at the action level may require goals to be reconsidered.

LAND FOR WILDLIFE PROGRAM

Background and rationale

Both the *Salinity Action Plan* and the *Salinity Strategy* identify conservation of remaining native vegetation as an important component of salinity management. The important contribution of native vegetation remnants to both conservation of biodiversity and achievement of sustainable land use is outlined in the chapter of this Review dealing with the Crown Reserves Program. The major threats to the long term viability and value of native vegetation remnants are also discussed in that chapter (see pages 32–56).

As noted in the chapter on Crown Reserves, all remnant vegetation, whether on public or private land, contributes to the control of salinity and protects nature conservation values. While the Crown Reserves Program focuses on protecting these values in reserves, a suite of programs, including Land for Wildlife, has been developed to help private landholders protect and manage their remnant vegetation.

In the *Salinity Action Plan* (page 10), the State Government identified that it would, through the Department of Conservation and Land Management, promote and support the conservation of remnant vegetation on farms through the establishment of a Land for Wildlife (LfW) Scheme, and a range of other programs. Subsequently, the State Government (through the *Salinity Action Plan* and now the *Salinity Strategy*) and Environment Australia (through the Bushcare Program of the Natural Heritage Trust) funded the LfW Scheme. The program was officially launched in February 1997 with the aim of assisting in the protection and management of native vegetation on private or local government land.

In the *Salinity Strategy* (page 46), the State Government confirmed its commitment to providing advisory and support services to landholders conserving native vegetation. Key components of this service, delivered through State agencies, are:

- LfW (as noted above, with joint State and Commonwealth funding);
- Remnant Vegetation Protection Scheme (a State scheme that funds fencing of remnant vegetation on private property although the scheme is under review); and
- general advice and a range of covenanting schemes managed by a variety of agencies.

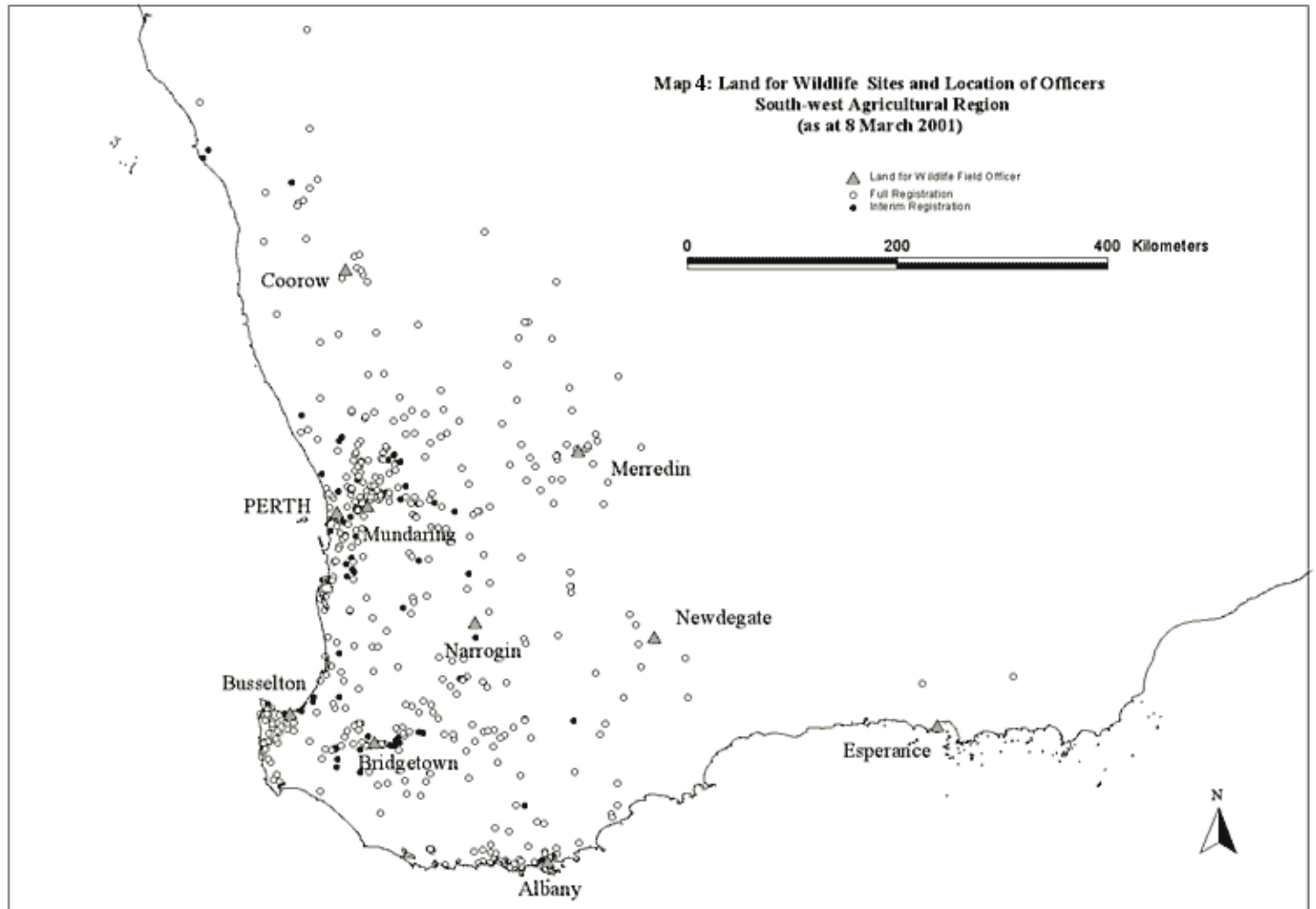
Complementing these are a range of Commonwealth programs funded through Bushcare.

LfW is unique amongst these programs in that:

- there is a long-term commitment by the Department to deliver the program;
- the client focus of the program is on one-to-one delivery; and
- once clients become a member of the LfW ‘club’, they will receive on-going advice and assistance—most other programs are effectively once-off or short-term contacts with no long-term servicing commitment.

In the context of the *Salinity Plan* and *Salinity Strategy*, the rationale for funding LfW is that healthy remnant vegetation will use more water than degraded areas, thus assisting in the control of salinity. Many studies have shown that it is much more cost-effective to preserve and enhance what we have than to start again, and that by doing this we can also achieve multiple aims such as biodiversity conservation, shelter, water management and erosion control.

**Map 4: Land for Wildlife Sites and Location of Officers
South-west Agricultural Region
(as at 8 March 2001)**



This chapter reviews the contribution of the LfW Program to native vegetation management on private and local government land, and thus its role in salinity control.

Objectives

LfW is a voluntary scheme primarily focussed on private landholders. However, other land, such as that under the management of local government, may also be considered. Its objective is: *to encourage and assist landholders to provide habitats for wildlife on their property.*

LfW (Western Australia) has six aims:

- to increase the wildlife habitat area under private and local government management which is actively managed for wildlife conservation (as ‘off-reserve’ nature conservation);
- to establish a register of properties included in the LfW scheme;
- to provide advice to enable such properties to be managed on a sound ecological basis to enhance wildlife habitat value;
- to provide direct assistance (if available) to landholders for fencing, replanting, managing wildlife habitats (especially demonstrations of new techniques), or alternatively, steering landholders towards appropriate grant schemes;
- to facilitate the expansion of the areas under such management through encouragement and the provision and identification of other resources and advice; and
- to encourage (or establish) wildlife monitoring programs.

Through achieving these aims LfW contributes to the protection of remnant vegetation, and thus contributes to the goals of the *Salinity Action Plan* and *Salinity Strategy*.

Implementation methods

Procedures

The LfW Program is implemented through the Department’s Nature Conservation Division with input from the Regional Services Division. Throughout the program, an aim has been to maximise on-ground outcomes. Therefore, to provide maximum interface with potential clients, funding has been focussed on the employment of part-time officers (3.2 FTE) throughout the south-west, as well as two full time officers (Table 10).

Table 10: Land for Wildlife staff

Position	Location	Hours	Salary funded by:
Coordinator	Perth	Full-time	Department
Administration Officer	Perth	Full-time	Department
Field Officer	Albany	Part time—40% FTE*	Bushcare
Field Officer	Bridgetown	Part time—40% FTE	Bushcare
Field Officer	Busselton	Part time—40% FTE	Bushcare
Field Officer	Coorow	Part time—40% FTE	Bushcare
Field Officer	Merredin	Part time—40% FTE	Department
Field Officer	Mundaring	Part time—40% FTE	Bushcare
Field Officer	Narrogin	Part time—40% FTE	Department
Field Officer	Newdegate	Part time—40% FTE	Department
<i>TOTAL</i>	<i>10</i>	<i>5.2 FTE</i>	<i>Department: 3.2 FTE Bushcare: 2.0 FTE</i>

*FTE = ‘full time equivalent’. For example, a 40% FTE is paid to work for 40% of the time of a full-time employee.

Placing field officers throughout the south-west provides the most cost-effective mechanism for delivering on-ground activities and outcomes. It also ensures that officers have a much greater empathy for the communities they service.

LfW officers all have considerable background and skills in ecology and conservation together with an understanding of the land use practices in the area where they live and work. Apart from property assessments, LfW officers organise and take part in workshops, seminars, field days, talks and excursions. However, their work is constrained by resources—field officers are only employed for two days a week.

LfW is jointly funded by the Department through the *Salinity Action Plan* (3.2 FTE plus all other costs), and by Environment Australia through the Bushcare Program (2 FTE).

In general LfW is implemented using two strategies:

Providing advice: to guide private landholders and local government in the management of wildlife habitat values using sound ecological principles (such as reducing herbivory by exotic and pest herbivores, managing weeds that detrimentally affect water use by woody vegetation). In particular LfW provides advice on:

- how to integrate wildlife habitat with other private land uses, to the benefit of the landholder and the wildlife, through farm and catchment planning;
- how to manage remnant bushland and the fauna occurring in the area;
- the ecological role and requirements of native flora and fauna; and
- how to include wildlife aspects into revegetation schemes and landcare.

Providing information, including:

- a folder containing LfW printed material, LfW’s quarterly magazine *Western Wildlife*, and other relevant literature;
- information about other forms of assistance and incentives (for example, covenanting schemes, fencing grants) that are available; and
- information on relevant seminars, workshops and field days.

As noted previously, the scheme deals directly with interested landowners. After landholders register with LfW (via the application form on the brochure) an on-site visit is arranged to discuss bush management, revegetation and anything else that may arise including possible integration into other projects within the catchment. A detailed report is written in a standard format, though this is varied to accommodate the needs of the landholder. Other information, as requested by the landowner, is often attached to the report. Landholders also receive a sign and an information package including books and brochures relevant to their needs and interests.

The report to landholders details management required to at least maintain, and at best enhance, the nature conservation value of the bushland coming into the scheme. Advice is given to help the landowner integrate conservation with other land uses, for example, agriculture. This information can easily be converted into a 'management plan' and, if a landholder requests it, this is done. The report recommends either full registration where adequate wildlife habitat is present, or interim registration where habitat reconstruction is required.

LfW recognises that each landholder will have individual aims and a different capacity to participate in the scheme. The critical criterion for membership will be a clear intention to attempt to integrate nature conservation with other land management objectives.

Guidelines and priority works for Land for Wildlife funds

Land is generally required to meet two broad criteria for admission into the LfW scheme:

- properties should be managed in a way so as to maintain or enhance native flora and fauna; and
- properties should be managed in a way that attempts to integrate nature conservation with other land management objectives.

A LfW officer assesses these criteria during a property inspection with the owner. The significance of habitat, or potential habitat, proposed for inclusion in the program may be considered either in isolation, or as part of a wider community project. The LfW officer may recommend full membership of the program, or interim membership if the area in question will become significant habitat with management.

Golf courses and other public recreation areas may also contain significant natural habitat and may be admitted into the program in a similar way to areas on freehold land. However, the relevant local authority, club committee or other responsible body must, of course, support a nomination and become a member of LfW.

Outputs and outcomes

Expenditure, outputs and activities

Expenditure

Salinity funds allocated to the LfW Program consist of \$0.075 million in 1996–97 and \$0.15 million per annum thereafter. These amounts were bolstered by \$100,000 from recovery catchment funds in 1998–99 and 1999–2000 as well as supplementary funds from the Department and grant funds from the Bushcare Program under the Natural Heritage Trust. The latter funds expire on 30 September 2001.

Outcomes and outputs

Work outputs and activities for the LfW Program are summarised in Tables 11 and 12.

In order to assess progress towards agreed goals, a number of performance indicators have been developed and monitored. These are also shown in Table 11.

Table 11: Land for Wildlife outputs and activities as at 1 September 2000

Performance indicator	Outputs/activity
1. The number of properties registered with LfW	<ul style="list-style-type: none"> 683 applications for registration received as at 31/8/2000 (refer Table 12).
2. The number of properties assessed	<ul style="list-style-type: none"> 509 properties have been assessed. 174 still await a visit.
3. The total property area and the area of remnant vegetation assessed	<ul style="list-style-type: none"> Total property area for the 509 properties that have been assessed is 417,715 ha, carrying 186,137 ha of remnant vegetation.
4. The area of dedicated wildlife habitat assessed (LfW sites)	<ul style="list-style-type: none"> Area of LfW sites for the 509 properties that have been assessed is 80,083 ha.
5. The number of landholders who have acted on the recommendations given during assessment	<ul style="list-style-type: none"> In a readership survey of LfWs Newsletter <i>Western Wildlife</i>, 74% of respondents said that they had used information gained from LfW to help manage their land, and 79% said they now have a better appreciation of their bushland. A detailed survey will commence in 2001 so there is a sufficiently long period to allow effective assessment.
6. The number of events organised by LfW	<ul style="list-style-type: none"> 19 workshops, field days, etc. have been specifically organised by LfW since August 1996, with 674 attendees.
7. The number of persons attending field days, displays, seminars and talks where LfW has a recognised presence	<ul style="list-style-type: none"> It is estimated that more than 4,500 people have been at events during which LfW gave a talk or otherwise contributed as a recognised presence.
8. The number of media articles mentioning LfW	<ul style="list-style-type: none"> 77
9. The response to printed materials, e.g. sales and circulation	<p>Results from a questionnaire in the first issue for year 2000, to obtain feedback on readers' attitudes to the magazine <i>Western Wildlife</i>. A total of 33% of readers returned responses, of which:</p> <ul style="list-style-type: none"> 100% found the magazine interesting and informative 91% like the style of design and layout 78% read it from cover to cover 96% keep copies for future reference 74% have used the information to help manage their land 79% have had a better appreciation of bushland since receiving the magazine.
10. The number of funding applications to which LfW staff have contributed	<ul style="list-style-type: none"> 50

Table 12: Status of Land for Wildlife as at 1 September 2000

Land for Wildlife status	Cumulative total
Number of applicants— assessed and registered	509
Number of applicants— to be assessed	174
Area of whole property (ha)	417,715
Area of remnant vegetation (ha)	186,137
Area of Land for Wildlife sites (ha)	80,083

In terms of outcomes, over three years the 509 registered applicants to LfW and their 80,000 hectares of registered land are a solid endorsement that the program is achieving its goal: ‘to encourage and assist landholders to provide habitats for wildlife on their property.’

From the viewpoint of the broader community, it is impracticable for governments to directly pay for the management of all remnant vegetation. LfW is one cost-effective means for greatly improving the management of some bushland on private property. The scheme has, during its life, improved the management of 80,000 hectares at a total cost of \$734,000 from salinity program funds. This is equivalent to \$9.175 per hectare. This does not take account of other wildlife conservation activities on properties that have been stimulated by LfW staff.

Problems/Difficulties

Lack of resources: Two major problems resulting from the limited resources provided to the program are insufficient staff to cover all areas where salinity is a problem (that is, spatial distribution of staff across the south-west could be improved), and not enough staff to quickly satisfy (within three months of notification) all requests for property assessments where LfW officers are based. A third major problem is the fact that resources are totally committed dealing with requests through word of mouth with no scope for targeted marketing. For example, there has been no concerted effort to target properties that are a high priority for nature conservation.

Once some landholders in a particular area become interested, registrations tend to snowball. Therefore, given resource constraints, the scheme is not promoted in areas where there are no staff to service demand. Areas where LfW staff are absent include districts with high salinity hazards. In these areas off-reserve native vegetation protection is vital for the long-term survival of the landscape and its wildlife. There are a number of locations where the establishment of new LfW officers would be valuable, as the residents are a long way from a source of accurate, site-specific conservation advice. Esperance, Katanning and Geraldton are three priority locations where LfW officers are needed. There are currently proposals to partly redress this situation.

The popularity of LfW services continues to increase, and requests for visits are growing faster than they can be handled. Between April and July 2000 some funds were made available from the Department’s recurrent funds to clear the backlog of requests for property assessments. While this cleared some of the backlog, some LfW officers still have more than a year’s assessments outstanding, not including new requests that will be received. It is not acceptable to tell people that they must wait up to a year for assessment. If more resources became available to enable the LfW officers to work longer hours, or to subdivide regions, this would help cope with the backlog.

Problems arising from lack of ability to service demand: As noted in the previous paragraph, there are insufficient resources in the scheme to satisfy the demand for site assessments. Among rural communities there is some resentment at the delays, and it is likely that if the current situation persists, this will have a lasting effect on the program. Furthermore, if the program is unable to provide ongoing one-to-one advice on demand, it is important to develop other mechanisms for communicating advice and ensuring that LfW members continue to feel part of an important 'club'. LfW is currently considering these issues.

Lack of understanding: Many landholders still do not recognise that protecting remnant vegetation protection is an important part of managing salinity. All remnant vegetation, especially if combined with appropriate revegetation, contributes to the control of salinity and protects nature conservation values. That the costs of protecting existing native vegetation are much lower than revegetating previously cleared land is also not adequately recognised. For example, based on a median revegetation cost of \$1,000 per hectare, existing remnant vegetation in the south-west agricultural region is worth \$7.3 billion in revegetation equivalents.

Benefits and highlights

Cost-effective outputs: LfW's free-of-charge, site-specific practical advice, is clearly cost-effective for the landholders involved. The on-site visits and discussions with landholders mean that remnant vegetation management recommendations are geared directly to the management of each site. The free published material also supplements this direct advice. As noted above, from the perspective of salinity program funds, gaining the improved management of 80,000 hectares at a cost of \$9.175 per hectare is a very cost-effective outcome.

Communities gain from local knowledge: As LfW officers live in the areas where they work, they not only have considerable background and skills in ecology and conservation, but also have a good understanding of local land use practices. Landholders registered with the LfW Program can take comfort in knowing that these officers have a local understanding of native vegetation issues (for example, soil type, typical flora species, common threats to native vegetation, knowledge of farmers' time constraints due to harvesting and other agricultural demands).

The program is unique in Western Australia in that it is geared to the needs of individual landholders by providing site-specific advice (that is, adviser and landholder working together on a one-on-one basis). As many of the LfW officers are already known within their community, their information is generally respected and well received. That is, the program has less of a bureaucratic flavour, and is instead more personable.

Involvement of community groups: While LfW has had considerable involvement with community groups through field days, seminars and so on, the contract work that has been undertaken for the Blackwood Basin Group has not only been a valuable collaborative project; it represents endorsement of the scheme by an important community group. At a broader level, LfW support networks offer technical information and management advice, and maintain group contact through newsletters, field days, seminars and other activities. This encourages on-going community involvement in nature conservation.

Benefits to both landholders and local wildlife: The scheme is important, not only for its ability to assist in delivering broader objectives within the salinity program (particularly its role in reducing recharge), but as an effective mechanism for promoting, conserving and integrating natural biodiversity into Western Australian farming systems. Each landholder receives a package of information and a LfW sign to acknowledge their efforts made on behalf of wildlife

conservation and as a symbol to other landholders that LfW is a way of benefiting both the landholder and local wildlife.

Demonstrating someone cares for private native vegetation: An increasingly important aspect of the LfW scheme is that it is demonstrating that people do care for their land, and are taking positive steps to ensure that flora and fauna outside reserves is protected for future generations. This is a very important message for the community from within the community.

Working with local government: The involvement of local government in the program has always been considered important. Currently, LfW is working with the Shire of Broomehill as part of a team developing management strategies for the local authority. This is an extremely exciting development, and could become a model for use in other local authorities.

Delivery of technical capacity and demonstrated on-ground results for natural resource management: If natural resource management is to achieve targets of sustainability and biodiversity conservation, it is necessary that on-ground results occur on both private as well as public land. Dryland salinity management cannot be achieved through management of just private land or just public land. LfW is helping to deliver a cross-community approach to land management, including salinity management.

Recommendations for future program

While funding under the LfW Program has made an important contribution to the protection and management of remnant vegetation on private property, its current funding is not sufficient to meet the increasing demand for property assessments in areas where LfW officers currently exist, nor for those officers to provide adequate follow-up support in the future. LfW also has insufficient funding to allow for these activities to be implemented in all areas where dryland salinity is a problem or indeed to target promotion of LfW in areas of greatest native vegetation conservation need. Consequently, there is a risk that failure to meet demand and satisfy the need for ongoing management advice will jeopardise the long-term success of the program.

