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Viability of revegetation incentives for meeting biodiversity and salinity objectives in the Goulburn-Broken Dryland

Michael Lockwood, Megan Hawke and Allan Curtis

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1. Introduction

This report is part of a project being undertaken by the Charles Sturt University Johnstone Centre and the Department of Natural Resources and Environment (DNRE). The research examined ways in which salinity mitigation and biodiversity conservation can be achieved in the dryland portion of the Goulburn Broken Catchment.

The project had four main stages.

1. A literature review and interviews with key stakeholders were undertaken to identify social factors affecting the implementation of the Goulburn-Broken Dryland Salinity Management Plan (GBDSMP), particularly with respect to the poor adoption rates for best management practices (BMPs).

2. Landholders were surveyed to explore the social factors identified in Stage 1, including the constraints that have prevented landholders adopting BMPs. The results of the survey have been published in Curtis *et al*. (2001).

3. A literature review of natural resource management policy approaches in Australia and a workshop with experts were used to identify policy options that would improve the adoption of BMPs in a revised GBDSMP. The review has been published as MacKay *et al*. (2000) and a summary of the workshop is given in Lockwood & Hawke (2000). A review was also undertaken of the potential of carbon credits to contribute to salinity mitigation (Hawke 2000a).

4. One of the requirements for salinity mitigation is to increase the area of perennial vegetation in the catchment. If this can be achieved, at least in part, through re-establishing native vegetation, then biodiversity objectives will also be addressed. A survey was undertaken to assess the extent to which the required level of revegetation could be achieved through re-establishment of native vegetation, and the amount of public investment that would be required.

This report addresses the fourth stage.

The Goulburn-Broken Catchment (GBC) is about 2.4 million ha in area (17% of Victoria), including 1.9 million ha of dryland (non-irrigated land) (GBCLPB 1996a; GBCMA 1998). The Goulburn Broken Dryland (GBD) has been estimated to contain 6,449 rural properties (Curtis *et al.* 2000). GBD agricultural enterprises include grazing, cropping, dairy, and a small amount of forestry and horticulture (SPPAC 1989; GBCLPB 1996a).

Salinity in the GBC is: threatening the viability of agriculture; adversely impacting water quality; damaging public, domestic and commercial infrastructure; and causing biodiversity loss (SPPAC 1989; Williamson *et al.* 1997; DNRE 2000). Areas affected by salinity often become subject to other forms of land degradation, such as soil erosion and exotic weed infestation (MDBMC 1999). Salinity is primarily the result of native vegetation clearance for agricultural activities since European occupation (Mackay & Eastburn 1990; Ghassemi *et al*. 1995; GBCLPB 1996a; MDBMC 1999; Walker *et al*. 1999).

The *Goulburn Dryland Salinity Management Plan Draft* was released in response to growing concern about increasing dryland salinity. This draft has since been superseded by the *GBDSMP - Five year review and future direction* (GBCLPB 1996a); the *GBDSMP - Five year review and future direction summary* (GBCLPB 1996b); the *GBDSMP - Implementation annual report* (GBCMA 1998); and the *GBC Management Authority final strategy* (GBCLPB 1998).

GBD stakeholders including private landholders, government agencies and the Catchment Management Authority (CMA) identified that adoption of BMPs has not occurred at the GBDSMP target rates (GBCMA 1998; Curtis *et al.* 2000). BMPs for dryland salinity management in the GBC include: the sowing of perennial pastures; farm forestry; the fencing of remnant native vegetation and waterways to manage stock access; the changing of grazing and fertiliser regimes to encourage native perennial grasses; and the instillation of ground water pumps to lower ground water levels (Curtis *et al.* 2000). The inadequate adoption of BMPs by GBD landholders is an indication that dryland salinity is not being satisfactorily addressed.

Large-scale reforestation is recognised as an essential component of any strategy to address salinity (NSCP 1990; Bari 1998; MDBMC 1999; DNRE 2000; NNRMTF 2000). Most other agricultural BMPs cannot reduce current rates of rainfall leakage at a catchment-scale to anything approaching leakage under native vegetation (NV) or some other form of tree cover. Trees situated on ground water recharge sites will reduce recharge (Walker *et al*. 1999). Options to achieve reforestation include:

- establishment of plantations of commercial species, either softwoods such as Monterey Pine (*Pinus radiata*) or native hardwoods such as Blue Gum (*Eucalyptus globulus*) or Shining Gum (*Eucalyptus nitens*);

- integrating commercial production of timber with grazing (agroforestry); and

- re-establishing native vegetation.