Additionally, LfW has been approached to actively promote the benefits of the scheme to landholders who are not members—such as those with threatened flora or fauna on their properties, or whose bushland has been fenced under various government schemes. Therefore, while responding to demand has been a positive way to begin the program and has demonstrated its value, it is essential that the priorities of the scheme and its integration with other activities are reviewed and amended as appropriate. In particular, it is important to:

- develop outcome statements that describe what will be achieved in relation to both remnant management and cultural change; and
- articulate strategies for delivering an effective program with a continually growing number of registered participants—there are boundaries to expansion.

Taking these points together, the following recommendations are made:

Recommendation 17

LfW should receive additional, ongoing funding of \$200,000 per year to enable the program to service areas where salinity is a significant issue, but there is as yet no LfW presence. This recommendation supports that made in the *Salinity Strategy*.

Recommendation 18

Natural Heritage Trust funding for LfW will cease on 31 May 2001. This will result in the loss of \$113,000 of Commonwealth funding. It is recommended that this be replaced with \$150,000 from State funds, an amount that will cover the loss of the Commonwealth funds plus a small

amount for increasing costs. It is stressed that the program will not be viable unless recommendations 17 and 18 occur. This money is required from the beginning of 2001–02 if the current LfW officers are to be maintained.

Recommendation 19

By December 2001 the Department's Wildlife Branch, in consultation with other stakeholders, should provide the Director of Nature Conservation with a strategic document that outlines how LfW should develop so that it is effectively integrated with other programs targeting private remnant vegetation, and is able to deliver effective management advice on an on-going basis.

Recommendation 20

LfW data should be GIS-based and compatible with other GIS developments proposed for the Natural Diversity Recovery and Crown Reserves programs.

BIOLOGICAL SURVEY PROGRAM

Background and rationale

During the development of the *Salinity Action Plan* it was recognised that the natural biodiversity of the south-west agricultural region was generally poorly documented. Consequently, it was essential to survey the biological resources of the area to provide a basis for better management in the face of increasing salinity. Specifically, it was stated that (page 24) “much better biological data are required to:

- select further recovery catchments, and provide ecological advice for catchment management; and
- understand and develop the resource base of species for use in land conservation and for commercial development.”

The accompanying Action Statement was that the Department of Conservation and Land Management “will:

- conduct a biological survey, in the agricultural region, with an emphasis on low-lying areas that are vulnerable to salinity, to identify nature conservation priorities and to identify plant species that are likely to be of value in revegetation for both commercial production and land conservation; and
- using the results of the biological survey and following discussions with peak advisory bodies and affected community groups, the Government will select an additional three or four key recovery catchments by the end of 2000.”

Funding of \$0.5 million per year was provided for the Department to undertake this work. Preliminary results from the survey were incorporated into the 1998 Draft Plan and the subsequent *Salinity Strategy*. These reviews led to some modification of the Biological Survey Program.

For example, it was proposed that the results of the Department’s Biological Survey be combined with those of the SS2020 project to help define biodiversity conservation priorities (*Salinity Strategy* page 31). This resulted from a report to the State Salinity Council by George *et al.* (1999a) dealing with the effect of recharge management on the extent of dryland salinity, flood risk and biodiversity in Western Australia.

Additionally, the need to use the Biological Survey Program to identify species that should, as a matter of priority, be collected for germplasm storage was also identified in the *Salinity Strategy* (page 32). Also, with the higher profile given to management of saline lands in the *Salinity Strategy*, the need for the Biological Survey Program to identify saline areas of high biodiversity for improved management was also noted (page 8 in the document containing the action statements).

A final change was that the Department would identify at least six more natural diversity recovery catchments by 2005 based on survey findings.

Thus within the *Salinity Strategy* the key recommendations are (with additions to the *Salinity Action Plan* shown in italics):

- “*complete and publish the results of the biological survey of the agricultural region begun in 1997, with an emphasis on low-lying areas that are vulnerable to salinity, to identify nature conservation priorities and to identify plant species that are likely to be of value in revegetation for both commercial production and land conservation;*
- *use the results of the biological survey and following consultation with peak advisory bodies and affected community groups, progressively select additional recovery catchments and develop and implement recovery plans;* and
- *conduct more detailed biological surveys needed at catchment and local scales.”*

Objectives

The objective of the biological survey of the south-west agricultural region was elaborated in a Science Division project proposal in June 1997. This proposal was finalised as a contract to Science Division in July 1997 (Appendix 11). A detailed draft budget was also submitted at this time for the duration of the project. The Director of Nature Conservation approved this budget on 25 June 1997.

The objective for the Biological Survey Program stated in the project proposal was to conduct a biological survey in the agricultural zone with an emphasis on low-lying areas that are vulnerable to salinity. The specific aims of the Biological Survey Program are to:

- identify and prioritise potential recovery catchments (with respect to nature conservation values);
- provide a regional perspective on nature conservation priorities to help determine and prioritise management actions, particularly in regard to salinity;
- provide baseline data and a regional framework for future monitoring; and
- in collaboration with appropriate groups and individuals (a) draw up lists of plant species that are likely to be of value in revegetation for commercial production or land conservation and (b) use survey data and other corporate databases (for example WAHERB) to provide advice on actual or likely areas of occurrence, and provide information for updating of REX, etc.

In order to have predictive value and to provide a basis for monitoring it was also concluded that the survey would be quadrat-based and incorporate measurements of physical attributes at each sampling site.

Implementation methods

For the purposes of the survey, the south-west agricultural region was divided into three zones: Northern, Central and Southern bands. Subsequently, a fourth area has been added comprising the Dandaragan Plateau (surveyed for flora as part of the West Midlands study) and the section of the third band lying to the east of Ravensthorpe. This area proved too large to be covered in the initial survey of the northern and southern bands. Implementation has largely followed the outline in the project proposal (see Appendix 11 for details). The project proposal was developed into a Science Project Proposal (98/0020) under the project leader, G Keighery.

Large bushland areas within the higher rainfall zone comprising State forest, the Swan Coastal Plain and other areas of the west and south coast were not covered by the survey as it was considered they were comparatively well documented by the Swan Coastal Plain Survey, work under the Regional Forest Agreement and the Warren Flora Study (Gibson *et al.* 1994, Gibson and Keighery 2000 and Lyons *et al.* 2000). Many of these areas are not threatened by salinity.

For effective management, the program and budget were divided into three groups:

- 1 Flora (Terrestrial and Wetlands): Greg Keighery, Neil Gibson , Andrew Webb, Mike Lyons, Angus Hopkins, Margaret Langley and Judith Harvey.
- 2 Fauna (Terrestrial): Norm McKenzie, Allan Burbidge, Paul Van Heurck, Jim Rolfe, Bill Muir, Nadine Guthrie, Elisha Ladhams and Bethea Loudon.
- 3 Fauna (Wetlands): Stuart Halse, Dave Cale, Winston Kay, Jane McRae, Adrian Pinder and Michael Scanlon.

Each of these groups is considered a theme for reporting purposes.

While not directly part of the Biological Survey Program, the work of the Wetland Monitoring Program also provided important information and is part of the Science Division group of programs established under the *Salinity Action Plan* with Principal Research Scientist G Keighery as the overall manager.

Outputs and outcomes

Expenditure, outputs and activities

Expenditure

The original budget of \$0.5 million per year was to provide 120 terrestrial zoology quadrats for the entire study area. In 1997 alone, 100 terrestrial zoology quadrats were established, and it was recognised that the original estimate of 120 quadrats in total would be inadequate to deliver the expected outcomes. Consequently, in 1998 funding was increased to \$0.7 million per year to ensure a more effective coverage and outcomes from the program. This included the need to cope with the increased number of quadrats and taxa sampled, sorted and databased.

Thus the program expanded from one based on 120 quadrats to one based on 300. Additionally, many more species were found during the survey than had been expected. For example, it had been anticipated (based on prior records) that some 130 taxa of spiders would be collected. However, about 600 taxa have been collected.

Given that the selection of areas for the Natural Diversity Recovery Program was dependent on an effective Biological Survey Program, it was decided to slow the selection of natural diversity recovery catchments—where start-up and development was, in any case, slower than expected—and allocate some resources across to the Biological Survey Program.

Therefore, the total budget for the Biological Survey Program for the review period has been \$1.956 million. This was expended by June 2000.

Outputs and activities

These are reported under the three themes.

Terrestrial botany: In 1997 it was decided to establish terrestrial flora quadrats at approximately double the number of the terrestrial zoology sites to cover the broad patterning of vegetation in the agricultural zone.

Outputs:

- By the end of 2000, approximately 700 terrestrial quadrats had been established, scored and databased for the three bands surveyed. Another 200 sites have been established as part of the community survey on private and local government lands. Soil samples have been collected at all sites, with approximately 400 analysed and databased as at the start of 2000.
- Some natural diversity recovery catchments have been surveyed. A major publication on the vegetation and flora of the Lake Muir Natural Diversity Recovery Catchment has been published in *CALMScience* (Gibson and Keighery 2000). A publication on the floral values of Drummond Nature Reserve (potential recovery catchment) has been submitted for publication.
- A separate floristic survey of the West Midlands area undertaken with the Department of Environmental Protection was concluded in 1999.

Terrestrial zoology: Initially 120 biodiversity quadrats were planned for the area (40 in each band). Increased funding has enabled all sections of the survey to greatly expand on these preliminary estimates. Twenty-four field survey areas (organised in four bands) have been established from Geraldton to Esperance to achieve an adequate regional coverage. A total of 12 to 13 biodiversity quadrats are positioned within each field survey area. Of these, at least one quadrat is positioned on a minimally disturbed site representing each of the 11 main geomorphic units in the landscape. The remaining two sites are selected to represent salt-affected examples of two of the geomorphic units. Uncleared sites have been chosen as typical examples of each unit, preferably within a conservation reserve to provide better security for long-term monitoring.

Outputs:

- 303 terrestrial biodiversity (fauna and flora) quadrats have been selected and established, with sampling complete for 264 quadrats.
- The central band areas were sampled in 1997–98. Vertebrate and arachnid collections from this band have been identified. The northern band areas were sampled in 1998–99. Vertebrate and arachnid sampling have been completed and the vertebrates identified. Arachnid collections are currently (October 2000) being identified. Field sampling of the southern band was undertaken in 1999–2000. Spring and summer arachnid collections have been collected. Invertebrate sampling in the Dandaragan Plateau and Esperance Cells has also been completed.

During the 2000–2001 financial year all sampling and identifications will be finalised. Compilation and analysis of the data to identify natural diversity recovery catchments will then be undertaken.

Wetlands: Sites were chosen to cover the full range of wetland types within the study area. Criteria used related to water quality, geographic spread, the need to include both primary and secondary saline sites, and wetland morphology. The 225 wetlands sampled for aquatic invertebrates had approximately 650 quadrats established on them to document the floristics of these wetlands. Another 30 wetlands and about 100 quadrats were sampled by the end of 2000.

Outputs:

- Approximately 750 floristic sites will be established and scored by the end of 2000. Approximately 600 of these are completed and databased.
- Survey work to date in wheatbelt wetlands has collected about 700 invertebrate species, distributed in 139 families and 270 genera. About 50% appear to be

described species and approximately 15% (about 105 species) are only known from the wheatbelt.

Problems/Difficulties

As with any long-term, complex study there were a number of problems:

- The magnitude of cost increases was not budgeted—for example, petrol cost rises greatly exceeded what could have been anticipated. Furthermore, some costs outside the control of the program manager were applied retrospectively—for example, vehicle leasing costs.
- The time devoted to meeting administrative requirements related to hiring staff and letting contracts placed a significant administrative burden on project staff.
- Estimates of taxonomic richness were based on current, institutional collections. These proved to be a gross underestimate of actual diversity. Hence additional resources were required to satisfactorily complete the survey.
- The population numbers and densities of vertebrates were low on many remnants. Thus trapping intensity had to be significantly increased, at much higher costs, to complete an effective survey.
- There have been numerous requests from both within and outside the Department for data collected during the survey even before the data have been analysed. While this is good in that it reflects the high value of the data, responding to such requests increases costs.
- Conflicting demands on senior staff, such as those arising from overlapping projects, have led to significant stress within the survey group.

Benefits and highlights

Many important benefits have arisen from the program:

- The Department's Biological Survey Program is recognised as the leading Australian study of the effects of salinity on biodiversity. The potential long-term effects of salinity are profound. This is exemplified by the 450 species of endemic plants that are threatened, in the long term, with extinction.
- Members of the study have now seen most of the reserves of the agricultural zone and a significant amount of expert knowledge has accumulated on the region's biodiversity and the threats to its persistence.
- When the information collected has been analysed, it will provide a firm basis for selecting new natural diversity recovery catchments and for helping to set priorities for the full range of biodiversity conservation programs. The outcomes will also provide the foundation for the further studies that are necessary to fully describe the region's biodiversity.
- The greatly improved knowledge of the status and distribution of biodiversity in the agricultural zone will contribute to improved management of the area for biodiversity goals.
- Because data have been collected using methods that are repeatable, it will provide the baseline of information essential to effective monitoring of changes in biodiversity.
- The survey has provided the first comprehensive picture of the conservation status of many native plants and animals of the agricultural zone.

- Comprehensive data collected on habitat requirements of potentially useful native plants, and information on the distribution of plants, will make an important contribution to the Search Program (see page 157–62) and other projects aimed at developing new industries based on native plants.

Recommendations for future program

While the Biological Survey Program has generated results of immense value, it is important to be realistic about what has been achieved given the magnitude of the task. Following the WA Museum surveys in the wheatbelt during the 1970s, there was a tendency to assume the wheatbelt was ‘known’. The current program has shown just how wrong this assumption was, and despite the vast gains under the current program, it has still sampled only a small percentage of a highly variable landscape of mega-biodiversity.

Two further matters have become particularly apparent over the past three years. Firstly, there are few people highly skilled in biological survey work and it is difficult to maintain the full range of expertise within individual consultancy groups. Therefore, while contracting will always be an important component of biological survey work, it is clear that a strong and capable group is essential within government to maintain the science of biological survey, to deliver important projects, and to provide effective management of consultancy work.

Secondly, comments in the Wetland Monitoring Program chapter (see pages 121-49) concerning the need to maintain corporate memory and a core of cross-disciplinary staff in the biological sciences are also relevant here. These points have all been taken into consideration in framing the recommendations.

It is recommended that three streams of biological survey work be maintained to deliver long-term needs for policy development and operational management. Each of these is briefly treated below.

Completion and delivery of initial results plus ongoing surveys and liaison

Specific projects in this category include:

Completion of the current survey: By 2001–2002, the field component of the survey will be completed. Funding in the final year will enable sorting, identification, databasing and voucher deposition of the organisms surveyed to be completed. Analysis and write up of the survey will occur as part of this process. Archiving of datasets will occur so that they are accessible for future work. It is unlikely that publication of the whole survey will be feasible before 2004.

Recovery catchment recommendations: By 2002 approximately eight recovery catchments will be nominated from analysis of information collected under this program. A further four to five will be prepared and nominated after 2002. These will be greatly influenced by the outcomes of the completed biodiversity survey analysis and will require ongoing staff input and funding through 2002 and 2003.

Liaison and utilisation of survey results: A major and ongoing component of the study during 2001 to 2003 will be incorporating survey results in the Department’s Western Australian Threatened Species and Communities Unit (WATSCU) programs for threatened communities and species, the Department’s seed store program for flora threatened by salinity and the natural diversity recovery catchments. Although much of the cost of these projects will be covered by additional funds sought through the *Salinity Strategy*, there are increasing requirements to liaise with and support a large number of other organisations. This includes non-government organisations—such as Greening Australia and World Wide Fund for

Nature—and other government departments. To do this effectively requires a GIS-based version of the dataset to be developed. This system would be constructed to incorporate old data as well as information from new surveys. Such a system is essential to effectively deliver comprehensive information.

Similarly, there is an ongoing need to keep promoting an awareness of the biodiversity of the south-west agricultural region at the local, State and national scale. This will only be achieved using a wide variety of communication methods. For example, it is proposed that scientists from this program prepare publications dealing with the biodiversity of specific localities of high nature conservation value.

It is important to note that significant funds have been ineffectively used in several recent (non-Departmental) projects that have involved gathering biodiversity information. This occurred because the projects were not able to effectively access all the relevant information, nor have they been able to accurately compile information for specific geographic boundaries.

Further survey work

As noted in the introductory comments to the Recommendations section, while the Biological Survey Program has significantly advanced understanding of the region's biodiversity, only a small proportion of the area's biodiversity has been sampled. Three types of projects are required to build on this foundation:

- Much more detailed surveys of natural diversity recovery catchments and other areas of targeted investment are required to provide information for operational managers.
- Areas not effectively sampled by the current program should be surveyed to complete our broad understanding of the region's biodiversity.
- Biological surveys to resolve particular issues. For example, understanding the natural diversity of salt lakes, including lake floors and related dune systems, is vital to tackle issues relating to drainage and evaporation proposals using salt lakes. The need to assess drainage proposals and their impacts on receiving wetlands will also require significant scientific resources. Also, a much more refined understanding of the value of wetland dune systems and their vulnerability to salinity is required for effective risk and hazard assessment.

Rapid Catchment Appraisal

Whatever form the Rapid Catchment Appraisal Project takes, it will require some level of continuous servicing by officers supervised by scientists. While the above two project streams will deliver the basis for this work, it will be sensible to designate specific staff to deal with catchment appraisals, particularly as this will involve officers with a high level of public communication and group interaction skills.

Recommendation 21

The current funding of \$500,000 to the Biological Survey Program should be maintained to deliver three related streams of work, namely:

- completion and delivery of the current surveys, including development and management of information systems that service the full array of clients;
- further biophysical surveys to complete the skeletal picture becoming available through current work, and to tackle specific issues; and
- delivery of natural diversity information to community groups and other clients.

APPENDIX I I

Proposal: Biological Survey in the Agricultural Zone of South-Western Australia

Prepared 10 June 1997

1. Project Title

Biological survey in the agricultural zone of south-western Australia.

2. Project Leaders

Community Resources Section,
Science and Information Division,
Department of Conservation and Land Management

Co-ordinating officers:

- Project formulation: Dr Allan H. Burbidge, with input from other members of the Section
- Project implementation: Greg Keighery

3. Project Objectives

The project has been designed to underpin management initiatives in the Salinity Action Plan. We will conduct a biological survey, in the agricultural zone, with an emphasis on low-lying areas that are vulnerable to salinity. Specific aims are as follows:

- identify and prioritise potential recovery catchments (with respect to nature conservation values);
- provide a regional perspective on nature conservation priorities to help determine and prioritise management actions, particularly in regard to salinity;
- provide baseline data and a regional framework for future monitoring; and
- in collaboration with appropriate groups/individuals (a) draw up lists of plant species that are likely to be of value in revegetation for commercial production and/or land conservation and (b) use survey data and other corporate databases (for example, WAHERB) to provide advice on actual or likely areas of occurrence, and provide information for updating of REX, etc.

In order to have predictive value and to provide a basis for monitoring, the survey needs to be quadrat-based, and to incorporate measurement of physical attributes of each sampling site.

4. Possible assessors

- Dr Chris Margules, CSIRO Wildlife and Ecology, Canberra
- Dr John Woinarski, Parks and Wildlife Commission of the NT

5. Other agencies or organisations involved in the proposal

Within the Department, there is scope for collaboration with Regional personnel and the Farm Forestry Unit. Details have not yet been worked out. Outside the Department, we would need to collaborate with experts in aquatic and terrestrial invertebrates. Dr Mark Harvey at the WA Museum has agreed to participate with respect to terrestrial invertebrates. Under the Salinity Action Plan, DEP will 'develop clear objectives and environmental criteria for recovery catchments' and so liaison will be required.

6. Scope and approach

The Salinity Action Plan has identified the need for a biological survey of the agricultural zone of WA, with an emphasis on areas low in the landscape. The Director of Nature Conservation has requested that the survey be quantitative, quadrat based, explicit and repeatable, such as in other recent regional surveys such as the WA rainforest survey, Carnarvon Basin survey and Swan Coastal Plain floristic survey. A broad approach is required to meet the Project Objectives listed in Item 3 above.

Approaches used to date to select areas of high conservation value in the agricultural zone have been non-quantitative or have been applied to limited areas. To support the Salinity Action Plan, there is a need for a data set that provides both a broad picture and site-based information to allow predictive modelling and interpolation into areas that have not been surveyed. Previous Departmental regional surveys have shown that this is most effectively achieved by a quadrat-based approach, measuring a range of biological and physical attributes in each quadrat. This link between the physical and biological data is essential to provide a basis for predicting the presence of species or species assemblages beyond the actual sampling points. In addition, a quadrat-based approach is essential to provide an explicit basis for monitoring.

Vascular plants and aquatic organisms will be sampled at individual quadrats, with physical parameters (such as soil/water chemistry) measured or estimated at each sample site. Waterbirds will also be surveyed at aquatic sites. Selected groups of terrestrial animals will be sampled at as many of the terrestrial floristic sites as possible. Lizards and arachnids are the priority terrestrial groups for sampling; frogs will also be sampled, but success in sampling burrowing frogs will depend on conditions at the time of survey. Birds will be recorded where observed, and data integrated with existing (reserve based) data, but it will not be possible to assemble a bird data set that could be analysed as rigorously as the above data sets. Presence of mammals will be recorded where noted.

The fact that the specified study area (from the 600 mm annual rainfall isohyet inland to the eastern edge of land clearing) includes parts of eight IBRA regions, substantial parts of four IBRA regions (including virtually all of the Avon-Wheatbelt) and a significant part of the Jarrah Forest bioregion, indicates that the study area includes a high degree of biological diversity and biogeographical complexity. Under such conditions, a minimum of 600 floristic sites and 200 aquatic sites will be needed. At a subset (ca. 200+; ca. 120 in the central zone) of the floristic sites, we will sample selected terrestrial vertebrates and invertebrates. Previous Departmental surveys have been based on a similar density of quadrats. The Carnarvon Basin survey (approximately one IBRA region compared with four plus in the agricultural zone) included 61 terrestrial quadrats (sampled for botanical and zoological attributes) plus an extra 80 floristic quadrats, in an area that is a lot less complex biologically than the wheatbelt. The Swan Coastal Plain floristic survey (less than one IBRA region) utilised about 500 quadrats, and this number has since been doubled by DEP to enable specific management and planning questions to be answered.

Because of the magnitude of the task, terrestrial quadrats will be selected on a 'gradsect' approach (Gillison and Brewer 1985), which should provide maximum information from a minimum number of quadrats. Sampling of wetlands will include many of those that have been monitored in the past for water quantity and quality, and site selection will be aimed at sampling the full range of wetland types that occur in the region. All wetlands currently thought to be regionally or biogeographically significant will be sampled to permit an across-region evaluation.

During the remainder of the 1996–97 financial year, relevant maps and existing site-based data will be located, collated and reviewed to (a) identify data sets which could be used in

subsequent quantitative analyses, (b) collate current knowledge with respect to biogeographical patterns in the wheatbelt (and identify gaps in knowledge) and (c) bring together data required to stratify the study area to enable efficient selection of representative sites for sampling and biological monitoring beginning in 1997–98. Final selection of sites will only be made following liaison with relevant Regional Managers in the Department.

Data analyses will be based on a multivariate approach, similar to that used in the Carnarvon Basin survey, with appropriate modifications to provide information about commercial species (Item 3, above). Some of these analyses will be done collaboratively with scientists outside SID's Community Resources Section.

7. Expected outputs

Throughout the project, we will provide whatever information we have collated or collected to land managers to improve implementation of the Salinity Action Plan and other land management decisions. (The process of liaison is already well under way.)

At the end of the first year of sampling, two catchments of high importance to nature conservation in the Avon-Wheatbelt Bioregion will be nominated to the Director of Nature Conservation. (Note that the exact ranking of these catchments may change as the project progresses further, samples of organisms are worked on in more detail, other catchments are sampled and data are analysed further.) By the end of the project, we will identify, in priority order, 10 or more catchments of high importance to nature conservation in the agricultural zone. Additionally, we will liaise with Regional staff at an early stage to assist in compiling a tentative list of catchments of priority for nature conservation, to enable important management actions to commence in the first year.

By the end of the first year a preliminary checklist of the flora of the Avon-Wheatbelt Bioregion will be available, and by the end of the project, an authoritative checklist, with species described by site, broad habitat type and life-form (see also below). As the project progresses, such information will become available for other parts of the study area.

Lists of vascular flora species most at threat will also be provided progressively as the project continues.

Within the limits of available resources, we will identify and develop a list of threatened ecological communities. However, most of this will be as a collaborative project with WATSCU, which is currently seeking funding for this from the Federal Government.

Authoritative checklists for the study area will also be provided for various animal groups as the project progresses. Vertebrate species most at threat are already reliably identified, but this is not so for invertebrate groups (either aquatic or terrestrial). The project will provide significant extra information in this regard for selected invertebrate groups.

In discussion with the Department's regional staff (and others as appropriate) we will help develop information on known and possible areas of occurrence of plant species likely to be of value in revegetation for commercial production and/or land conservation. Part of this process will include a classification of species by broad habitat type (for example, occurrence in salty areas) and by life form. This will facilitate use of the data, e.g. for incorporation into REX.

Results from the survey will help provide a regional framework for improved management of remnant vegetation in the agricultural zone; in particular, it will help identify which sites, communities and taxa are important with respect to nature conservation.

Because of the survey design (site specific, with measurement of both biological and physical parameters), survey sites can be incorporated directly into future monitoring. A further output of the project will be to provide a regional context for interpreting monitoring data.

Milestones

<u>Item</u>	<u>Expected date</u>
Nomination of 2 priority catchments (central zone)	June 1998
Preliminary flora checklist	June 1998
Nomination of further 2 priority catchments	June 1999
Nomination of further 2 priority catchments	June 2000
List of top 10 priority catchments, plus further priority list	June 2001
Authoritative flora checklist	June 2001

8. Location

The specified study area is the agricultural zone of south-western Australia, from the 600 mm rainfall isohyet inland to the clearing line (Figure 2 of the Salinity Action Plan). In order to sample in an orderly fashion with maximum efficiency and effectiveness, we plan to start in the central part of the area (in the Avon-Wheatbelt Bioregion) in the first year of sampling, and move south and then north of here in subsequent years.

9. Area of project in hectares

About 25 million hectares (i.e. about 10% greater than the area of the state of Victoria). More than nine million hectares of the Avon-Wheatbelt Bioregion is in the study area.

10. Project staff

The following persons are likely to be involved in site selection, field sampling, data analysis and interpretation. Other staff will be appointed on a temporary basis as required.

Botanical: Greg Keighery, Dr Neil Gibson, Angus Hopkins

Aquatic: Dr Stuart Halse

Zoological (terrestrial): Norm McKenzie, Dr Allan Burbidge

Significant collaborations will be required with other workers outside the Section, both within and outside the Department.

11. Actions needed

1997–98

	Action	Notes and comments
1	Site selection and establishment	Early 1997–98; aquatic and terrestrial; needs to include liaison with the Department's Regional staff
2	First spring sampling of floristics, aquatic invertebrates and terrestrial zoology	Spring 1997; primarily in the Avon-Wheatbelt Bioregion; includes sorting and identification of specimens, specimen preparation and incorporation
3	First autumn sampling, as above	Autumn 1998, sites as above
4	Data input and analysis; identification of catchments with high conservation values	Beginning after first sampling; preliminary analyses winter 1998
5	Writing up and communication of preliminary results	Including liaison with the Department's regional staff

1998–2001

Actions in 1998–99 and 1999–2000 will be similar, with similar costs. This will be followed by overall analyses, input/advice to other programs (for example, revegetation, monitoring) (2000–01) and publication.

12. Budget

The budget allocation of \$500,000 been equally divided (\$160,00 each) between the three arms (botanical, aquatic and terrestrial zoology), with a contingency account of \$20,000. Of this, for each component, \$90,000–\$100,000 will be spent on consultants (for example, in the case of terrestrial zoology one of the two consultants will be dedicated to assist identification of invertebrates and the other on the general sampling) and \$60–70,000 on costs directly related to the survey.

More detailed costings are being prepared for each component.

Costs (\$s) per action plus salaries of permanent staff members (SID and Regional staff)

	1997–98	1998–99	1999–00	2000–01
Action 1	80,000	80,000	80,000	
Action 2	160,000	160,000	160,000	
Action 3	160,000	160,000	160,000	
Action 4	80,000	80,000	80,000	
Action 5	20,000	20,000	20,000	490,000
Totals	500,000	500,000	500,000	490,000

* This year will involve costs of publication, writing and a large amount of liaison.

WETLAND MONITORING PROGRAM

Background and rationale

The following has been drawn from the *Salinity Strategy*, pages 10 and 18.

Salinity is the greatest environmental threat facing Western Australia—1.8 million hectares in the south-west agricultural region are already affected by salinity to some extent. Projections show that without rapid, large-scale intervention, including significant changes to current land use practices, about three million hectares will be affected by 2010–2015 and six million hectares, or 30% of the region, will be affected by the time a new groundwater equilibrium is reached.

Without intervention, 450 plant species endemic to the region will become extinct, and three-quarters of the region's waterbird species will severely decline.

Of the 61 more common waterbird species in the south-west, only 16 prefer strongly saline (more than 20,000 mg/L) or hypersaline (more than 50,000 mg/L) conditions. An average of five waterbird species use hypersaline wetlands, compared with 20 in saline wetlands and 40 in fresh wetlands containing live trees and shrubs. Death of trees and shrubs in many wheatbelt wetlands due to salinity has caused a 50% decrease in the number of waterbirds using them.

Over 560 invertebrates have been identified in wheatbelt wetlands during biological surveys to date, with 45% restricted to fresh water (with salinity less than 3,000 mg/L). If all wetlands in the wheatbelt become saline (more than 10,000 mg/L), approximately 220 of these aquatic invertebrate species will disappear from the wheatbelt.

Thus it is predicted that substantial changes in native plant and animal diversity will occur at local and regional scales. It is probable that numerous species will become extinct if no action is taken. Therefore, it is essential that changes be monitored to confirm their trajectory and to evaluate the effectiveness of salinity management.

South-west wetland monitoring by the Department

In the late 1970s, the Wildlife Research Branch of the Department of Fisheries and Wildlife, later to become a part of the Department of Conservation and Land Management, began monitoring water depth, salinity and pH in a large number of wetlands south-west of a line from Geraldton to Esperance. The program was initiated to provide an objective basis for deciding annual recreational duck-shooting seasons. A second objective, more important in the long term, was to monitor three primary determinants of the ecological character of wetlands in nature reserves of south-western Australia. Regular monitoring began in September 1979 and by November 1980 was being conducted in September and November each year at 65 wetlands (Lane and Munro 1983).

During 1981–85 monitoring was undertaken every two months to coincide with a major survey of waterbird use of all south-west nature reserves (Jaensch *et al.* 1988). The total number of monitored wetlands was increased to 119. In addition to the other factors, total phosphorus concentrations were monitored during 1984–85. At the end of this period the number was reduced to a more manageable 85 wetlands. These included some new sites in national parks near the coast.

During 1987–88 the vegetation of 106 of the above wetlands was surveyed to provide a baseline for long-term monitoring (Halse *et al.* 1993).

In 1992 recreational duck shooting was banned throughout Western Australia and the number of wetlands in the monitoring program was reduced to 59. The focus of the program also changed; monitoring of many saline wetlands of the inland agricultural area was discontinued while more freshwater sites near the coast were added.

Funding for the Wetland Monitoring Program declined during the mid-1990s. By 1996 there were insufficient funds to continue regular sampling, and depth gauges and security datums could not be maintained. The program was on the verge of closure.

Salinity Action Plan and Salinity Strategy

During 1996, the *Salinity Action Plan* for Western Australia was being prepared. Personnel involved in its preparation identified the Department's wetland monitoring program as one of very few providing routinely collected, long-term salinity data across the south-west, and the only program providing this type of data for a large sample of south-west wetlands (K Wallace, pers. comm.). This awareness led to a recommendation in the *Salinity Action Plan* (page 28) that the wetland monitoring program be re-established and expanded to include monitoring of wetland biota. Thus:

A program to re-establish systematic monitoring of wetlands as an indicator of catchment health is required. Wetlands provide an important measure of the dynamic changes in salt water loads moving through catchments. Furthermore, changes in flora and fauna due to salinisation will be most pronounced, in the short term, in valley flats and their wetlands. Wetland monitoring will provide a basis for evaluating achievement of biodiversity conservation goals and will focus on both physical and biotic characteristics.

The accompanying Action Statement was:

The Department of Conservation and Land Management will monitor a sample of wetlands, and their associated flora and fauna, throughout the south-west to determine long term trends in natural diversity and provide a sound basis for corrective action.

An appended table (Item 7) states that the additional recurrent funding needed from State Government is \$0.25 million and suggested the National Wetlands Program as a possible source of Commonwealth funds. Wetland monitoring was to be undertaken in all rainfall zones.

The 1996 wetland monitoring Action Statement was repeated *verbatim* in the 1998 re-draft of the *Salinity Action Plan* and in the *Salinity Strategy* (page 20 of *Salinity Actions*). These latter documents confirmed the ongoing funding level from State sources at \$0.25 million per year.

Objectives

The principal objective of wetland monitoring undertaken by the Department under the *Salinity Action Plan* and *Salinity Strategy* is contained within the relevant Action Statements, that is, “to determine long term trends in natural diversity [within wetlands] and provide a sound basis for corrective action”.

This objective was subsequently elaborated within the relevant Departmental project proposal (June 24, 1997) as follows:

This project is designed to provide on-going monitoring of wetland salinity and biological resources in wetlands of the agricultural zone of south-west Western Australia.

Specific project objectives are:

1. analyse and report trends in salinity and depth of agricultural zone wetlands monitored by the Department since 1978.
2. monitor salinity, depth and nutrient status of a broad range of wetlands.
3. monitor waterbirds, fish, frogs and aquatic invertebrates in a sub-set of wetlands to measure any changes in fauna of the wetlands.
4. monitor floristic composition and tree health in the same sub-set of wetlands to measure any changes in flora occurring in, and around, the wetlands.

The Salinity Action Plan identified the need for monitoring to determine the effectiveness of the Plan and, in particular, to determine natural bio-physical trends and the likely impact of land management changes on trends over time.

Implementation methods

Implementation of wetland monitoring by the Department under the *Salinity Action Plan* and *Salinity Strategy* is based on a project proposal (dated 24 June 1997) developed by a team of Departmental officers comprising Ian Herford (Chair) representing the Nature Conservation Division, Ken Wallace (Wheatbelt Regional Manager), and Neil Gibson, Stuart Halse and Jim Lane from the Department's Science Division.

In that proposal, the following Departmental scientists were identified as being responsible for selection of wetlands and design of field programs, sampling, data analysis and reporting: J Lane (salinity); S Halse (fauna); N Gibson and G Keighery (flora).

Science Division technical staff also participate and consultants are hired to assist as required.

The project proposal described the project scope and approach, expected outputs, milestones, actions needed and budget allocations for the first full year (1997-98).

A copy of the proposal is provided at Appendix 12.

Since 1997, annual meetings chaired by Science Division *Salinity Action Plan* Project Leader Greg Keighery have been held to decide annual budget allocations. Gibson, Halse, Keighery and Lane have also liaised concerning various aspects of the project, particularly selection of wetlands to be monitored, field programs and reporting.

Outputs and outcomes

Expenditure

The annual budget for the Wetland Monitoring Program has been \$0.25 million per year in 1997-98, 1998-99 and 1999-00. An additional amount of \$19,000 was allocated in 1996-97 for urgent maintenance of the depth gauge network used in wetland monitoring.

Annual expenditure in each of the sub-programs is provided in Table 13. These amounts include only expenditure from *Salinity Action Plan* funds. The salaries of permanent staff and other costs borne by the Department are not shown.

Table 13: Annual expenditure (\$) of Salinity Action Plan funds on the Wetland Monitoring Program

Sub-program	96-97	97-98	98-99	99-00
Physico-chemistry and bathymetry (JL)	18,930	96,563	99,618	97,667
Flora monitoring (NG)	–	61,816	59,293	58,500
Shallow groundwater monitoring* (SH) and fauna monitoring* (SH)	–	91,621	91,089	93,833
TOTALS	18,930	250,000	250,000	250,000

* Some additional groundwater monitoring and fauna monitoring expenditure has been charged to the Biological Survey Program.

Total expenditure over the review period has therefore been \$769,000. All funds allocated have been expended.

Outputs and outcomes

These are reported below under four sub-programs: physico-chemical monitoring of surface waters (managed by J Lane), flora monitoring (managed by N Gibson), shallow groundwater monitoring (managed by S Halse) and fauna monitoring (managed by S Halse).

Physico-chemical monitoring of surface waters

Selection of 100 wetlands

By 1996, the number of south-west wetlands regularly monitored by the Department had declined to 59 from a peak of 119 in 1983. The total number of wetlands that had been monitored at some time during this period was somewhat greater than 119, reflecting the fact that while many wetlands (mainly inland) had been dropped from the program in 1985 and 1992, some (mainly near the coast) had been added.

In 1997 it was decided within the Department that, in order to meet the wetland monitoring objectives of the *Salinity Action Plan*, the number of wetlands being monitored should be increased to 100, with most additions being in the inland agricultural area. Initially, wetlands that had formerly been monitored were added, with preference being given to those that had relatively low salinity ranges, were reasonably accessible, and would provide a wide geographic spread. In 1999 and 2000, wetlands that had not previously been monitored, but had been shown by the Biological Survey Program (see Biological Survey Program chapter) to have significant conservation values, were added, bringing the total to 100.

Output

List of 100 wetlands to be monitored under the *Salinity Action Plan* (and 51 additional wetlands monitored in the past).

Gauge maintenance and installation

In 1996, the most urgent concern with the Wetland Monitoring Program was that, due to insufficient funding, the depth gauge network was deteriorating. Some gauges were unreadable, others had been moved or were missing, and some Departmental security datums (see below) were damaged. Early in 1997 funding was allocated to urgent repair and replacement of gauges and datums, focussing on those where further damage or loss would mean that gauges could not be confidently installed to the same height, thus reducing the value of historical data.

In 1997 and subsequent years, the Department has embarked upon a major program of resurveying all previously installed gauges and security datums, and surveying of these to new Department of Land Administration (DOLA) benchmarks (see below). Gauges have been replaced where necessary and additional gauges installed where this will facilitate monitoring. New gauges have been installed on some wetlands where previously there were only temporary depth markers. New gauges have also been installed on wetlands recently added to the program (see above) that have not been previously monitored. Of the 100 wetlands proposed for ongoing monitoring, 97 now have functional depth gauges.

Outputs:

- Depth gauges of 122 previously monitored wetlands re-surveyed, and repaired or replaced.
- Depth gauges installed to replace temporary markers on six wetlands.
- Depth gauges installed on 15 new wetlands.

Benchmark installation (all sites) and survey to Australian Height Datum

When the Department of Fisheries and Wildlife established the depth gauge network, a 'security datum' was installed near the gauge or gauges at each wetland. These datums were typically small concrete blocks embedded in the ground some metres above normal high water mark. The gauges were surveyed by 'dumpy level' to these blocks. Their purpose was to enable gauges to be re-installed to exactly the same height in the event that gauges were vandalised or otherwise damaged or moved.

By the mid-1990s it was apparent that these datums were not adequate for long-term security purposes. Some were found to have been damaged by vehicular traffic or earthmoving activity, some had been moved by root growth of nearby trees or by erosion of surrounding soil, and a few had cracked apart.

It was initially envisaged that the security of the Department's gauge network would be achieved by surveying all gauges and security datums to Australian Height Datum (AHD). Upon investigation, however, it was found that this approach would be prohibitively expensive. On the other hand, installation of DOLA benchmarks and accompanying reference marks, and survey of gauges to these marks, would adequately achieve the same objective.

Under the Wetland Monitoring Program licensed surveyors, employed by the Department under contract through DOLA, are installing bench and reference marks at all 151 wetlands where monitoring has been or is currently being conducted. The benchmarks are far more substantial structures than the former security datums. They also have the added security of reference marks installed nearby, and are legally protected from damage or interference. To date, bench and reference marks have been installed at 134 of the 151 wetlands. Pre-existing DOLA bench and reference marks have been located and utilised at a further seven wetlands. Bench and reference marks will be installed at the remaining ten sites during autumn 2001. At the same time, all depth gauges have been surveyed to the benchmarks, and these form part of DOLA's statewide geodetic network.

Where the cost of surveying benchmarks to AHD has not been thought excessive (that is, not more than 40 minutes additional survey time per wetland), this has been done at the time of installation. DOLA has also opportunistically surveyed some benchmarks to AHD when doing other survey work nearby. More than 29 benchmarks have now been tied to AHD. Surveying these marks to AHD has the advantage of allowing the positions (horizontal and vertical) of lake beds, shorelines, overflow points and water levels to be precisely determined in the future, thus facilitating lake and catchment management investigations and activities.

Outputs:

- DOLA bench and reference marks installed at 134 wetlands (and pre-existing marks located at an additional seven wetlands).
- Depth gauges surveyed to DOLA benchmarks at 139 wetlands.
- Benchmarks surveyed to Australian Height Datum at 29 wetlands by the Department.
- Benchmarks surveyed to AHD at additional wetlands by DOLA.

Monitoring of continuing, resumed and new sites

The number of wetlands being monitored has increased under the Wetland Monitoring Program from 59 in 1996 to 100 in year 2000 and beyond (see above). Monitoring is conducted twice each year, in September and November, to facilitate comparison with data from earlier years (monitoring has been conducted during a pre-defined nine-day period in each of these months every year since 1979). Parameters monitored are wetland depth, salinity/conductivity, pH, total phosphorus (unfiltered and 0.45 micron filtered) and, since September 2000, total nitrogen. Four teams, each comprising one paid officer often accompanied by a volunteer, conduct monitoring more or less simultaneously. Each team visits approximately 25 of the 100 wetlands. Wetlands are grouped geographically into northern, central, south-eastern and south-western sectors. pH is measured at the time of sampling, conductivity/salinity is measured at the Department's Woodvale centre, and the other parameters are measured at the WA Chemistry Centre. The Chemistry Centre also analyses some samples for ionic composition.