To enable commercially viable growth rates, plantations and agroforestry plantings need to be established in areas with sufficient rainfall or accessible non-saline groundwater. Areas with commercial forestry potential have rainfall of 750 mm or more per annum (SPPAC 1989). The northern and western portions of the GBD receive less than 750 mm rainfall. Re-establishing native vegetation can therefore address biodiversity conservation issues, as well as being a more suitable mechanism for salinity mitigation than plantations or agroforestry across much of the GBD. However, landholders do not have the capacity, in terms of time, money and in some cases expertise, to undertake widespread re-establishment of native vegetation (Curtis *et al*. 2000, Lockwood & Walpole 2000). This research establishes the extent to which GBD landholders are willing to re-establish native vegetation, and how much financial support they would require.

2. Revegetation targets in relation to biodiversity and salinity priorities

Less than 30% of pre-European cover of native vegetation remains in the GBC. The GBC contains 95 flora species and 85 fauna species classified as threatened (GBCMA 1999). It is anticipated that further biodiversity loss will occur in the GBC due to the impact of dryland salinity upon native vegetation (NNRMTF 2000).

The native vegetation in the GBC has been classified into 13 Broad Vegetation Types (BVTs), with a separate category for wetlands. BVTs below 30% of their pre-European cover are considered to be moderately depleted, and those less than 10% severely depleted. A long-term biodiversity goal would therefore be to have all BVTs at least 30% of their pre-European cover. Three GBC BVTs - Plains Grassy Woodland, Herb-Rich Woodland and Valley Grassy Forest had, as of 1993, less than 10% of their pre-European cover remaining (Table 1). Box Ironbark Forest is moderately depleted, with an extant cover of 22%.

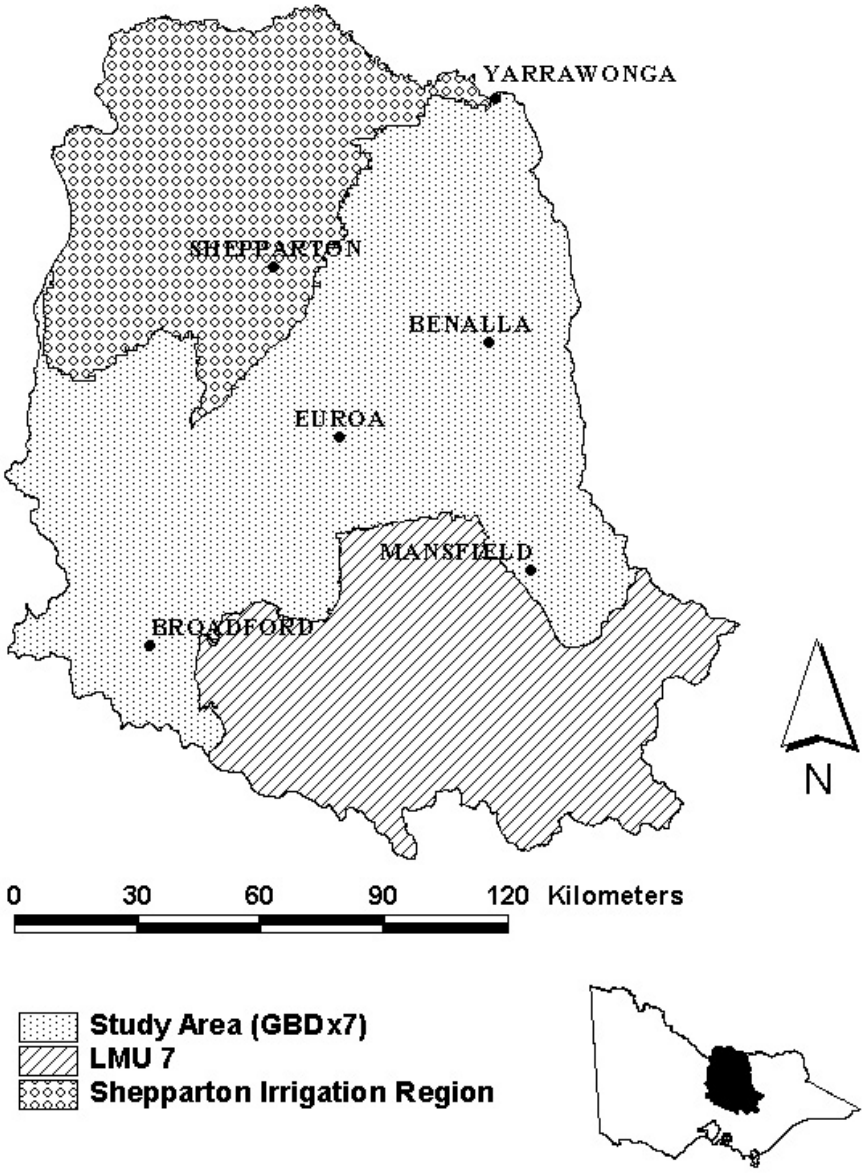
In the short to medium term, it is unrealistic to set a 30% target for these severely depleted BVTs. The *Draft Goulburn Broken Native Vegetation Management Strategy* (GBCMA 1999) has as one of its goals to increase the area of severely depleted BVTs to at least 15% of their pre-European cover by 2030. This was seen as being a 'challenging', but 'reasonable goal'. Even with this level of revegetation, 'some ecosystem breakdown (resulting in some loss in species) would be expected' (GBCMA 1999, p. 30). The area of the next most depleted BVT, Box-Ironbark Forest, is also probably not sufficient to maintain full ecosystem function. A desirable medium term target for Box Ironbark Forest is therefore to increase its cover to at least 30%. If this was achieved, Box Ironbark Forest could be taken off the 'moderately depleted' list.