Outputs:

Water level, salinity and other water quality data collected from 74 wetlands in 1997, 75 in 1998, 85 in 1999, and 100 in 2000.

Design and construction of new database

Data from the Department's south-west wetland monitoring program have been stored on computer since the late 1970s. By 1996, the programming (dBase) for this electronic database was no longer adequate for the task. For example, there was no provision for entry of conductivity or nutrient data, identification of individual depth gauges from which readings were taken, or for addition of explanatory remarks. The semi-automatic graphing function was also unable to cope with the long time series of data. By 1996 there was a clear need to update the database software.

Funding through the Wetland Monitoring Program has enabled a new database, using Microsoft Access software, to be designed and constructed for the program. A specialist consultant from Greenbase Consulting Pty Ltd was engaged to undertake this work, in close consultation with Jim Lane and Yvonne Winchcombe of the Department's Science Division. The new database, SWALMP (South West Athalassic Lake Monitoring Program), is now operational and will greatly facilitate future entry, storage, management, provision and analysis of wetland water level, salinity and other physico-chemical data, including nutrients and conductivity.

A largely automated graphing facility is needed for rapid checking and comparison of SWALMP data. Microsoft Access is not well suited for this purpose. The suitability of other software will be assessed in 2001 with a view to subsequent development of an appropriate graphing facility.

Outputs:

A new database, SWALMP, for storage and management of physico-chemical data from 100 *Salinity Action Plan* wetlands (and 51 additional wetlands monitored in the past).

Prepare salinity and water level data for analysis

During the more than 20-year history of the south-west Wetland Monitoring Program, a number of different methods and instruments have been used for determining the salinity of water samples. It is highly desirable that these methods, and consequent salinity values, be reviewed prior to analysis of data for long-term trends or other statistical outputs.

Water levels need to be calculated for wetlands that previously had, due to funding inadequacies, only temporary depth markers not surveyed to lake beds. There is also a need for some water level data to be adjusted following the recent re-survey of depth gauges.

Some progress has been made in completing the above. Methods and instruments for determining the salinity of water samples from saline lakes have been reviewed. The results of this review are being applied to data from Dumbleyung Lake in preparation for trends analysis (see below). Results will subsequently be applied to data from other saline lakes of the program. A similar process will be followed for reviewing data from fresh-brackish lakes. Water level data will be checked and corrected where necessary during this process. Rainfall data for the catchment of each monitored wetland will be obtained for analysis and comparison of water level, salinity and trends over more than 20 years. This will be a key activity during 2001.

Salinity, rainfall and water level trends analyses

Salinity and water level data are currently being prepared (see above) for trends analysis. In the first instance, trends in salinity, water level and catchment rainfall data for Dumbleyung Lake will be analysed. Subsequently, trends in data from other lakes will be determined following preparation of their data for analysis. This will be another key activity in 2001.

Bathymetric mapping, water volume and salt load calculation

Bathymetric mapping (surveying of lake beds, shorelines and outflow levels) allows stored water volumes to be calculated from water level measurements, and salt loads to be calculated from these volumes and corresponding salinity measurements. This information is required to evaluate the effects of drainage proposals and other lake or catchment management activities on lake water levels and salinities. From this, likely impacts on wetland biota and conservation values can be predicted. Bathymetric maps also have other management applications, including the calculation of the flood mitigation role of individual lakes, planning of remedial or other works on wetlands, and management of approved aquatic recreational activities. The value of wetland monitoring data is greatly enhanced by bathymetric mapping. Because sedimentation and other factors influence the depth and shape of lakes, it will be necessary to repeat bathymetric work at infrequent intervals. For inland agricultural lakes bathymetric mapping probably needs to be repeated once every 50 or so years.

Under the Wetland Monitoring Program, a provisional bathymetric map with vertical spot height accuracy of ± 5 –10 cm has been prepared for Dumbleyung Lake following survey work

conducted in 1998. It is hoped that mapping of this lake can be completed in March or April 2001, by which time (barring unseasonable rainfall) the south-eastern end of the lake should be sufficiently dry for survey vehicle access. This part of the lake was too boggy for access in 1999 and 2000.

Mapping of Coyrecup Lake, east of Katanning, was planned for 1999 or 2000 but in both years the water level was too high for terrestrial survey. With much lower than usual water levels in this lake in September 2000 it is hoped that Coyrecup will be sufficiently dry for a terrestrial survey to be conducted in March or April 2001.

Because conditions have frustrated plans to conduct bathymetric surveys of important inland wetlands during the past two years, and because some of these lakes have recently filled to exceptionally high levels, the use of boat-based survey methods is being trialed in October 2000. Lakes Hinds and Ninan, near Wongan Hills, have been chosen for this trial. These lakes have large storage capacities, potentially large salt loads and a long history of monitoring. They provide a variety of survey conditions and are conveniently located close to each other and to Perth. Both lakes are significant waterbird habitats and are partially (Ninan) or largely (Hinds) reserved for conservation and managed by the Department.

Following completion of the work at Hinds and Ninan, criteria for selection of other lakes will be developed in consultation with Departmental scientific and operational staff.

Progress with bathymetric survey is behind that envisaged in the June 1997 Science Division project proposal. It was originally thought that as many as 25 wetlands would be mapped by June 2000 and 40 by June 2001. This delay has been due mainly to priority being given to other work, particularly the maintenance, re-survey and installation of depth gauges and the installation of DOLA bench and reference marks. High water levels in recent years have also hindered the survey program. Consequently, some trialing and development of terrestrial and (more recently) boat-based survey techniques have been required. It is anticipated that more rapid progress will be made during 2001.

Outputs:

- DOLA (1998) report on methodologies for mapping of Dumbleyung Lake.
- Bathymetric map for Dumbleyung Lake.
- Depth-volume calculators for Dumbleyung Lake.
- Calculated water volumes and salt loads of Dumbleyung Lake, 1979–1999.

Reporting

Progress in the above works has been reported annually at meetings of Departmental staff involved in the Wetland Monitoring Program. Progress was reported to a wider audience at the Science Division's Biological Survey and Wetland Monitoring Thematic Seminar held at CSIRO Floreat in June 2000. This chapter has also been prepared to meet reporting requirements and provide a basis for evaluating achievement of program objectives.

Outputs:

- Presentation at the Science Division's Biological Survey and Wetland Monitoring Thematic Seminar in June 2000.
- This report of October 2000.

Data supply

Since wetland monitoring began in the late 1970s, many requests have been received for water level and water quality data. These requests have come from many sources, including Departmental operations and scientific staff, other government agencies, tertiary students and lecturers, conservation organisations, landholder groups, individual landholders and consultants. Data have been supplied in hard copy or electronic (initially dBase) formats.

Funding under the current Wetlands Monitoring Program has facilitated the supply of data by enabling a new database (SWALMP, see above) to be developed for data storage and management.

Personnel

The physico-chemistry sub-program of the Wetland Monitoring Program is supervised and managed by Science Division Principal Research Scientist Jim Lane. Since 1996 (and earlier) a minor portion (approx 0.1 FTE) of his time has been allocated to this program.

Science Division Senior Technical Officer Grant Pearson and Technical Officer Alan Clarke both have major roles in the sub-program, including installation and maintenance of depth gauges, field supervision of contract surveyors, collection of data and water samples, conducting and arranging analysis of samples, maintenance and calibration of field and laboratory equipment, supervision and logistic support for bathymetric surveys, preparation of work programs and presentational material, calling of quotes and other administrative tasks. Since 1996, their time allocation to this project has been about 0.15 FTE and 0.5 FTE respectively.

Technical Officer Yvonne Winchcombe has provided computing support for the sub-program, including purchase, installation and management of hardware and software, management of design and construction of SWALMP database by a consultant, comparison of conductivity/salinity conversion formulae, input and supply of data, preparation of presentational material and other support. Since 1996, Yvonne's time allocation to the project has been approximately 0.15 FTE. Ten months leave was taken in 1999–00.

Licensed surveyors (Scanlan Surveys Pty. Ltd., John Bullock and Associates) have been contracted through DOLA to install benchmarks and reference marks at all monitored wetlands, to survey Departmental depth gauges and former security datums to benchmarks, and to survey benchmarks to Australian Height Datum where affordable. A licensed surveyor (Sea and Land Surveying) has also been contracted to conduct bathymetric surveys of selected wetlands.

DOLA (1998) has provided information, advice and guidance to the Department concerning depth gauge and bathymetric survey methodologies and the use and installation of DOLA-standard survey marks. DOLA has also managed (on commission) the contracting of licensed surveyors and has incorporated survey data into the State geodetic information system. DOLA has provided additional support by installing and upgrading survey marks to facilitate bathymetric mapping of selected wetlands and opportunistically surveying benchmarks to AHD. Jim Payne of DOLA assisted in the earliest stages of the project.

Greenbase Consulting Pty Ltd (Russell Marks) was contracted to design and construct the new database for this sub-program.

It should be noted that the costs of Government staff listed above (except Yvonne Winchcombe) have been met from agency resources that pre-dated the current Wetland Monitoring Program.

Flora monitoring

Selection of 25 wetlands

The 25 wetlands selected for biological monitoring are a sub-set of the 100 wetlands monitored for salinity, water depth, pH and nutrient levels described above. They represent a range of fresh, secondarily salinised and naturally saline wetlands throughout the agricultural zone. They include basin lakes and seasonal wetlands of high conservation value.

Outputs:

The 25 wetlands for biological monitoring have been selected.

Determination of flora monitoring methodology

Between two and five permanently marked transects have been established at each of the 25 wetlands to accurately monitor changes in wetland vegetation. Transects were initially positioned using air photographs with the final location of each transect being determined using GPS and marked on maps for future reference.

Transects are made up of contiguous 20 x 20 metre quadrats and run perpendicularly from the shoreline into upland vegetation. The lower extreme (wetland floor) of each transect includes emergent macrophytes where they are present. Each of the 20 x 20 metre quadrats is divided into five permanently marked 4 x 20 metre quadrats within which vegetation is described and individual trees marked and assessed for vigour.

Within 4 x 4 metre subplots, all perennial understorey plant species (sedges and shrubs) are recorded and canopy cover measured. Photographs of transect vegetation are taken each monitoring year from two marked reference points, one at each end of the transect. Both photographs are taken looking towards the centre point of the transect.

Surface soil salinities at each transect are measured using an EM 38 and validated with limited soil sampling and direct measurement (EC of 1:5 soil:water extracts). Three EM 38 measurements are also taken within each overstorey subplot.

Individual transect profiles are constructed using a 'dumpy level', allowing species composition and health to be tied into topographic position.

Outputs:

The survey methodology has been documented in a detailed specification.

Flora transect site selection

The number of transects established at each wetland depends upon the number of distinct community types, the spatial variability in impacts and the size of the wetland.

Flora transect establishment and initial monitoring

Eighty transects have been established on the 25 wetlands and data collected on species composition, tree diameter and height, tree health, frequency and cover of plants making up the perennial understorey, and soil salinity measurements. The methodology has undergone minor refinement over the initial three years.

Outputs:

Eighty transects have been established at 25 wetlands and all have had their initial monitoring completed. In all, this involved measuring more than 6,000 trees in 197 quadrats and recording understorey data from 985 subplots.

Flora identification and curation

Selected voucher specimens have been collected for each of the 25 monitored wetlands. These will be lodged in the WA Herbarium. This will allow taxonomy of the species recorded on the transects to be updated as revisions of taxa occur. Ongoing collections of material not previously seen in flower or fruit will be a continuing requirement of the project.

Outputs:

Selected voucher specimens have been collected from the 80 transects on the 25 wetlands.

Data storage and analysis

Data have been compiled on a yearly basis and supplied as both hardcopy reports (Odgen and Froend 1998, Gurner *et al.* 1999) and digitally in the form of Excel spreadsheets. Copies of the reports have been lodged in the Department's Woodvale Library and have been supplied to the relevant Departmental Regions. Dr Gibson is presently the custodian of the electronic data with one copy stored in a fireproof safe at the Department's Woodvale centre.

Outputs:

- Three annual reports containing hard copy of all data have been lodged in the Department's Woodvale library.
- Electronic copies of all data are stored on CD-ROM at the Department's Woodvale centre in a fireproof safe.

Connection of flora quadrat elevations to lake depth gauges

At each wetland, it is highly desirable to relate the ground elevations of each flora quadrat to depth gauge readings. This information will allow wetland plant distributions and population structures to be compared with historical trends in water level. This will provide an insight into the water requirements of fringing and emergent vegetation and the conditions under which recruitment will occur. Possible methods for 'connecting' quadrat elevations (and groundwater levels—see below) to gauge readings are being investigated during 2000–01. Adoption of a traditional terrestrial survey approach for all quadrats at all 25 wetlands would be expensive. It appears that several methods should perhaps be used, some opportunistically. For example, elevations could be precisely determined during bathymetric mapping of some monitored wetlands at no extra cost. Options will be reviewed in 2001.

Reporting

Annual reports have been prepared detailing the initial sampling at each of the 25 wetlands. These reports describe the methodology and give a full account of data collected from transects. Progress was also reported at the Science Division's Biological Survey and Wetland Monitoring Thematic Seminar held at CSIRO Floreat in June 2000. The present document has also been prepared to meet reporting requirements and provide a basis for reviewing progress against program objectives.

Outputs:

- Annual reports detailing methods and hard copy of all data.
- Presentation at the Science Division's Biological Survey and Wetland Monitoring Thematic Seminar in June 2000.
- This report of October 2000.

Personnel

The flora sub-program of the Wetland Monitoring Program is supervised and managed by Science Division Senior Research Scientist Dr Neil Gibson. Since 1997 a minor portion (about 0.05 FTE) of his time has been allocated to this sub-program. This allocation has been used primarily in developing the specifications for monitoring and in supervision of consultants.

The initial monitoring of the 25 wetlands over the three years has been undertaken by personnel led by Dr Ray Froend from the Centre for Ecosystem Management at Edith Cowan University under contract to the Department.

Shallow groundwater monitoring

Selection of 25 wetlands

See Flora monitoring section above.

Output:

All bore locations selected.

Shallow groundwater monitoring bore site selection

Bore locations could be determined only after vegetation transects had been established because the bores had to be located beside the transects. This, together with the difficulty of finding someone to install bores at reasonable cost without extensive damage to wetland vegetation, has delayed the bore installation. However, all bores are now installed or arrangements are in place to do so.

At each vegetation transect, shallow groundwater monitoring bores are established beside the landward end of the transect and mid-way along it. The bores are offset from the edge of the transect by a few metres, with the aim being to measure depth to groundwater at the upslope end and in the middle of the transect. The lower ends of transects lie on wetland floors, and water levels provide a measure of groundwater unless the wetland is perched. Vegetation transects all run perpendicularly to the wetland shore and the purpose of bore design is to enable vegetation condition along each transect to be related to depth and salinity of groundwater.

The shallow groundwater monitoring bore design now being used is less sophisticated than proposed in the scoping document of 24 June 1997 as a result of further discussion with hydrologists and cost constraints. However, it should still produce the information required (see *Bore establishment*).

Output:

- Design of system of monitoring groundwater levels around a wetland and relating vegetation condition on wetland banks to groundwater depth and salinity.
- All bore sites selected.

Bore establishment

A total of 139 groundwater monitoring bores has been installed in association with 69 of the 80 vegetation transects. Bores are soon to be installed (unless there are unseasonable rains) near the remaining vegetation transects at Lakes Logue, Coomalbidgup and Ronnerup, where extreme flooding in the summer of 1999 inundated transects and so far has made access impossible; and at Kulicup, where groundwater is below 10 metres and a relatively heavy drill rig is required. To prevent damage to the vegetation transects, other sites have been hand-augered or a light drill rig behind a Landcruiser has been used. Bores have been installed to standard specifications prepared by an experienced hydrologist. Dr Richard George (Agriculture WA) approved the specifications.

Output:

One hundred and thirty-nine bores established.

Bore monitoring

Where bores have been established, depth to groundwater and salinity have been measured four times at one wetland, three times at eight, once at one and twice at the remainder. Measurements have been made in summer and late winter. Another round of measuring was completed in 2000–01. Some of the bores are still being developed (i.e. current results reflect surface water intrusion, etc.) but results from the next round of sampling should be reliable at all bores.

Output:

Groundwater depth and salinity measured, usually two or more times, at 139 bores.

Data storage and analysis

Data are stored in the Access database developed for the wetland component of the Biological Survey Program. The database also contains information on the location, invertebrates, waterbirds and surface water quality for each wetland. This database is located on the Department's Woodvale server and regularly backed up. Copies of the bore data are also stored on Excel spreadsheets.

Some preliminary analysis of patterns in vegetation health and groundwater information has been undertaken.

Output:

All data electronically stored on corporate Access database.

Connection of groundwater levels to lake depth gauges

Possible methods for 'connecting' groundwater level measurements (and flora quadrat elevations—see above) to gauge readings are being investigated during 2000–01.

Reporting

Maps of bore locations and a spreadsheet of results to September 2000 have been deposited in the Department's library. Progress was also reported at the Science Division's Biological Survey and Wetland Monitoring Thematic Seminar in June 2000. The present document has also been prepared to review progress in achieving *Salinity Action Plan* and project objectives.

Output:

- Report giving bore locations and monitoring results to June 2000.
- Presentation at the Science Division's thematic seminar in June 2000.
- This report (October 2000).

Personnel

The shallow groundwater sub-program of the Wetland Monitoring Program is supervised by Dr Stuart Halse as part of his role in the program. In the early part of the project, significant time was spent developing the specifications for the project and then finding someone to undertake the work program. Since 1998 only a minor portion of time (about 0.05 FTE) has been spent on supervision of the project.

All bore installation and monitoring has been undertaken by Dr Colin Walker of Geo & Hydro Environmental Consultants under contract to the Department.

Fauna monitoring

Selection of wetlands

See Flora monitoring section above.

Determination of fauna monitoring methodologies

Aquatic invertebrates and waterbirds are being monitored every second year. The scoping document suggested frogs would be monitored. However, difficulties associated with frog monitoring led to their later omission from the program. Aquatic invertebrates are monitored each October, while waterbirds are monitored in August, October and March. Detailed water chemistry is collected in October in conjunction with the invertebrate sampling, and a subset of measurements is collected in August and March.

Aquatic invertebrates are collected at two sites from each wetland to reduce sampling error. Sites are located in different wetland sectors and sampling covers as many microhabitats at each site as possible. All invertebrates in the samples are identified to species level.

The aim of the waterbird surveys is to record all species present at the time of survey, with an estimate of numbers of each species. Surveys are undertaken in different seasons to capture variations in the use of wetlands at different times of the year.

Faunal results will be interpreted with the aid of the physical data collected. For example, a large flooding event in a saline lake, which may occur once a decade, will usually decrease salinity and cause different invertebrates and waterbirds to use a lake during this fresh phase. Analysis of trends in faunal use will be restricted to periods with similar rainfall and lake depths.

Outputs:

- Invertebrate survey methodology documented and subjected to peer review in Halse *et al.* (2000) and Halse *et al.* (submitted for publication).
- Waterbird survey methodology documented in scoping document and annual reports; analytical methods published in Halse *et al.* (2000).

Fauna monitoring site selection

In most cases, waterbirds are surveyed throughout a wetland; hence the selected wetlands are the survey units. At some wetlands there are contiguous waterbodies and only part of the wetland system is surveyed. The area chosen for survey reflects (a) a large enough portion of the wetland to produce consistent results, (b) navigational considerations if the survey is usually done by boat, and (c) ease of repetition.

Of the two invertebrate sampling sites in each wetland, one is located at or near the Department's depth gauge; the other is in a different sector. Water chemistry is sampled at the invertebrate sampling sites. Sites have been selected for all wetlands except Toolibin and Dumbleyung Lakes, which have not yet contained sufficient water to enable sampling.

When faunal monitoring preceded the establishment of the physico-chemical monitoring program in a wetland, the Department's depth gauge was subsequently installed at an existing invertebrate sampling site.

Outputs:

- Twenty-three wetlands or parts of wetland systems selected for waterbird survey.
- Forty-six invertebrate sampling sites selected.

Fauna monitoring site establishment and initial monitoring

Fauna monitoring sites are not marked although Departmental depth gauges provide an approximate location of one site. Dr Halse holds sketch maps showing location of invertebrate sampling sites at the Department's Woodvale centre. Latitudes and longitudes of these sites have been determined by GPS and are on the wetland database referred to in the monitoring bore section above, together with a description of their location within the wetland.

All sites that have contained water have been sampled since 1997; five sites had been sampled twice by June 2000 and a further 12 are currently (October 2000) being sampled a second time. Data have been collected on waterbirds, invertebrates and water chemistry.

Most monitoring programs use high levels of replication (five or more samples), which is extremely expensive. In 1997, four invertebrate sites were sampled at each of five wetlands to demonstrate that two sites provide sufficient information to detect changed invertebrate communities.

Outputs:

- Sketch maps of invertebrate sampling sites and locations databased.
- Twenty-three wetlands surveyed/sampled, five of them twice. This includes 46 invertebrate sampling sites, 10 of which have been sampled twice.
- Validation of monitoring methodology (see *Determination of fauna monitoring methodologies*).

Sample sorting, identification and curation

All invertebrate samples from 1997, 1998, and 1999 have been sorted and all taxa identified except for some cladocerans and rotifers. Identification of the latter, which is done at the CRC for Freshwater Ecology in Albury NSW, will be completed by January 2001.

Vouchers of all species are retained at the Department's Woodvale centre. Voucher material is sent to specialist taxonomists to check identifications if specimens are outside the specialist expertise of project staff. It is intended to transfer a duplicate collection to the WA Museum at

the completion of the Biological Survey but details are still to be arranged. Type material of new species described during the course of the monitoring project has already been transferred.

Outputs:

- All invertebrate samples from 1997–99 have been sorted and identified, except for some cladocerans and rotifers being done externally.
- Vouchers of all species have been retained.

Data storage and analysis

All waterbird survey and water chemistry data up to August 2000 have been databased on an Access database put together for the Biological Survey Program. Waterbird data have also been entered on a general waterbird database held by Dr Halse.

Invertebrate data have also been entered on the program database using a national invertebrate coding system maintained by the Victorian Environmental Protection Authority.

Data from Lake Bryde, one of the wetlands monitored in 1997, were used to support nomination of the Lake Bryde Natural Diversity Recovery Catchment.

Outputs:

- All waterbird and water chemistry, and almost all invertebrate data, entered on database.
- Data used to support recovery catchment nomination.

Reporting

Annual reports covering 1997 and 1998 waterbird and invertebrate monitoring have been circulated to Regional Managers and Nature Conservation Division staff and are lodged in the Department's library. Data for 1999 will be presented in a three-year review of the program due in March 2001, although much of the 1999 information was presented at a Science Division thematic seminar in June 2000 on the Biological Survey and Wetland Monitoring programs.

The present document has also been prepared to review progress in achieving project objectives, and an article based on Dr Halse's wetland invertebrate monitoring appeared in the magazine *Ecos* (volume 105, pages 15–17, 2000).

Output:

- Annual reports for 1997 and 1998.
- Papers on Toolibin work and 1997 monitoring results (Halse *et al.* 2000; Halse *et al.* in preparation).
- Presentation on faunal results at the Science Division thematic seminar.
- This report (October 2000).
- *Ecos* article.

Personnel

The fauna sub-program of the Wetland Monitoring Program is supervised by Dr Halse (0.25 FTE), who also does all project fieldwork in conjunction with David Cale, who works three days a week as a temporary Technical Officer. Mr Cale, Dr Edyta Jasinska, who worked two days a week in 1997 and part of 1999, and Melita Penniford, who currently works two days a week, have sorted the invertebrate samples and identified about half the species.

The remainder have been identified by Dr Halse and Dr Russell Shiel of the CRC for Freshwater Ecology, Albury NSW. Dr Shiel is a project collaborator and receives a small portion of the project budget.

Progress in relation to objectives

The Department is currently meeting the requirements of the *Salinity Action Plan* and *Salinity Strategy* for this program, which are that: “the Department will monitor a sample of wetlands, and their associated flora and fauna, throughout the south-west to determine long-term trends in natural diversity and provide a sound basis for corrective action”.

In doing so, the Department has also met the expectations (*Salinity Action Plan* page 28) that the Department will “... re-establish systematic monitoring of wetlands as an indicator of catchment health” and that “Wetland monitoring will provide a basis for evaluating achievement of biodiversity conservation goals and will focus on both physical and biotic characteristics”.

The expectation (*Salinity Action Plan* Appendix) that the monitoring program will include wetlands in all three identified rainfall zones (<400; 400-600; >600 mm/year) of the south-west agricultural area is also being met.

Problems and difficulties

Physico-chemical monitoring of surface waters

As discussed above, progress with bathymetric mapping of key wetlands has been hampered because high water levels prevented terrestrial surveys during 1999 and 2000. Boat-based survey methods are now being trialed as a possible means of partially overcoming this problem. Years in which water levels are neither very high nor very low will continue to present problems. Over the next several years, however, it should be possible to survey most, if not all, selected wetlands.

Other technical problems that have arisen since 1996 have mostly been minor and have been dealt with at the time.

Importantly, funding through the *Salinity Action Plan* is enabling a number of pre-existing problems, described in previous sections, to be addressed and progressively rectified.

The project supervisor, Jim Lane, has not been able to allocate adequate time to this important project during the past three years, due to other competing demands. Priority is currently being given to completing other projects in order that more time can be allocated to the program in 2001.

Flora monitoring

Minor technical and administrative problems have been dealt with at the time.

Shallow groundwater monitoring

The difficulties in the groundwater monitoring program mostly occurred at the start and were related to developing appropriate bore designs and finding someone to implement them at reasonable cost. Other government agencies with hydrological expertise were unable to give substantial help due to other commitments; however, Dr George (Agriculture WA) gave

invaluable advice. There have subsequently been only minor administrative problems. However, high water levels at three wetlands have prevented access.

Fauna monitoring

The only problem has been lack of water at Toolibin and Dumbleyung Lakes, which has prevented commencement of faunal monitoring at these sites.

Benefits and highlights

Physico-chemical monitoring of surface waters

The original Departmental south-west wetland monitoring program, which in 1996 was on the verge of closure, has been resurrected, expanded, and placed on a more secure footing. Regular monitoring is now being undertaken at 100 wetlands across the south-west agricultural area.

Water level data from all but a few of the 100 wetlands and 51 additional wetlands monitored in the past have been secured by the installation and 'survey to gauges' of DOLA bench and reference marks. These survey marks now form part of the State geodetic network.

A new database, SWALMP, has been constructed to store and manage all data from the Wetland Monitoring Program. The new database will also facilitate the presentation and analysis of data and supply to third parties. Progress has been made in preparing salinity data for trends analysis.

A bathymetric map and depth-volume calculator have been prepared for Dumbleyung Lake, allowing stored water volumes and salt loads to be calculated from monitoring data collected since 1979. These data will permit the calculation of effects of drainage proposals and other activities on lake water levels and salinities, and from this the prediction of likely impacts on wetland conservation values. They will also allow precise calculation of the lake's role in flood mitigation. Bathymetric maps and depth-volume calculators are currently being prepared for Lakes Hinds and Ninan and are also planned for other significant south-west lakes.

Flora monitoring

The initial baseline survey of 197 quadrats on 80 transects over 25 wetlands has been completed. These baseline surveys have been fully documented in three reports that have been lodged in the Department's Woodvale library. These data will allow future change in response to catchment management activity in these wetlands to be accurately monitored.

Shallow groundwater monitoring

Shallow monitoring bores have been established at 21 wetlands and will be installed at the other four when water levels recede sufficiently, which should occur during the 2000–01 summer. Groundwater measurements have been collected to provide the baseline for future monitoring but they also reveal surprising diversity of groundwater condition in the monitored wetlands. Maps and a data report are available in the Department's library.

Fauna monitoring

Baseline data on waterbirds and aquatic invertebrates of 23 wetlands are available. The other two wetlands selected for monitoring have not yet contained enough water to sample. Results have shown that waterbirds and invertebrates both respond to changes in lake condition and will be sensitive indicators of the effect of changing wetland conditions on wetland biodiversity. All data collected have been entered on the corporate wetland database. Reports have been lodged with the Department's library and a paper on invertebrate monitoring submitted.

See also the Recommendations for future program section below for a summary of the broader values of the program.

Recommendations for future program

During the preparation of the *Salinity Action Plan* and supporting documentation in 1996, it became clear how little robust information actually exists describing biodiversity changes resulting from salinity. It is probable that losses in biodiversity, even at a State level, have occurred without any record. Thus there can never be a complete record—certainly at a local and regional level—of biodiversity changes. This weakens our capacity to plan biodiversity management at local, regional and State scales.

This lack of information also has serious consequences for predicting and managing the future course of salinity across the landscape. Our wetlands are critical indicators of both landscape health and changes in landscape function.

The Department's wetland monitoring data (which began under the Department of Fisheries and Wildlife) provide one of very few long-term data sets—particularly for inland areas in the <600 mm annual rainfall zone—of increasing salinity. Consequently, the importance of significantly upgrading wetland monitoring was recognised through the *Salinity Action Plan* and led to the funding of the Wetland Monitoring Program.

It is emphasised that the Wetland Monitoring Program not only provides vital datasets for documenting and managing changes in wetland biota; it also provides, in conjunction with other programs:

- Baseline information for assessing hydrological changes in the landscape as a whole. This information is essential to assess the value of changed land use practices in upper catchments. Monitored wetlands will provide important information for catchment groups and other agency personnel to assess the impacts of their programs.
- A means for assessing the flood mitigation and other landscape functions of wetlands. This information will be critical to management of discharge including the evaluation of drainage and the use of some wetlands as evaporation basins.
- Data on the relationship between salinity and vegetation, information that will contribute to revegetation and vegetation management for all land use objectives.

Thus the Wetland Monitoring Program is not only essential to meet the specific objectives established for it under the *Salinity Action Plan* and *Salinity Strategy*; it also makes a vital contribution to a range of salinity management programs. In delivering these outcomes the program forms one of a series of interlocked, long-term monitoring programs. Those managed by the Department include the Wetland Monitoring Program, monitoring in natural diversity recovery catchments, and monitoring associated with the Biological Survey Program (see pages 108–19). Taken together, these programs are critical to delivering the three points above as well as the feedback necessary to manage biodiversity.

It is important to note that the Wetland Monitoring Program would have been much less effective without:

- a) a core of Departmental officers with sufficient knowledge of past monitoring projects to interpret and re-establish past data and procedures;
- b) a group of experienced Departmental officers from a range of biological disciplines working in close proximity and able to develop, manage and implement a complex program involving significant taxonomic expertise; and
- c) access to experienced staff in other agencies including Agriculture WA, DOLA and WRC.

Points (a) to (c) emphasise that a core of experienced and knowledgeable staff within agencies is essential to maintain effective long term monitoring programs. It is also important that these officers represent an accumulation of corporate history so that past programs are known, and can be re-interpreted. There is anecdotal information that an eastern states institution shredded datasets that, following staff losses, had become uninterpretable.

Taking into consideration all the above, the following recommendations are made:

Recommendation 22

The fauna monitoring program should be expanded by an additional \$30,000 per annum commencing 2001–02 given that the current budget is not viable without substantial field and laboratory input by Dr Halse, and his input cannot continue indefinitely.

Recommendation 23

The overall program (physico-chemical monitoring of surface waters, flora monitoring, shallow groundwater monitoring, and fauna monitoring) should be maintained with an additional increment of \$50,000 per year (starting with \$12,000 in 2001–2002, \$25,000 in 2002–2003 rising to \$50,000 in 2003–2004) to cover inflation and other cost increases. It should be noted that, if additional funds are not provided, sampling frequencies will have to be reduced to less than desirable levels.

Recommendation 24

Following completion of installation and development of the bore monitoring network, consideration should be given to whether some greater efficiencies might result from adding ongoing bore monitoring and its budget to the physico-chemical monitoring program.

Recommendation 25

Scientists involved in the program should advise the Director of Nature Conservation on means of presenting findings on trends so as to inform decision-making on salinity projects. While the monitoring program is only in its early stages, and there has been little repeat monitoring, it is important that analyses of trends are made available as soon as practicable for policy development and management.

Recommendation 26

The importance of maintaining a core of cross-disciplinary staff in the biological sciences to deliver effective long-term monitoring and value-adding to information should be explicitly recognised. Specifically, it is recommended that a long-term staff succession plan be prepared under the direction of the Science Division Director, and that its implementation be negotiated with the program purchaser.

APPENDIX 12

CALMScience Wetland Monitoring Program—proposal of 24 June 1997¹²

Proposal: Monitoring Salinity and its Effects on the Biota of Wetlands in the Agricultural Zone of South-Western Australia

1 Project title

Monitoring salinity and its effects on the biota of wetlands in the agricultural zone of south-western Australia.

2 Project leaders

Wetland Monitoring Project Team

[Mr Ian Herford, Nature Conservation Division (chair), Mr Ken Wallace, Wheatbelt Region, Dr Neil Gibson, Dr Stuart Halse, Mr Jim Lane, Science and Information Division].

3 Project objectives

This project is designed to provide ongoing monitoring of wetland salinity and biological resources in wetlands of the agricultural zone of south-west Western Australia so that the progress and success of the Salinity Action Plan can be assessed. The Salinity Action Plan is a new initiative to reduce the extent, and impact, of secondary salinisation in Western Australia through tree planting, better water management practices, and the protection of remnant vegetation. Maintenance of biological and physical diversity in the agricultural zone is one of the major objectives of the Plan. This project focuses on monitoring salinity and biodiversity in wetlands that, because they are low in the landscape, are the habitat most affected by salinity.

Specific project objectives are:

- (1) analyse and report trends in salinity and depth of agricultural zone wetlands monitored by the Department since 1978;
- (2) monitor salinity, depth and nutrient status of a broad range of wetlands;
- (3) monitor waterbirds, fish, frogs and aquatic invertebrates in a sub-set of wetlands to measure any changes in fauna of the wetlands;
- (4) monitor floristic composition and tree health in the same sub-set of wetlands to measure any changes in flora occurring in, and around, the wetlands.

4 Possible assessors

Dr Sue Briggs, NSW National Parks and Wildlife Service

Prof. Bill Williams, Coordinator, National Wetlands Program, University of Adelaide.

5 Other agencies or organisations involved in the proposal

Within the Department, Regional officers will be consulted in the selection of monitoring sites. Outside the Department, Agriculture WA and Water and Rivers Commission may be involved in installation of piezometers to assist interpretation of data on vegetation health. Data on streams to complement the wetland data from this project will be collected by Water and Rivers Commission, as part of the Salinity Action Plan, and by Stuart Halse as part of the Commonwealth-funded Monitoring River Health Initiative. Data generated by the projects will be suitable for State of the Environment reporting.

¹² Includes later amendments to vegetation component.

Parts of the project may be contracted out, perhaps to universities, but details remain to be worked out.

6 Scope and approach

The Salinity Action Plan identified the need for monitoring to determine the effectiveness of the Plan and, in particular, to determine natural bio-physical trends and the likely impact of land management changes on trends over time.

Salinity, water depth, pH, nutrient levels (total N, total P) and several other parameters will be measured each September and November in about 100 wetlands selected to represent a range of fresh, secondarily salinised and naturally saline wetlands through the agricultural zone. The program will consolidate and enhance the work of Lane and Munro (1983) by relating wetland depths to the Australian Height Datum, providing bathymetric maps and salt load calculations for selected sites, and analysing 19-year trends in salinity for more than 60 wetlands.

The 25 wetlands selected for biological monitoring will be a sub-set of the wetlands monitored for salinity. They will represent a range of fresh, secondarily saline and naturally saline wetlands and will include wetlands with very high conservation value. The faunal monitoring will consist of regular waterbird and aquatic invertebrate surveys and *ad hoc* sampling of frogs and fish. The vegetation monitoring will involve triennial measurements of floristics and tree vigour. More detailed measurements of water chemistry will be made in the wetlands selected for biological monitoring and piezometers will be installed to monitor changes in groundwater levels so that changes in tree vigour and other biological attributes can be interpreted more easily.

Complete counts of waterbirds and careful searches for nest and broods will be made in August, October, and March every second year to obtain information about trends in waterbird breeding and use of the wetlands as drought refuges (see Halse and Jaensch 1989, Halse *et al.* 1990). Salinity and depth data will be collected in conjunction with the waterbird surveys and data from periods when wetlands are in the final stages of drying (perhaps <0.4 m) will be excluded from analyses. During the October waterbird count, aquatic invertebrates will be collected in two 50 m sweep samples along standard transects using pond nets with 250 µm mesh and in two 20 m samples with 50 µm mesh size. Salinity, pH, dissolved oxygen, temperature, total N, total P and chlorophyll levels will be measured at each site. Ionic composition will be measured at each wetland on the first sampling occasion and every fourth year subsequently.

Few fish species are likely to occur in most parts of the agricultural zone (Allen 1982). Therefore, fish will be monitored in an *ad hoc* fashion, relying mostly on catching any species present with a dip net during invertebrate sampling. If a wetland appears to support several fish species, additional methods of capture (such as seine netting and rotenone) will be employed. Detection of frogs is strongly influenced by weather conditions, so it is difficult to standardize survey effort (Froend and Storey 1996). Therefore, the aim of the monitoring program will be limited to compiling longer term lists of the frog species at each wetland from records of tadpoles caught during invertebrate sampling and adults heard calling or seen while spotlighting at night. Data gathered during additional programs, such as mammal and reptile surveys where pit-fall trapping is used, will also be incorporated into the species lists.

The different structural units of vegetation at each wetland will be mapped from aerial photography and between three and six permanently marked transects will be placed around the wetland. The transects will be made up of contiguous 20 x 20 m quadrats and run perpendicularly from the shoreline into upland vegetation. Ground levels (in relation to the deepest point in the wetland) will be determined at 50 cm intervals along the transects.

Monitoring will occur every third year. The 20 x 20 metre quadrats covering the transition from wetland to upland vegetation will be divided into five permanently marked 4 x 20 metre quadrats, within which vegetation will be described and individual trees will be marked and assessed for vigour (Froend *et al.* 1987, Bell and Froend 1990). Within 4 x 4 metre subplots, all sedges and shrubs will be marked. In the higher parts of the transects, vegetation will be described and a general assessment made of vigour.

Floristic data on submerged vegetation will be collected from four to six 2 x 2 metre permanent quadrats, randomly located in the littoral zone.

Three or four pairs of piezometers will be installed across each wetland, aligned with the direction of groundwater flow. There will be a pair on the shoreline each side of the wetland and one or two pairs on the lakebed. Of each pair of piezometers, one will be screened about 2 m below the water table to measure shallow groundwater and the other will be screened at 6–7 m. Piezometers will not be installed until groundwater is less than 10 m below the lakebed. Where possible, piezometers will be installed through the local Land Conservation District Committee, using light vehicles. Occasionally, a more sophisticated design may be required than that outlined above and the piezometers will be installed in conjunction with the Water and Rivers Commission.

Wetlands will be selected for monitoring after a review of the current wetland monitoring program (Lane and Munro 1983) and evaluation of other data on the wetlands of the agricultural zone, including results of the biological survey proposed under the Salinity Action Plan. There have been extensive surveys of waterbirds in the agricultural zone (Jaensch *et al.* 1988, Halse *et al.* 1990) and a moderate amount of information is available on wetland vegetation (see Halse *et al.* 1993), but aquatic invertebrate studies are few (Halse 1981, Doupe and Horwitz 1995), despite the utility of invertebrates as ecological indicators.

Because of the need to incorporate results from the biological survey when selecting monitoring sites, the monitoring program will be phased in over a three-year period. This will allow techniques to be validated and refined, if necessary, on a small set of wetlands in the first year.

Data analyses will be a mixture of simple statistics and more complicated univariate and multivariate analyses (see Froend *et al.* 1996).

7 Expected outputs

Summaries of salinity, vegetation and fauna monitoring will be produced each year, highlighting significant findings in relation to the Salinity Action Plan. There will also be a comprehensive report every three years that analyses trends in salinity and biodiversity at individual wetlands and in the agricultural zone as a whole.

Results of the monitoring program will be suitable for use in State of the Environment reporting and will provide feedback about the effects of management actions on natural values of wetlands.

Milestones

Date	Output
June 1998	Report salinity trends in 60 wetlands monitored for 18 years Report current condition of vegetation and fauna of 8 and 5 wetlands, respectively, to provide baseline for future monitoring
June 1999	Report wetland salinities and any changes observed in response to management action Report baseline condition of vegetation and fauna for a further 8 and 12 wetlands, respectively
June 2000	Comprehensive review of wetland salinity and its trends in the wheatbelt and changes as a result of Salinity Action Plan management initiatives Comprehensive review of condition of wetland vegetation in the wheatbelt in relation to salinity Comprehensive report of the fauna of wetlands in the wheatbelt, its tolerance of salinity and faunal responses to Salinity Action Plan management initiatives
June 2001	Report wetland salinities and any changes observed in response to management action Report changes in condition of vegetation and fauna in response to management action

8 Location

The study area will be the agricultural zone of south-west Western Australia, from the 600 mm rainfall isohyet to the eastern extent of land clearing (Fig. 2 of the Salinity Action Plan).

9 Area of project in hectares

About 25 million hectares.

10 Project Staff

The following staff will be responsible for selection of wetlands, design of field programs, sampling, data analysis and reporting. Consultants will be hired to assist, as required.