Table 1. GBC BVT cover (GBCMA 1999)

BVT	Pre-European area (ha)	Extant on public land (ha)	Extant on private land (ha)	% extant	Target
Plains Grassy Woodland	848,336	7,112	10,374	2%	15%
Herb-Rich Woodland	97,287	3,171	4,131	8%	15%
Valley Grassy Forest	17,638	532	1,002	9%	15%
Box Ironbark Forest	288,082	48,469	15,738	22%	30%
Inland Slopes Woodland	22,034	3,927	3,100	32%	-
Riverine Grassy Woodland	129,293	43,545	4,896	37%	-
Dry Foothill Forest	709,159	268,815	82,249	50%	-
Moist Foothill Forest	209,315	134,501	17,783	73%	-
Sub-Alpine Grassy Woodland	2,323	2,166	0	93%	-
Montane Moist Forest	5,635	5,199	60	93%	-
Sub-Alpine Woodland	6,445	6,393	0	99%	-
Montane Grassy Woodland	6,592	6,559	0	99%	-
Montane Dry Woodland	66,255	65,933	17	100%	-
Total area (ha)	2,408,394	596,322	139,350		-

The study area adopted for Stage 4 of the work was the private property in the GBD excluding LMU 7 (Figure 1). LMU 7 was not included in the Stage 4 survey because it contains low priority BVTs and is located in a high rainfall part of the catchment, making plantation forestry a more attractive option than revegetation with native species. All data presented in the rest of this report concern the GBD excluding LMU 7, which will be hereafter referred to as the GBD_{x7}.

Figure 1. Goulburn Broken Catchment



The areas of pre-European and extant native vegetation in the GBD_{x7} are shown in Table 2, and the current distribution of native vegetation on private property is shown in Figure 2. Plains Grassy Woodland, Herb-Rich Woodland, Box Ironbark Forest and Riverine Grassy Woodland have been most heavily cleared. Since the BVTs are not distributed evenly over the GBC, some are better represented in the GBD_{x7} than they are in the catchment as a whole.

Figure 2. Study area showing distribution of extant native vegetation on private land (as of 1993)