Water salinity: Mr Jim Lane

Fauna: Dr Stuart Halse

Flora: Dr Neil Gibson, Mr Greg Keighery

11 Actions needed

Year	Action
1996–97	
1	Review available information
2	Prepare existing wetland salinity data for analysis
1997–98	
1	Select 70 wetlands for salinity monitoring, begin monitoring
2	Analyse existing data on salinity of 130 wetlands
3	Select 8 wetlands for vegetation and five for fauna monitoring, install piezometers
4	Validate biological monitoring techniques
5	Report results
1998–99	
1	Review salinity monitoring program and expand to 90 wetlands
2	Map contours of 10 wetlands for salt load calculation
3	Add eight wetlands for vegetation and 12 for fauna monitoring, install piezometers
4	Report results
1999–00	
1	Expand salinity monitoring program to 100 wetlands
2	Survey 55 depth gauges to Australian Height Datum (AHD)
3	Map contours of 15 wetlands for salt load calculation
4	Monitor vegetation at 9 new wetlands and fauna in 8 new and 5 re-sampled wetlands, install piezometers
5	Review program and provide major report
2000–01	
1	Annual monitor salinity, depth etc in 100 wetlands
2	Survey remaining 45 depth gauges to AHD
3	Map contours of 15 wetlands for salt load calculation
4	Two–three-yearly biological monitoring of 25 wetlands
5	Report results

12 Budget

Item	1997-98
Salinity	
Field costs	24,450
Laboratory costs	1,100
Chemical costs	11,500
Capital costs	9,600
Salaries (incl OT)	55,850
Admin. overheads	2,500
Sub-total	105,000
Fauna	
Field costs	7,600
Laboratory costs	500
Chemical costs	1,950
Capital costs	12,500
Salaries (incl. 20%)	34,950
Admin. overheads	2,500
Sub-total	60,000
Flora	
Field costs	8,000
Laboratory costs	1,000
Chemical costs	1,000
Capital costs	4,000
Salaries (incl. 20%)	45,000
Admin. overheads	1000
Sub-total	60,000
Piezometers	
	25,000
Sub-total	25,000
TOTAL	250,000

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APPENDIX 13

Progress in relation to the proposed CALMScience Wetland Monitoring Program (see Item 7, Appendix 12)

2a. Progress in relation to Item 7 “Expected Outputs”

Date	Output	Status (Oct 2000)	Comments
June 1998	Report salinity trends in 60 wetlands monitored for 18 years (JL)	Not completed	Design and construction of new database, SWALMP, was initiated in 1998, in preparation for data adjustment and trend analyses
	Report current condition of vegetation and fauna of 8 and 5 wetlands, respectively, to provide baseline for future monitoring (NG, SH)	Completed	Current condition of vegetation reported in Odgen and Froend (1998)
June 1999	Report wetland salinities and any changes observed in response to management action (JL)	Not completed	Construction of database continued in 1998/99. Past methods of salinity measurement were being investigated in preparation for trend analyses
	Report baseline condition of vegetation and fauna for a further 9 and 12 wetlands respectively (NG, SH)	Completed	Baseline condition of vegetation of additional wetlands reported in Gurner <i>et al.</i> (1999)
June 2000	Comprehensive review of wetland salinity and its trends in the wheatbelt and changes as a result of SAP management initiatives (JL)	Not completed	Little progress was made with database or analyses in 1999/00 due to extended absence on leave of database analyst and program manager
	Comprehensive review of condition of wetland vegetation in the wheatbelt in relation to salinity (NG)	Completed	Gurner <i>et al.</i> (2000). This report completes the initial sampling of the 25 wetlands
	Comprehensive report of the fauna of wetlands in the wheatbelt, its tolerance of salinity and faunal responses to SAP management initiatives (SH)	Agreed deferral	Will be done by March 2001 (needed to allow time to complete identifications etc from 1999 before analysis)
June 2001	Report wetland salinities and any changes observed in response to management action (JL)	-	Construction of database completed Sep 2000. Data currently being prepared for trends analyses
	Report changes in condition of vegetation and fauna in response to management action (NG, SH)	-	Vegetation data will only include initial monitoring. Detailed assessment of response to management actions will require several further sampling sessions to have been completed. Too early in fauna monitoring for trends to emerge, baseline just completed

JL = J. Lane, NG = N. Gibson, SH = S. Halse

2b. Progress in relation to Item 11 “Actions Needed”

Year	Action proposed	Status (Oct 2000)	Comments
1996–97	Review available information (JL, NG, SH)	Completed	
	Prepare existing wetland salinity data for analysis (JL)	Not completed	Preparatory work commenced 1997–98
1997–98	Select 70 wetlands for salinity monitoring, begin monitoring (JL)	Completed	
	Analyse existing data on salinity of 130 wetlands (JL)	Not completed	Design and construction of new database, SWALMP, was initiated in 1998, in preparation for data correction and trend analyses
	Select 8 wetlands for vegetation and 5 for fauna monitoring, install piezometers (NG, SH)	Completed	Selection of wetlands for vegetation monitoring reported in Odgen and Froend (1998)
	Validate biological monitoring techniques (NG, SH)	Completed	Validation of vegetation monitoring techniques reported in Odgen and Froend (1998)
	Report results (JL, NG, SH)	Partially completed	Results of salinity data analysis not reported as preparatory work was incomplete
1998–99	Review salinity monitoring program, expand to 90 wetlands (JL)	Completed	
	Map contours of 10 wetlands for salt load calculation (JL)	Partially completed	Contours of Dumbleyung Lake mapped. Other wetlands not mapped due to priority being given to gauge maintenance, resurvey and installation, and installation of DOLA bench and reference marks
	Add 8 wetlands for vegetation and 12 for fauna monitoring, install piezometers (NG, SH)	Completed	Addition of wetland for vegetation monitoring reported in Gurner <i>et al.</i> (1999)
	Report results (JL, NG, SH)	Partially completed	Results of salinity data analysis not reported as preparatory work was incomplete
1999–00	Expand salinity monitoring program to 100 wetlands (JL)	Completed	
	Survey 55 depth gauges to Australian Height Datum (JL)	Partially completed	Alternative approach of installing DOLA bench and reference marks and surveying gauges to these was adopted. Nonetheless, as part of this process, gauges of 29+ wetlands were surveyed to AHD by June 1990
	Map contours of 15 wetlands for salt load calculation (JL)	Not completed	No additional wetlands mapped in 1999–2000 due to excessive water levels. Inquiries into boat-based mapping were initiated
	Monitor vegetation at 9 new wetlands and fauna in 8 new and 5 re-sampled wetlands, install piezometers (NG, SH)	Largely completed	Monitoring of vegetation of additional wetlands reported in Gurner <i>et al.</i> (2000). Faunal work remains uncompleted at two wetlands owing to lack of water
	Review program and provide major report (JL, NG, SH)	Completed	
2000–01	Annual monitor salinity, depth etc in 100 wetlands (JL)	Completed	
	Survey remaining 45 depth gauges to AHD (JL)	-	
	Map contours of 15 wetlands for salt load calculation (JL)	-	
	Two/three-yearly biological monitoring of 25 wetlands (NG, SH)	-	
	Report results (JL, NG, SH)	-	

JL = J. Lane, NG = N. Gibson, SH = S. Halse

OIL MALLEE PROGRAM

Background and rationale

Under the *Salinity Action Plan* development of new vegetation systems—including commercial, woody perennials—was highlighted as a priority area for salinity management. The need to significantly reduce recharge to groundwater was, and remains, a key target.

In 1996 it was estimated that three million hectares of revegetation would be required to combat salinity. While it was expected that 40% of this target could be achieved through land conservation and biodiversity plantings, the remaining 60% (1.75 million hectares) was to be achieved through commercial plantings (1.25 million hectares) and forage crops (0.5 million hectares). Subsequent calculations of the area that needs to be revegetated to deliver recharge control suggest that a much larger area must be treated (George *et al.* 1999b).

Commercial plantings were to be driven by three programs:

- In the higher rainfall areas, bluegums (*Eucalyptus globulus*) already provide a commercially viable option. This species provides the basis for economically increasing water use across many high rainfall landscapes where soils are appropriate.
- In the medium rainfall zone—400 to 600 mm annual rainfall—the Department committed to develop maritime pine (*Pinus pinaster*) as a commercial crop.
- Where rainfall is <400 mm, the Department and the Oil Mallee Association were to complete development of the oil mallee as a commercial crop.

The development of further commercial crops, especially for the low rainfall areas, was also seen as an important priority.

Apart from resources generated by the internal redistribution of funds and assets within the Department, none of these programs was provided with new funds under the *Salinity Action Plan* as it was proposed to seek Commonwealth funds for such research and development programs. The Department did, however, have funding committed to ongoing research and development of the oil mallee project. In partnership with the Oil Mallee Company and Oil Mallee Association, the Department has continued to play an important role in the development of oil mallees. The group of collaborators has also been successful in sourcing funds for development through a range of Commonwealth programs.

It is also well recognised that more than one new industry is required to achieve the level of revegetation required to combat salinity. The development of other commercially prospective species is dealt with in a separate chapter (pages 157–62).

Under the *Salinity Strategy* the need for new industries based on woody plants is confirmed, and the need for the Oil Mallee Program to continue is endorsed. However, no new funds were proposed from State resources for the program. Rather, it was expected that private enterprise and Commonwealth funds would be sourced to complete industry development.

Objectives

The broad aims of the Oil Mallee Program are to:

- establish a new commercial industry in rural areas that has multiple benefits to the State; and
- improve recharge control in the low rainfall zone by providing a commercially viable option for increasing water use.

Within the *Salinity Action Plan*, it was recognised that market forces alone would not be sufficient to drive commercial investment in the development of new, high water use industries based on woody plants. Therefore, a stated task (page 8) in the Plan is that the “Government will invest funds to:

- create the climate and provide information to facilitate existing commercial solutions; and
- support development of new tree crop species and industries.”

The Oil Mallee Program falls into the latter strategy. While initial product development focussed on the potential to use cineole, a major component of the eucalyptus oil found in some mallees, as an industrial solvent as well as in pharmaceutical products, there are also potential markets for mallee biomass. These include:

- panel board and industrial fibre products;
- charcoal and activated carbon; and
- bioenergy, including both electricity and transport fuels.

Implementation methods

In broad terms, the strategic approach of the Oil Mallee Program has been that the program will:

- supply the initial public investment essential to develop new plant industries. It is assumed, based on experience with bluegums and pine industries, that, once established, commercial revegetation will be self-financing and government will be able to withdraw resources. Thus the cost to public funds is short to medium term;
- have a strong, unified, grower base that is professionally led. This will enable them to deal competently with private enterprise groups that are always less sensitive to the wider issues of sustainable agricultural systems and local social and regional development issues; and
- provide, through its success, the basis for developing further industries utilising native plants. The production systems based on oil mallees will be applicable to a wide range of native plants that have the potential to produce a variety of commercial products.

It was also recognised that large-scale commercial revegetation with native species will favour conservation of natural diversity, and will avoid the introduction of weed plants. It will also produce large-volume, low-value feedstocks that have to be locally processed, thus supporting regional development. Therefore, the program has considerable potential to deliver a range of benefits, and the importance of capitalising on these was recognised very early in program development.

There have been three phases in the development of oil mallees in Western Australia. Firstly, for a number of years there was a low level of research interest and a series of very small trial plantings. These were mainly developed through the work of Allan Barton at Murdoch University.

Secondly, considerable impetus and the start of serious industry development began in 1993 when the Department initiated an Oil Mallee Project. Early work by the Department included the search for high oil producing species and individuals (the beginning of the current breeding and seed production program), establishment of broadscale plantings in six target areas, and initial work on harvesting and distillation.

Finally, as the project evolved, it became clear that either a significant (probably overseas) investor had to be found, or growers and local investors (including government) had to significantly increase their commitment to industry development. The latter approach has been taken, and a growers' representative group, the Oil Mallee Association, was formed in 1995. This group assumed control of the project in 1997, and sponsored the formation of the Oil Mallee Company to conduct harvest, processing and market development.

In 1999 the Company and Western Power Corporation (WPC) jointly investigated the feasibility of integrated processing of oil mallees. This investigation showed that integrated processing of mallee feedstocks to concurrently produce three products (eucalyptus oil, activated carbon and electricity) should be commercially viable. WPC is planning to construct a \$5 million demonstration-scale plant to operationally test integrated processing.

Procedures

Initially the Department focussed on planting a resource base at six sites: Canna, Kalannie, Narembeen, Toolibin, Woodanilling and Esperance. The Department, with Commonwealth funds (Farm Forestry and National Landcare programs), supported the initial planting program with a mixture of full-time and part-time officers. Seedlings were financed under a *Profit a Prendre* agreement between the Department and growers.

Currently the Oil Mallee Association manages resource establishment. As noted above, the Oil Mallee Company is concerned with market development, and the research and development of harvesting and processing equipment.

Outputs and outcomes

Expenditure, outputs and activities

Expenditure

Up until June 2000 investment in the Oil Mallee Program—excluding the proposed Integrated Mallee Processing Project—has been \$19.1 million distributed as shown in Table 14.

Table 14: Investment in the Oil Mallee Program 1992–2000 (excluding expenditure on Integrated Processing Project)

Source of funds	Expenditure
The Department (includes small amounts from other State sources)	\$5,000,000
Commonwealth Farm Forestry Program	\$500,000
National Landcare Program	\$500,000
Bushcare Program	\$1,500,000
Growers' on-farm costs (17 million seedlings @ 60 cents)	\$10,200,000
Growers' levies to the Oil Mallee Association (3 cents per seedling)	\$360,000
Rural Industries Research and Development Corporation (including Joint Venture Agroforestry Program).	\$750,000
Growers' equity contributions to the Oil Mallee Company	\$300,000
TOTAL	\$19,110,000

It is emphasised that these figures do not include some smaller project plantings such as those involving cost sharing in natural diversity recovery catchments.

Outputs and outcomes

The Oil Mallee Program has been highly effective in attracting farmers into revegetation and in the establishment of large plantings. Up to and including the winter of 2000, the program had involved 900 growers and the planting of 17 million seedlings (equivalent to 6,800 hectares).

With support from the Bushcare Program (1999 and 2000 planting years, see Table 15) 799 farmers (note that many individuals are counted twice as this figure includes farmers who planted in both years) have been involved in plantings totalling 7.9 million mallees and 2.4 million trees planted for biodiversity objectives. In addition, 260 hectares of remnant native vegetation has been protected—by fencing and by buffering against recharge—as part of the program. This is an average of nearly 10,000 mallees and 3,000 concurrently planted trees for biodiversity purposes per farmer. In addition, farmers' plans indicate 3,400 more trees will be planted for biodiversity purposes per farmer before completion of their farm plans. This comfortably exceeds the 25% proportion of planting for biodiversity purposes that was the target of the Bushcare Program.

Table 15: Review of Oil Mallee Project biodiversity performance 1999 and 2000

Biodiversity performance factor	P1999	P2000
Total number of farmers planting mallee	329	470
Total number of mallees planted	2,900,000	5,000,000
Area actually planted to oil mallee (<i>number/2500 = ha</i>)	1,160 ha	2,000 ha
Area effectively treated for recharge control by mallee (<i>number/400 = ha treated</i>)	7,250 ha	12,500 ha
Total number farmers undertaking concurrent biodiversity works ¹	230	423
Total number of trees planted for biodiversity purposes	970,000	1,466,718
Total number of trees projected to be planted for biodiversity purposes	1,000,000	1,670,000
Area effectively treated with trees planted for biodiversity purposes (<i>no/400 = ha treated</i>)	2 425 ha	4,168 ha
Remnant vegetation area benefiting from oil mallee planting (<i>estimated to be 10% of the area effectively treated</i>)	100 ha	167 ha
Total number with farm plan sketches	329	470
Total number plantings incorporated into local catchment/landcare plans	202	288
Mallee planting design: <ul style="list-style-type: none"> • block • belt, alley or contour on cropping land • waterway 	20% 70% 10%	15% 75% 10%
Relationship of mallee to biodiversity works <ul style="list-style-type: none"> • mallee upslope of biodiversity planting • mallee upslope of remnant vegetation • mallee adjacent to biodiversity 	60% 20% 20%	60% 20% 20%
NHT cost per tree planted (mallee + biodiversity)	13 cents / tree	12 cents / tree

Note: It was agreed (in the correspondence associated with the original project approval) that oil mallee planting could precede biodiversity planting in the farmers' farm plans. Hence regional managers could approve plans where the farmer indicated that his plan was to include subsequent works for biodiversity purposes.

The unit cost of planting being achieved in this project (12.5 cents/tree) is competitive with costs in other Bushcare projects. Note that not all of the associated biodiversity revegetation receives public funding and this further improves the viability of this method of revegetation.

Problems/Difficulties

Farmer adoption rates: Farmers have shown great interest in becoming familiar with oil mallee as a crop that combines landcare with a potential commercial outcome. However, few farmers can venture much on an activity that is not commercially proven. Hence mallees tend to be adopted to a limited extent by many farmers, but they then 'sit on the fence' waiting for the commercial development process to deliver. Planting is also sensitive to the availability of discretionary funds. Following the poor season in 2000 a steep slump in planting is expected in 2001. The Oil Mallee Association is confident that very rapid planting will occur when commercial returns are available.

Development of harvesting and handling systems: Investigation of existing machines for harvest and handling of woody plant crops around the world indicates that none are suitable for this industry. Hence the industry has had to embark on development of its own equipment. This is extremely expensive. Nearly \$1 million has been spent so far and the planned development of an operational prototype has a budget of more than \$6 million. However, it has proved to be extremely difficult to raise research and development funds to support this type of work and development is proceeding very slowly. The use of mallee-type crops has potentially very large application around the nation and a national-scale response to this impediment is warranted.

Markets: While production volumes are small there will be no difficulty in finding markets for the range of products that could be produced from mallee feedstocks. However, large-scale expansion will need to generate economies of scale and low costs of production, and be accompanied by very large product and market development before mallees could become a significant industry. Investigations to date show that there are good prospects for developing large markets, but that to do so will require significant resources.

Establishment and management practice: Good general management practice has been developed but particular challenges remain. Breeding, propagation and seed production techniques applicable to the seven major species of mallee require considerable further research and development investment. Methods of yield prediction and carbon sequestration for all species and site types will be required to better target commercial planting. Harvest regimes that maintain the health and productivity of mallees across all seasons and frequencies of harvest must also be defined.

Benefits and highlights

Cost-effective on-ground achievements: The key result from this program for salinity management has been the cost-efficient establishment of 17 million seedlings (equivalent to 6,800 hectares) in recharge zones. If the industry becomes fully commercial, then there will be a major surge in plantings, and this will contribute significantly to recharge control as well as providing a basis for further industry developments.

High quality of stock and regional development: The large volume of seedlings ordered and centrally coordinated by the Oil Mallee Association has been instrumental in managing the price and quality of nursery stock volume, and in building up the skills and sales volume of regional nurseries. This benefit has spilled into seedlings for other species to some degree as well.

Increased adoption rates: The Oil Mallee Program has attracted many farmers who might not otherwise have considered planting trees. There is anecdotal evidence that, once inducted into regular planting, farmers soon diversify their types of planting.

Delivery of integrated catchment management outcomes: More than 60% of oil mallee plantings are incorporated into local or regional catchment planning activities conducted by various landcare groups. These groups often have funding from other Natural Heritage Trust projects. Oil mallee planting is becoming a standard part of any catchment plan, and oil mallee regional managers participate in catchment planning activities both directly and through the agency of local landcare workers. Many oil mallee managers commission these landcare workers to help with the logistics of farm planning and revegetation works, making payments from their farmer oil mallee levy revenue. This is a promising model for financing planning in future years if public funds are no longer available.

Planting on cropping lands: It is generally very difficult to stimulate adoption of revegetation for biodiversity purposes on cereal-growing land. A feature of the Oil Mallee Program is the

proportion of trees planted on good cropping land. Some 75% of plantings are in alley or belt configurations, virtually all of which are on good cropping land. This is easier to achieve with mallees because they tolerate grazing and do not require fencing. Mallees can therefore be used to complement lower slope biodiversity works by increasing the proportion of revegetation on hill slopes, thus improving both landscape water balance and longevity of plantings.

Maintenance of local landscapes and weed prevention: Most of the mallees planted occur naturally within the wheatbelt of Western Australia. Thus they help to maintain the local character of the landscape. At the same time, they greatly reduce the probability of woody weeds being introduced.

Recommendations for the future program

As noted in the introductory information, commercially driven, broadscale revegetation is a vital component of effective recharge control. The Oil Mallee Program is currently the only comprehensive development that aims to deliver this aspect of recharge control in the low rainfall zone. If successful, it will provide a model for a range of other industries based on native species.

Consequently, it is essential that the program is maintained so that integrated objectives of sustainable land use and biodiversity conservation may be achieved. For an explanation of the value of the Oil Mallee Program in the broader context of the total salinity program, see Concluding Remarks and Strategic Recommendations.

The following recommendations are made:

Recommendation 27

There should be a coordinated State and Commonwealth commitment to systematic development of this major project. Funds of the order of \$2 to 3 million per year are required to maintain its momentum. Major items for development are:

- genetic improvement and seed production;
- definition of yield potential and harvest management regimes; and
- development of harvest and materials handling systems.

Public investment in these areas could be secured against future industry earnings.

Recommendation 28

The Department should retain its role as the main channel for State and Commonwealth Government agency support.

DEVELOPMENT OF TREE AND SHRUB CROPS— LOW/MEDIUM RAINFALL PROGRAMS

Background and rationale

The development of commercial perennial crops, especially for the low rainfall zone (<400 mm annual rainfall), was identified as an important priority under both the *Salinity Action Plan* and *Salinity Strategy*. For the rationale behind programs aimed at developing new industries based on woody plants refer to the chapter on the Oil Mallee Program (page 150–56).

The key characteristics of woody plants that should be developed as a priority were identified when the *Salinity Action Plan* and its companion document, the *Situation Statement*, were prepared. These characteristics included that plants should:

- show exceptional promise for providing the basis of new economic industries for the agricultural region;
- favour broadscale, rather than boutique, industries. This characteristic is necessary given the need for broadscale revegetation;
- be compatible with agricultural systems; and
- be native to the region for which they are being developed. This would not only minimise the risk of introducing woody weeds (a significant risk), but also acknowledges that the rich Australian flora, particularly that of the south-west, has been poorly explored for species of economic value. Furthermore, such plants hold the key to integrating sustainable land use and biodiversity conservation objectives.

Currently there is no rigorous method for identifying and selecting woody plants that meet these criteria. As it is expensive to develop potential commercial species, designing procedures to screen and identify prospective species is the most important initial task in any serious thrust to develop new commercial industries.

To begin this work, the Department designed and now leads a joint project with Agriculture WA and the Farm Forestry Program to develop a search procedure and begin the development of ‘best bet’ species. Farm Forestry funds and State resources, particularly from the Department, support this project. No new funds for the project were allocated under the *Salinity Action Plan* as it was anticipated that such work, particularly given its national values, would be supported by Federal funds.

While the official title of this project is ‘Selection and Development of Multiple Purpose Species for Large Scale Revegetation’ (NHT Project 973849), it is generally known as the Search Project. The latter title is used throughout this review. The remainder of this chapter focuses on this project, given that it provides a framework for the development of all new plant industries based on woody species.

The *Salinity Strategy* confirms the need for new industries based on woody plants, and \$1.05 million per year, rising from a base of \$750,000, were proposed as new funds from State resources. To date Government has not committed these funds.

Objectives

The objectives of the Search Project are to:

- a) develop a search procedure that systematically analyses native plant and product attributes and objectively identifies best prospects for development (the search component);
- b) assemble technical, economic and biodiversity information to select and rank a shortlist of the 12 most prospective species for development (pre-feasibility investigation);
- c) establish a preliminary selection of best bets as demonstration trials (part 1, industry exploration); and
- d) develop establishment practice and planting design for prospects identified in (a) and (b) (part 2, industry exploration).

Implementation methods

The four objectives listed above are undertaken within the following framework for development of woody plant crops.

Search: develop a procedure by which the most prospective perennial species and products can be systematically identified. This will consist of sets of biological, environmental, management and economic attributes for assessment of prospects.

Pre-feasibility analysis: more rigorous assessment of search attributes to identify a shortlist of the most prospective combinations of species and products with particular reference to:

- cost of production;
- yield and quality;
- markets and prices;
- potential for economies of scale;
- biodiversity, landcare and community benefits; and
- initial economic analysis.

Industry exploration: plan and commence building the foundation for an industry.

- Technical development:
 - select and improve genetic resources;
 - produce improved seed and develop propagation techniques;
 - design all aspects of agronomy/silviculture for multiple purpose management;
 - develop harvest and processing techniques;
 - invest in product development science; and
 - investigate residue utilisation.
- Environmental design and management:
 - design agricultural systems to incorporate land, water and biodiversity conservation;
 - evaluate prospects for commercial species mixtures;
 - investigate role of revegetation and biomass residue in carbon sequestration and as a renewable energy resource;
 - assess the economic value of environmental benefits; and
 - prepare extension materials to promote land, water and biodiversity conservation.

- Commercial and business development:
 - build a grower constituency;
 - establish an initial resource;
 - establish demonstration planting/farms;
 - investigate major product option;
 - find buyers and markets; and
 - conduct economic analyses.

Full feasibility investigation: prepare business and industry plans.

- assemble all interests;
- prepare full feasibility and industry development plans;
- develop a corporate structure;
- raise capital;
- develop legal arrangements; and
- seek tax incentives.

The Search Project as currently designed will take this process up to and including the first two steps of industry exploration. This program as a whole must find sufficient resources to complete all elements in the framework, and commence implementation of business and industry plans.

Procedures

The Search Project has developed two lines of work to achieve the objectives listed above:

1. Appointment of a consultant to manage research and development of the search routine.
2. Identification of a range of initial best bet species, and implementation of initial demonstration plantings managed by 1.5 contract staff. While normally this step would not begin until (1) was complete, the funding body considered it was important to quickly demonstrate a presence on the ground while the search routine was under development.

Outputs and outcomes

Expenditure, outputs and activities

Expenditure

- Search: \$77,000 to 30 June 2000. The projected expenditure to 30 September of \$575,000 was not reached due to delays in commissioning pre-feasibility investigations.
- Demonstration planting: \$208 000 to 30 June 2000 and \$270 000 to 30 September 2000.

Once pre-feasibility investigations begin, expenditure will rapidly increase given the cost of tests. It is anticipated that expenditure and outcomes will be back on schedule by 30 September 2001.

Outputs and outcomes

The project commenced in July 1999. Achievements to winter 2000 include:

- Appointed Search project manager. The biological criteria for the Search routine (to pick the best bet species) have been developed and the computer software selections have been made. A prototype of the model has been developed (as at December 2000).
- Conducted a rigorous species selection process to identify native species with the best prospects for commercial success (with input from the Search routine).

- Collected, documented, and processed 100 seed collections of prospective native plants from the wheatbelt. Took specimen samples of all selected plants to confirm species identifications and lodged samples in the WA Herbarium.
- Spoke to >100 farmers and catchment groups as part of the process of selecting planting sites. Attended 30 field days and evening meetings of farmer groups to achieve this.
- Documented planting site biophysical attributes and planned layouts for all sites.
- Raised 250,000 seedlings from the seed collections. These collections include 139 taxa from 44 species.
- Selected, prepared and planted 75 five-hectare farm demonstration sites across the wheatbelt (Map 4).
- Monitored sites for weed and locust problems.
- Conducted five field days and prepared 12 publications (including seminar proceedings, research papers and brochures).
- Assembled the National Consultative Panel and held a meeting in Canberra.

Problems and difficulties

Delay in starting project: It has been very difficult to attract funds to develop new woody industries, particularly for the <400 mm annual rainfall zone. This is because the risks are too high during the developmental phase to attract either private enterprise or most government agencies seeking economic development outcomes alone. On the other hand, despite the need for extensive revegetation to achieve biodiversity outcomes, conservation organisations have been reluctant to fund prospective commercial species. Thus it has been difficult to attract resources to the program, and negotiations during the start-up phase have been understandably prolonged.

Poor understanding of developmental costs: The Oil Mallee Program, poised on the edge of success, has taken nearly \$20 million to develop (including development of a resource base). While this seems a large amount of money, it is probably the minimum one could expect to pay for the development of a new industry. Given the enormous benefits, both economic and environmental, of new industries based on regionally native species, this is a trivial sum, particularly given that it is in any case a cost-effective form of revegetation irrespective of the industry outcomes. However, many involved in the management of salinity have not understood the enormous potential gains, their centrality to tackling salinity, and the comparatively small sums involved. Other matters, such as the slow rate of positive physical change as a result of revegetation and gaps in knowledge (see the concluding chapter, pages 166–75 for a detailed discussion) have compounded these issues.

Infrastructure and staff development: As with other salinity programs, there has been a delay in getting started due to the need to recruit suitable personnel and establish the necessary infrastructure (including offices and equipment) to begin. These problems have now been overcome in the Search Project.

Approval of the final stage of the project: A continuing grant application for the Industry Exploration part of the project was submitted as required but awaits (as at December 2000) Bushcare approval.

Benefits and highlights

The Search Project has achieved a national profile even before it has produced any results. For example, groups in CSIRO and eastern states agencies have sought collaboration, and the Rural Industries Research and Development Corporation listed compatibility with the objectives of the Search project as a selection criterion for new proposals. In effect, this entails proponents gaining a letter of support from the program manager. The concept of systematic

and objective selection of species and products upon which to focus commercial development effort has been decisively supported.

A Cooperative Research Centre proposal (CRC for Plant Based Management of Salinity) has incorporated the Search concept into its proposal.

The substantial national level of interest provides the opportunity to achieve economies of scale and efficient allocation of expensive pre-feasibility investigations that are a major part of the Search Program. For example, manufacturing laboratory samples of products for testing and conducting a full analysis may cost up to \$50,000 for a single sample.

Recommendations for the future program

Development of suitable woody industries is crucial to effectively tackling the recharge component of salinity management. Astute development of such industries will also provide a mechanism for tackling a range of important matters including biodiversity conservation and regional development. Although the importance of such industries is addressed in the *Salinity Action Plan* and *Salinity Strategy*, the level of funding proposed is quite inadequate to complete the developments necessary to achieve salinity management. Under the *Salinity Strategy* \$1.05 million is proposed for allocation to the development of new industries based on native plants. While this is a significant improvement on the current situation, the reality is that development of a single new industry—and several are required—will cost in the order of \$20 million over 10 years.

Consequently, to develop the 10 best commercial prospects, of which it would be expected that at least two would develop into full industries, is likely to cost an estimated \$20 million per year for 10 years.

It is therefore vital that:

- funding for development of woody plant industries is substantially increased to deliver the recharge outcomes necessary for salinity management; and
- the program continues to receive strong support from the Department.

The importance of husbanding the successful development of the Search Project to fruition, and of aggressively developing commercial industries that integrate sustainable land use and conservation of biodiversity, cannot be over-emphasised. A critical element to the success of the Department's conservation programs in agricultural areas will be its ability to fully develop and implement the Search Project including related industry developments.

It is therefore strongly recommended that:

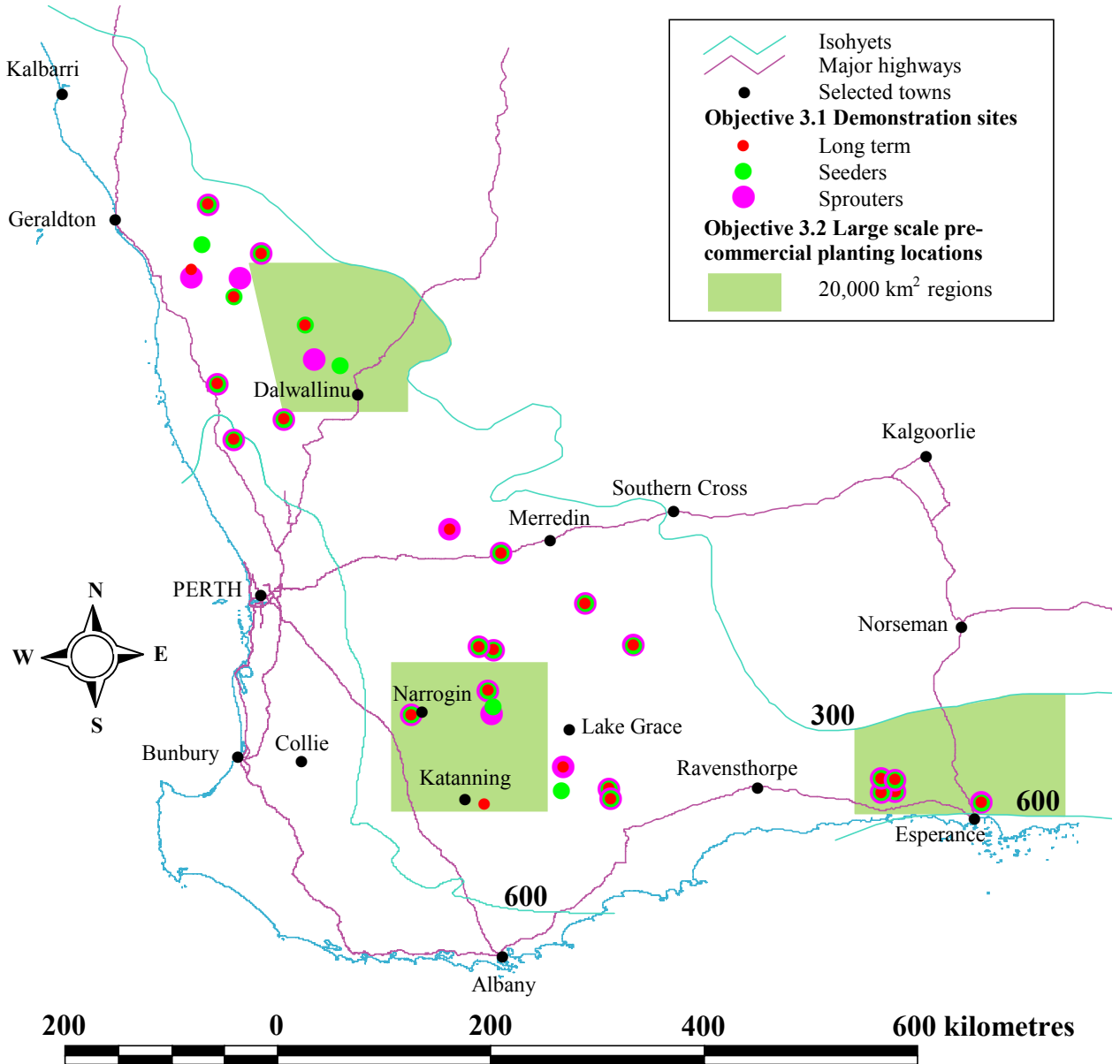
Recommendation 29

The Department should strengthen its leadership role and infrastructure support for the Search Project and related developments.

Recommendation 30

Additional funding of \$20 million per year (scaled up over five years, with a total expenditure of \$200 million over 15 years) should be sought for research and development of new industries based on native plants. The intellectual property developed in this work should be used to enhance the competitive position of new enterprises committed to strategic, rapid industry development.

Map 4
Trial planting locations for NHT Project 973849: Developing multiple purpose species for large scale revegetation (the Search Project)



MARITIME PINE PROGRAM

Background and rationale

Under the *Salinity Action Plan*, development of new vegetation systems—including commercial, woody perennials—was highlighted as a priority area for salinity management. The need to significantly reduce recharge to groundwater was, and remains, a key target.

For the rationale behind programs aimed at developing new industries based on woody plants, refer to the chapter on the Oil Mallee Program (pages 150–56). In this context the development of an industry based on maritime pine (*Pinus pinaster*) is one of the key elements for revegetation in the medium rainfall zone (400 to 600 mm annual rainfall).

None of the programs aimed at developing new industries based on woody plants was provided with new funds under the *Salinity Action Plan*. As part of the plan the Department did, however, undertake to redistribute existing funds to support the development of the Maritime Pine Program. While outside the specific scope of this review, general information is provided on the development of the Maritime Pine Program below. This provides, along with a discussion of the Oil Mallee and Search Programs, a more complete picture of the Department's activities as foreshadowed in the *Salinity Action Plan*. However, it should be noted that carriage of the Maritime Pine Program was transferred to the Forest Products Commission upon its establishment in November 2000.

Maritime pine (*Pinus pinaster*) has proved to be a hardy species well suited to medium rainfall areas. This assessment is based on early plantings from 1923 and more recently the location of some 290 plots in the lower rainfall parts of the State.

The first plantings of maritime pine under the Maritime Pine Program began in the sandy areas around Perth in 1995. These plantings were seen as a replacement for the plantations at Wanneroo. In 1996, in response to the threat of salinity, maritime pine was identified as being suitable for establishment in the medium rainfall zone. The Department estimated that there are potentially 800,000 hectares of suitable land available in this zone. Given that plantings in this zone generally target the deeper sands that are high recharge areas and are also unsuitable for cereal growing, the Maritime Pine Program promised to deliver an important aspect of recharge control.

The continued development of the maritime pine industry was supported under the *Salinity Strategy* (2000), but no new funds were designated.

Objectives

The broad aims of the Maritime Pine Program are to:

- establish a new commercial industry in rural areas that has multiple benefits to the State; and
- improve recharge control in the medium rainfall zone by providing a commercially viable option for increasing water use.

Within the *Salinity Action Plan*, it was recognised that market forces alone would not be sufficient to drive commercial investment in the development of new, high water use industries based on woody plants. Therefore, a stated task (page 8) in the plan is that the “Government will invest funds to:

- create the climate and provide information to facilitate existing commercial solutions; and
- support development of new tree crop species and industries.”

The Maritime Pine Program falls into the latter strategy.

Implementation methods

Procedures

There is a substantial industry based on the maritime pine resource at Wanneroo (approximately 20,000 hectares). The log resource from this area is harvested and supplied to sawmills and a medium density fibre (MDF) plant. Early plantings of maritime pine for salinity management were seen as building on, then extending, this industry.

Staffing and location

The Department (and now the Forest Products Commission) has offices at Guildford, Esperance, Collie, Katanning and Albany associated with the program. There are approximately 20 staff employed in a full-time capacity on the project and remaining expenditure goes into local and regional communities through contractors and the purchase of materials and equipment.

Nursery

All seedlings are produced at the Department’s Plant Propagation Centre at Manjimup, where some \$12 million was spent in 1999–2000 on expanding the nursery facilities to accommodate cuttings production and an expanded program. The Manjimup Plant Propagation Centre can now produce an average of 8.5 million pine seedlings per year specifically for the Maritime Pine Program. The nursery can also potentially produce 500,000 seedlings¹³ per year for biodiversity plantings. The final number required depends on the size of the area to be established per year under the program.

Outputs and outcomes

Expenditure, outputs and activities

Planting cells established

In 1996 the Government announced the potential to establish 500,000 hectares of maritime pine over 30 years. The current plan is to establish 150,000 hectares over 10 years.

Since the initial plantings in the Perth area, the program has expanded to new planting cells. In 1996 it was extended to Albany on the South Coast and to the Collie/Darman and Katanning areas in 1997. In 1999 the program was extended to the Esperance region. There have also been plantings at Moora, Wickepin, and Kojonup. In 2000 there were also some 150 hectares

¹³ In the *Salinity Action Plan* (table, page 7) there is reference to “land conservation and biodiversity plantings, for example hardy species for salt prone areas, shelterbelts, plantings which add to existing remnant vegetation”. These seedlings fall into this category of revegetation.

planted in the Warren River Water Resources Recovery Catchment and about 340 hectares in the Lake Warden Natural Diversity Recovery Catchment (plantings completed at Lake Warden by 30 July 2000).

Progress in the various plantation cells is summarised below in Table 16.

Table 16: Hectares of maritime pine planted in each plantation cell by planting year

Planting year	Hectares planted by cell				TOTAL
	Mid West	South Coast	Lower West	Esperance	
1995	266				266
1996	515	104			619
1997	627	511			1,138
1998	1,142	540	289		1,971
1999	1,358	768	227	496	2,849
2000	2,550	635	561	1,170	4,916
TOTAL	6,377	2557	1157	1,666	11,757

The total area due to be established in 2001 is 5,000 hectares.

Shareholders involved

As at July 2000 there are some 255 individual sharefarmers with maritime pine established on their properties.

Supplementary plantings (biodiversity)

In 1996 the option of including supplementary plantings of up to 10% of the area planted to maritime pine was introduced. These plantings were seen to offer landcare and biodiversity benefits. This was initiated to enhance the existing package and make it more saleable to landowners as well as addressing broader conservation needs. Up to December 1999 some 650 hectares were planted to supplementary species¹⁴ and the plantings were primarily associated with drainage lines. In 2000 the supplementary planting program was broadened to include a \$70 per hectare biodiversity payment that could include fencing native vegetation and conducting salinity surveys as well as carrying out tree planting. This work could be ‘in kind’ and had to be completed under an approved management plan.

Expenditure

In 1999–2000 expenditure, excluding funds allocated to the Propagation Centre upgrade, was some \$6.152 million. The expenditure budget for 2000–01 is set at \$7.520 million. Previously funding was raised through the sale of Departmental assets. For 2000–01, \$4.520 million was to be borrowed. In future, funding is most likely to be sourced from investors or from the Government as a community service program. The Forest Products Commission will continue with concerted efforts to attract investor funding and its success will rely largely on whether

¹⁴ Australian native species with a mix of biodiversity, land conservation, and prospective commercial values.

international agreement can be reached on the extent to which carbon sequestered by trees can be used to off-set carbon emissions.

Benefits and highlights

The program has been promoted as a crop share scheme based on the inputs of the Department and the farmer. Potential returns include wood production, biodiversity conservation and landcare benefits. The concept of carbon credits is seen as an important part of attracting investor funding for the program.

The program has potential to diversify farm incomes, provide regional development in the long term and, more recently, has provided considerable local employment with many farmers opting to prepare the land and plant trees themselves. The program also encourages landowners to develop their own expertise in tree planting and to consider long-term land use options for deep-rooted perennial species with commercial value within their farm plan.