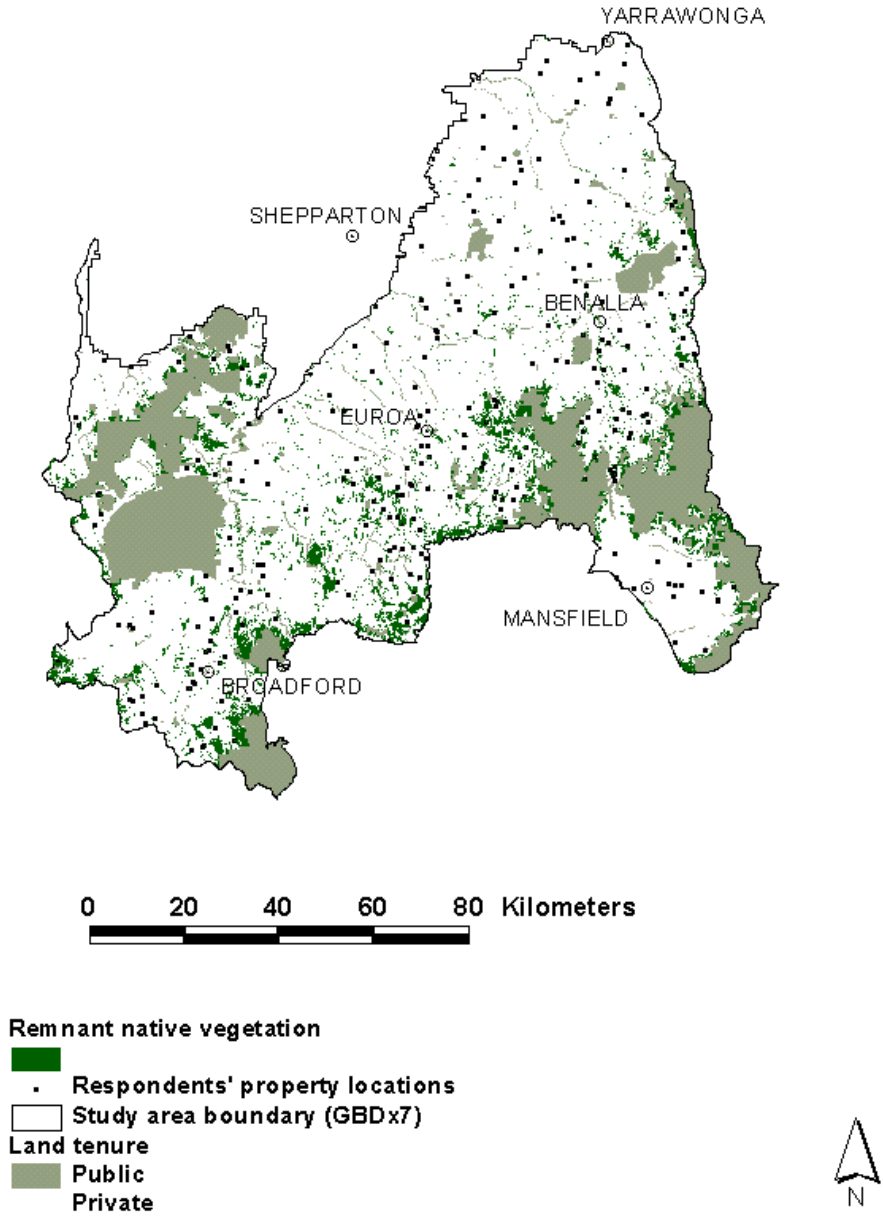


Table 2. Area of Pre-European and extant native vegetation in the GBD_{x7}

BVT	Pre-European area (ha)	Pre-European area on private land (ha)	Extant area on private land (ha)	Extant area on public land (ha)	% remaining in GBD_{x7}	% remaining on private land	GBD_{x7} revegetation targets (ha)
Plains Grassy Woodland	377,257	354,756	6,262	22,501	7.6	1.8	56,589
Herb-Rich Woodland	93,209	80,485	3,803	12,724	17.7	4.7	13,981
Valley Grassy Forest	17,638	14,463	2,330	2,904	29.7	16.1	2,646
Box Ironbark Forest	274,160	197,703	13,652	76,457	32.9	6.9	82,248
Inland Slopes Woodland	25,619	20,283	3,548	5,336	34.7	17.5	
Riverine Grassy Woodland	7,827	7,178	640	650	16.5	8.9	
Dry Foothill Forest	286,577	216,450	36,854	60,957	34.1	17.0	
Moist Foothill Forest	105,560	66,575	16,385	36,658	50.2	24.6	
Total	1,187,848	957,893	83,475	218,187	25.4	8.7	155,464

Table 4. Cleared private land in the GBD_{x7} in relation to biodiversity priorities, salinity priorities and forestry potential

Salinity Priority	Very High		High		Low		Total
Forestry Potential	No	Yes	No	Yes	No	Yes	
BVT	Cleared area ha (%)	Cleared area ha (%)	Cleared area ha (%)	Cleared area ha (%)	Cleared area ha (%)	Cleared area ha (%)	Cleared area ha (%)
Plains Grassy Woodland	271,709 (98.2)	1,328 (99.4)	23,532 (98.7)	1,547 (95.3)	17,970 (96.2)	32,408 (99.4)	348,494 (98.2)
Herb-Rich Woodland	66,621 (96.3)	507 (98.7)	3,455 (98.2)	211 (89.7)	2,840 (99.6)	3,049 (72.3)	76,682 (95.3)
Valley Grassy Forest	2,655 (98.1)	3,666 (91.7)	1,985 (93.2)	2,624 (59.7)	1,185 (98.8)	18 (46.8)	12,133 (83.9)
Box Ironbark Forest	96,940 (89.9)	1,680 (98.0)	40,759 (97.4)	10,758 (89.7)	33,913 (98.9)	0 (0)	184,051 (93.1)
Inland Slopes Woodland	2,218 (93.7)	79 (37.1)	182 (86.3)	526 (99.2)	13,689 (80.9)	42 (93.8)	16,735 (82.5)
Riverine Grassy Woodland	5,284 (96.5)	591 (96.9)	0 (0)	0 (0)	0 (0)	664 (60.6)	6,538 (91.1)
Dry Foothill Forest	42,825 (92.7)	45,679 (85.1)	9,847 (81.1)	6,172 (54.3)	33,070 (89.9)	42,003 (74.6)	179,596 (83.0)
Moist Foothill Forest	310 (62.5)	1,031 (43.9)	2 (18.1)	1,316 (51.3)	6,146 (83.8)	41,385 (76.9)	50,190 (75.4)
Total	488,562 (95.6)	54,560 (84.7)	79,762 (95.3)	23,153 (70.8)	108,812 (92.2)	119,568 (80.7)	874,418 (91.3)