Recommendations for the future program

As noted in the background, this program now lies within the Forest Products Commission, and not within the Department. While the program has been included in this review to complete reporting of the Department's activities against the *Salinity Action Plan* to 30 June 2000, recommendations concerning the future of the program are now the province of the Commission.

Nevertheless, an industry based on maritime pine remains one of the key elements of an effective revegetation package in the medium rainfall zone. It is essential that the commercial drivers for large-scale revegetation are developed as a matter of priority, and that the State capitalises on the potential synergies between the various projects aimed at developing such new industries. Continued support for the program as endorsed under both the *Salinity Action Plan* and *Salinity Strategy* is recommended.

CONCLUDING REMARKS AND STRATEGIC RECOMMENDATIONS

Progress against salinity

The preceding chapters have described important achievements. While to this point progress in particular programs managed by the Department has been the focus, this chapter takes a broader view, and considers the Department's programs and role in the context of salinity management in general.

Despite the valuable outputs from work to date, it is also clear from the review that we must do better in key areas to achieve the goals of the *Salinity Action Plan* and *Salinity Strategy*. While the programs reviewed all contribute to the achievement of sustainable land use and conservation of natural diversity, outside one or two recovery catchments there is little direct evidence that salinity is being slowed or reversed. This is not peculiar to the Department's activities; it applies to all current activities—private and government—carried out under the salinity management banner.

Reasons for this situation across the full range of salinity programs, both private and government, include:

1. Broad scale adoption of integrated salinity management practices has not occurred. This is largely because there are no economically viable solutions for either recharge control or discharge management that are widely applicable.
2. It takes a long time to bring about physical change at local scales, and even longer at landscape scales. Solutions are very slow to take positive effect. For example, revegetation in the <500 mm annual rainfall zone is unlikely to lower water tables for at least five years following planting. And in the current situation, stabilisation of the water table (which may also take at least five years) is a positive outcome in any case.
3. With the exception of some recovery catchments and some specific projects, there are no rigorous goals or accepted environmental management frameworks being used to define problems, generate management priorities, and set performance indicators. Even in recovery catchments the management framework is not adequate, although goals and recovery criteria ensure that management is focussed and accountable. At the scale of the whole salinity management program, there has been no assessment of priorities for action. The significant problems this creates are underlined by the fact that, while (1) above is the pre-eminent barrier to success, it receives few funds under the *Salinity Strategy*.
4. We are learning the science of salinity as we tackle it. While there is broad consensus on the general principles of salinity development and management, there is no consensus on either the detail of salinity development or its management. This situation has been exacerbated by a more recent focus on the bleaker outcomes of salinity. This has encouraged amongst researchers and managers feelings of despair and futility that are unhelpful to achieving progress.
5. Various leaders have made an important contribution to salinity management. However, for successful salinity management, more strong leaders and visionary personalities are required. Unfortunately, the uncertainties generated by points (1) to (4) make leadership roles difficult.

6. It is difficult for community and other groups to remain, over extended periods, active and fully engaged in salinity management. This includes sufficient capacity and experience among rural government officers to service effective salinity management. (1) to (5) above and (a) to (e) below are all barriers to overcoming these points, as is our lack of knowledge concerning the relationships between socio-cultural processes and natural resource management. The last point is underlined by use of public participation and group action models with communities that cherish their individuality and independence, and by the application of overly simplistic models of top-down versus bottom-up social processes.

While (1) to (6) are the key issues that need to be addressed, they are compounded by:

- a. The lack of an effective regulatory environment in which to operate. Difficulties with the Soil and Land Conservation Act and Regulations in relation to drainage and land clearing are the most obvious examples. There has also been an inclination to view regulation merely as a negative enforcement tool, rather than as one element of a package to deliver a broader public outcome.
- b. The tendency, in the face of complex, difficult issues that require long-term solutions, to focus on process rather than goals. This is expressed through the disproportionate energy that has gone into describing the salinity problem, and planning, facilitation and coordination activities.
- c. People casting around for comparatively simple things to change, rather than tackling core problems. For example, while institutional reform can have value and institutional arrangements can always be improved, as a mechanism for tackling salinity this is a minor activity despite the attention it has received. At a purely organisational level, improved training, recruitment and retention of quality staff, particularly in rural areas, would bring about far more profound and positive change within organisations than any institutional reforms. Issues in this general area are also compounded by a tendency to assert a problem without defining or generating a range of alternative solutions.
- d. A rural culture degraded by a range of factors including lack of succession on farms (that is, sons and daughters moving back onto farms), low profitability, ageing communities, and an increasingly urban-centric view of life that is ever more disconnected from the agricultural way of life.
- e. People's dissatisfaction with formal political processes, leading to development of alternative methods of accessing resources and power. Unfortunately, as with (c), this is done without investigating what the real problem might be, and assessing how to fix it, rather than by-pass it. Generally the latter process has tended to cloud issues and duplicate structures rather than resolve them.

Improving outcomes

There are five areas in which the Department can make significant contributions to improved outcomes in relation to the issues raised above and salinity management in general.

Developing effective natural resource management goals and environmental management frameworks

As noted in the Introduction, it is vital to develop clear goals in natural resource management. It is also important that goals are attached to timescales and probability of achievement. Not only is it important to articulate goals relevant to on-ground implementation; these must be amenable to change in the light of new knowledge and circumstances. Given its direct

involvement with land management and biodiversity conservation, the Department is well placed to help elaborate appropriate goals for natural resource management.

Furthermore, in current discussions of salinity management, there are two issues that are tending to encourage an unnecessarily bleak view of our efforts to combat salinity:

- People are becoming so focussed on combating salinity as the environmental issue of the moment that they forget that, even if we cannot stop development of salinity, all the activities designed to combat salinity will still be of value in the broader context of achieving more sustainable, profitable land use and conserving natural diversity.
- Some forms of salinity management are predicted to hold off salinity for only 30–60 years. People are seeing this as sufficient reason not to take action, but in doing so deny the enormous technological progress that has been made over the past 20 to 30 years and the likelihood that there will be major advances during the first half of the 21st century.

This emphasises not only the need for rigorous goal formulation, but also the need to view their achievement over periods that reflect the timescales of technological development and adoption.

It is also essential that goals for natural resource management are developed within an environmental management framework that:

- identifies all relevant, key components of the environmental system;
- describes the cycles that drive component interactions;
- articulates the threats to goal achievement, and their relative impacts;
- takes into consideration the difficulty of integrating different land use goals;
- allows priority strategies to be identified and reviewed from time to time in a flexible, iterative process. This entails effective risk management linking values, threats and management strategies; and
- enunciates performance indicators that effectively link goals, on-ground outputs and outcomes.

Aspects of such a system relevant to Western Australia are described in Main (1992), Young and Millar (1997), Salafsky and Margoluis (1999) and Wallace and Beecham (submitted for publication). These articles and their associated references provide a firm basis for developing an appropriate environmental management system. The Department should develop such an environmental management system for management of natural diversity in line with statutory responsibilities. Such a system will not only assist planning within the Department; it will also contribute to the development of a model for decision-making and priority setting in relation to salinity management and natural resource management as a whole. It is imperative that current priority-setting processes continue to be improved.

A difficult challenge in this process will be to devise performance indicators and outcome statements that satisfy the needs of effective management and the demands of political cycles. Among Departmental salinity programs, the Natural Diversity Recovery Program has the most effective mechanisms for meeting this combined demand. If the Crown Reserves Program is restructured as outlined in the recommendations in that chapter, then targets may be set and performance evaluated using techniques similar to those in the recovery program.

Provided research and monitoring programs, including industry development, are connected to outcomes through an environmental management system, their targets and evaluation should be clear. Performance indicators for Land for Wildlife, particularly in relation to outcomes, are more difficult given their socio-cultural orientation.

However, a message from Agriculture WA's Focus Catchment Program is that targeted investments that ignore a large percentage of landholders create political issues. While

programs for salinity managed by the Department are, by their nature, strongly targeted to areas of high public value, and should remain so, it is still important to offer programs and assistance to all landholders. This is an important value of the Land for Wildlife Program.

In summary, the Department is well placed to help elaborate natural resource management goals and contribute to the development of an environmental management system for Western Australia. Both are critical to improved management, identification of politically acceptable outcomes, and significantly improved strategic allocation of funding.

Developing technical solutions to ameliorate recharge and discharge

For some time it has been widely recognised that salinity management must address the twin issues of recharge control and discharge management. Rarely will management of either alone be the most cost-effective solution at landscape scales. The range of techniques for achieving both is described in the *Situation Statement* (see in particular its Appendix). Although the broad issues are understood in principle, there has been quite inadequate effort to develop economically viable industries that deliver recharge control and discharge management sympathetic to natural resource management goals.

A failing of the *Salinity Action Plan* was that, while it foresaw the need to allocate significant funds to these endeavours, it left funding almost entirely to the proposed Commonwealth bid and no 'core' funds were allocated. While the *Salinity Strategy* at least addresses the issue of funding industry development for recharge control (perennial woody vegetation), no new industry development funds are identified for industry development in relation to discharge management.

Although the industry for which the Department has immediate responsibility—the commercial development of woody plants—is addressed by the *Salinity Strategy*, the level of funding proposed is inadequate to achieve the developments necessary for salinity management. Under the *Salinity Strategy* \$1.05 million (includes \$0.05 million for seed collection) is proposed for allocation to the development of new industries based on native plants. While this is a significant improvement on the current situation, the reality is that development of a single new industry—and several are required—will cost in the order of \$20 million over 10 years.

Consequently, to develop the 10 best commercial prospects, of which it would be expected that at least two would develop into full industries, will cost an estimated \$20 million per year for 10 years.

It is therefore vital that:

- funding for development of woody plant industries is substantially increased to deliver the recharge control outcomes necessary for salinity management; and
- the program is strongly supported by committed leadership within the Department.

The importance of husbanding the successful development of the Search Project (see pages 157–162) to fruition, and of aggressively developing commercial industries that integrate sustainable land use and conservation of biodiversity, cannot be over-emphasised. It is no exaggeration that the Department's success in these areas, and its ability to deliver multiple objectives, will be a major factor in determining the effectiveness of the organisation in conservation throughout the agricultural region for at least the next 25 years.

While the need to develop environmentally sensitive and profitable industries based on discharge control lies less clearly within the Department's statutory functions, their development will have a significant, long-term impact on values managed by the Department.

It is vital that the Department takes a pro-active role in their development through natural diversity recovery catchments to:

- Ensure that we use cutting-edge, engineering technology to achieve environmental outcomes in recovery catchments.
- Research, test and develop discharge control techniques and industries that are environmentally sound. For example, the Department has a strong interest in developing aquaculture industries that support salinity control without introducing biota or techniques that are environmentally damaging. Similarly, it is clear from events to date that the Department has a strong interest in the development of drainage technologies and industries that deliver salinity management outcomes without threatening other land use values.
- Ensure that engineering practices—for example, drainage methods—are integrated with a range of salinity management techniques, and that on-site technologies are developed to treat waste products.
- Maintain a government push for integrating salinity management technologies. The Department is the agency land manager with the strongest interest in integrated solutions to salinity. However, it is essential that the push to implement integrated solutions is a collaborative effort between the Department, Agriculture WA and the WRC.

Finally, it is important to note that the Department, given its statutory roles, is the organisation best placed to:

- Lead integrated land use/conservation/industry development in a way that focuses simultaneously on outcomes for sustainable land use and conservation of natural diversity. While elements of this capacity also lie within other agencies, and these are essential to effective progress, the Department is the only organisation with significant operational capacity and multiple goals that include both conservation and delivery of land uses. However, the human and other resources to maintain and expand effective implementation are fragile—it is important that they are bolstered; and
- Test and implement on-ground technologies, largely through recovery catchments, a re-structured Crown Reserves Program, and forest/plantations research and development expertise. However, it should again be noted that both the WRC and Agriculture WA are also essential to achieving this outcome. They have been vital to success within the Department's existing recovery catchments, and their important role should be publicly acknowledged. Also, both have some capacity to deliver on-ground results in this area, and they should be encouraged to do so through the recovery catchments they manage.

Encouraging an appropriate culture

Our current Australian culture is not fully consistent with the achievement of sustainable land use and biodiversity conservation. As stated in Burbidge and Wallace (1995, page 12):

In western societies such as Australia, the goal of conservation of biological diversity will be achieved only if most individuals accept, for whatever reason, that this goal is in their personal best interests. The combination of private ownership of businesses and agricultural lands, individual long-term leases of pastoral lands, western concepts of 'individual rights' and the cultural importance of material wealth, make this essential.

To facilitate the appropriate changes in culture will be a significant challenge. This is not an area in which the Department has particular expertise; however, we can assist and encourage the research and development of:

- socio-cultural frameworks that effectively describe the functioning of rural-urban systems in terms of natural resource decision-making and adoption of new innovations;
- methods for developing and maintaining robust and resilient rural communities; and
- links between quality of life at the individual level and natural resource management, particularly conservation of natural diversity.

All of the salinity programs, but particularly Land for Wildlife, have an important role in contributing to the development of an appropriate culture.

Enact effective legislation and regulation

Over recent years it has become obvious that State legislation and associated regulations are not effectively underpinning natural resource management objectives. While incentives and regulation tend, in the current social and political environment, to be played off against each other, evidence suggests that changes in human practice at the community level must entail a mixture of both plus effective programs of education and, where appropriate, training (for example, the mix used to combat cigarette smoking).

Among this mix of elements, enforcement and regulation tend to be the worst managed. While the Department's legislation and regulatory management is least in question, the issues should be taken into consideration in the replacement of the Wildlife Conservation Act with new biodiversity conservation legislation, and the Department should encourage the development of greatly improved regulatory management through the Soil and Land Conservation Act and other relevant legislation.

Furthermore, while there have been numerous reviews of incentive systems (for example, the work by Carl Binning and Mike Young of CSIRO), there has been no serious attempt to analyse what mix of incentives (including disincentives) may deliver better natural resource management in Western Australia.

Maintaining and developing partnerships

General

Comments occur throughout this review on the valuable outcomes that have arisen from partnerships between the Department and other bodies. Groups involved have included public and private, and range from individuals through small groups to large agencies. While the lessons learnt to date are reasonably self-evident, five are forgotten frequently enough in practice to list here:

- Individual self-interest is the prime motivation for action and involvement, whether stakeholders are private or public. Unless a project or proposal meets a sufficient level of self-interest of those involved, then success is jeopardised. While people do not have to be involved for the same reason, they do have to be involved for a reason that meets their personal needs. Effective recognition and management of individual interests is essential in both one-to-one and group dealings.
- One-to-one planning is usually essential where freehold landholders are involved in implementation on their own land. While group processes are important, there is a limit to what they can be expected to deliver.

- Groups to deliver on-ground outcomes should be formed, and plan, at the scale of the issue. For example, in one catchment a drainage issue was not resolved until the matter was reduced from a catchment debate to a sub-group of the actual players.
- Goals must be clear. This seems obvious, but there have been important cases in natural resource management where projects have foundered because goals were either not clear, or not explicitly agreed between participants.
- Enthusiasm of at least one participant in a project, and preferably more, is vital to success.

The importance of continuing to build and improve relationships with private and public groups in the delivery of on-ground projects is emphasised. Such relationships will be of increasing importance, particularly if the recommendations to restructure the Crown Reserves Program are adopted. While the development of one-to-one and group relationships is resource expensive, they are essential to fully effective delivery and two-way transfer of information and knowledge. It would be valuable to train Departmental staff to develop their understanding of group and one-to-one interactions. However, it should be noted that this does not necessarily mean training in facilitation and coordination. At first, Departmental staff must understand their own goals and need to be confident in explaining and using them as a basis for developing projects of mutual benefit with groups and individuals.

Regional groups

The role of natural resource management groups at a regional level has developed considerably since 1995. However, while they have provided a valuable forum for information flow and the development of ideas, and managed some projects, they are yet to articulate fully a clear role for themselves in natural resource management. A range of the relevant issues is discussed in Jenkins and Moore (1999) and Wallace (submitted for publication).

The useful role regional groups can play in developing and testing ideas and in information exchange has generally been under-rated. It is proposed here that the Department help regional groups and government expand this role and better define what additional roles regional groups can effectively undertake. To do this, it is imperative that the Department first clarifies its own goals and objectives in relation to biodiversity conservation in the agricultural region. The corporate planning process should achieve this outcome.

At the same time, regional groups should be encouraged to engage in rigorous goal setting and analysis of their roles. Where groups are seeking to undertake roles requiring statutory powers, it is imperative that the ramifications of this are clearly analysed and the reasons and values of such an approach are properly evaluated. In particular, it is vital that the inter-relationships between regional groups and existing tiers of government are examined.

Recommendations

The following are recommended:

Recommendation 31

Funding to salinity programs managed by the Department should be expanded as outlined in Table 1. These amounts take into consideration recommendations made in the *Salinity Strategy* as well as in this document (see individual chapters for details).

Table 1: Current and proposed funding for salinity programs managed by the Department

Program	Budget 2000–01*	Proposed Budget 2001–02	Proposed Budget 2002–03	Proposed Budget 2003–04	Proposed Budget 2004–05	Proposed Budget 2005–06
Crown Reserves	1.250	1.250	1.250	1.250 Review	1.250 as adjusted	1.250 as adjusted
Recovery Catchments	2.50	3.00	3.50	4.50	5.50	5.50 Review
Land for Wildlife	0.15	0.50	0.50	0.50	0.50 Review	0.50 as adjusted
Biological Survey	0.50	0.50	0.50	0.50 Review	0.50 as adjusted	0.50 as adjusted
Wetland Monitoring	0.25	0.292	0.305	0.33	0.33 Review	0.33 as adjusted
Monitoring (Salinity Strategy M&E project)	0	0.10	0.10	0.10	0.10 Review	0.10
Woody plant industry development	0	3.00	5.00	10.00	15.00	20.00 Review
Threatened flora seed collection, storage and databasing	0	0.16	0.16	0.16	0.16 Review	0.16
Databasing of threatened and priority flora in saline environments	0	0.05	0.05	0.05	0.05 Review	0.05
Databasing of threatened and priority fauna in saline environments	0	0.025	0	0	0	0
Carnaby’s cockatoo ‘flagship’ project	0	0.015	0	0	0	0
TOTALS	4.65	8.892	11.365	17.39	23.39	28.39

*The *Salinity Strategy* recommended that additional funds be granted in 2000/01. As at December 2000, these funds have not been granted; therefore it is proposed here that these funds become available in 2001/02.

Recommendation 32

The Department should develop goals and an environmental management system suitable for effective delivery of sustainable land use and conservation of natural diversity. The product should also be used to help develop both a model for managing natural resource management issues and a mechanism to rank programs and activities for salinity management.

Recommendation 33

Additional funding of \$20 million per year (scaled up over five years, with a total expenditure of \$200 million over 15 years) should be sought for research and development of new industries based on native plants. At the same time, the position of Government on ownership of intellectual property and on-ground resource development needs to be clarified. This is required to guarantee adequate return to the State on investment while still ensuring that substantial and focussed commercial development occurs. Government should use public intellectual property to give exclusive commercial advantage that carries with it an obligation to meet social and environmental bottom lines.

Recommendation 34

The Department should contribute strongly to the development of new, sustainable agronomic systems and industries that are sympathetic to conservation. Recommendation 33 is an important component of the Department's contribution; however, it is also crucial that the Department contributes to the development of new industries based on environmentally sound treatment of saline discharge. Recovery catchments and a reconstructed Crown Reserves Program should be the key mechanisms for implementing this recommendation.

Recommendation 35

The Department should assist and encourage the research and development of:

- socio-cultural frameworks that effectively describe the functioning of rural-urban systems in terms of natural resource decision-making and adoption of new innovations;
- methods for developing and maintaining robust and resilient rural communities; and
- links between quality of life at the individual level and natural resource management, particularly conservation of natural diversity.

Recommendation 36

The Department should expand its capacity to develop and maintain partnerships and collaborative projects by:

- providing additional resources (internal re-allocation) to support partnership building;
- training staff in building and maintaining partnerships and collaborative projects;
- where practicable and appropriate, encouraging staff to participate in community groups involved in natural resource management; and
- participating in regional groups and, in particular, helping them and government better define the roles and functions of these groups.

Recommendation 37

The Department should encourage and assist the development of effective legislation and regulation, particularly with respect to land clearing and drainage. This should also be undertaken in conjunction with a review of the broader array of mechanisms—such as tradeable quotas, targeted tax rebates and cross-compliance—that may be applied to improve natural resource management in Western Australia.

Recommendation 38

A senior officer should be appointed to manage the complexity of the salinity management program and to provide an organisational focus for natural resource management within the Department. This officer would need support from one junior officer (level 3 or 4) skilled in databasing and spreadsheet operations to manage collation and analysis of data and to assist with administration and information management.

Recommendation 39

The Director of Nature Conservation should review budgets annually. Adjustments between Departmental programs should be made as appropriate and as endorsed by the Executive Director.

Recommendation 40

The total program managed by the Department should be reviewed in detail during the 2005–06 financial year. In the case of specific programs, earlier reviews are desirable—review years are provided in Table 1. The earlier reviews are for those programs whose funding has been stable for three consecutive financial years.

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