This means that the percentage of NV remaining in the GBD_{x7} (Table 2, column 6) is not an accurate indication of the regional status of the BVT. We therefore converted the GBC-wide targets to GBD_{x7} targets based on the relative proportions of each BVT in the two regions (final column in Table 2).

It is also important to consider the extent that priorities for biodiversity objectives match with salinity mitigation priorities. Priority areas for tackling salinity in the GBD have been identified according to Land Management Units (LMUs). LMUs have similar geological and hydrological features, and therefore similar salinity characteristics including common causes, effects and downstream consequences (SPPAC 1989). The GBD contains 14 LMUs, four of which have been identified as 'very high priority' for salinity control measures (Table 3).

Table 3. Priority LMUs for salinity control in the GBD (Curtis *et al.* 2000)

Priorities for salinity control	GBD LMUs
Very high priority	6, 7a, 10, 13
High priority	1, 2, 3, 5
Medium priority	7
Low priority or significance	4, 8, 9, 11, 12

The relationships between the area of cleared private land, BVTs, salinity priorities and forestry potential in the GBD_{x7} are shown in Table 4. All strata greater than about 2,000 ha have been predominantly cleared. There is a low proportion of land with forestry potential in areas of very high and high salinity priority, indicating the limited opportunity for using commercial plantations or agroforestry to meet salinity objectives in the GBD_{x7}. On the other hand, revegetation of very high and high priority BVTs, especially Plains Grassy Woodland and Box Ironbark Forest, would address both salinity mitigation and biodiversity conservation objectives.

3. Policy proposal

As noted in Section 1, the current range of opportunities and policy instruments have so far failed to achieve sufficient revegetation or adequate adoption of BMPs in the GBD. From Stage 2 of the research, Curtis *et al.* (2001) found that landholders had little or no economic capacity to invest in BMPs. GBD landholders are more likely to respond to appeals that address concerns about low on-property incomes rather than salinity.

Stage 3 of the research utilised an expert panel to identify potential new approaches (or the better integration of current approaches), which might be more successful in achieving the implementation of revegetation targets and BMPs. The expert panel considered the Stage 2 survey findings (Curtis *et al.* 2001) and the literature review (MacKay *et al*. 2000). Participants of the expert panel included representatives from: the DNRE; CSU; the Commonwealth Scientific and Industrial Research Organisation; the Strathbogie and Delatite Shires; the Murray-Darling Basin Commission; the Goulburn Broken Catchment Management Authority; the Department of Infrastructure; and Australian National University.

The potential policy options identified by the panel included the following:

- compensation for farmers rights;
- green accreditation;
- green card for property sale (based on key indicators);
- the encouragement of end user industries to invest in natural resource management;
- cross subsidies (for example, BMP requirements for recipients of financial assistance);
- covenants or management agreements;
- the establishment of a revolving fund for purchase, covenanting and resale of private land;
- landscape re-configuration to match land use capabilities;
- local government rate relief;
- re-development grants (to assist landholders during low or negative income periods);
- incentives for landholders to change land uses;
- performance payments based on results (for example, the reduction of salinity recharge could be rewarded);
- the implementation of a state environmental levy;
- the establishment of markets for native species (flora and fauna);
- forestry investment vehicles (for example, environmental credit integration);
- land lease/exchange bank (for example, lease from landholders not wishing to sell);
- rural life strata titles;
- State/local government restrictions on clearing;
- research and development into agricultural production alternatives;
- increased restrictions on sub-division;
- the development of a Natural Resource Investment Fund (NRIF) to (i) attract investment and establish and/or manage tradeable natural resource credits in salt, carbon or biodiversity and (ii) strategically allocate funds to support landholders' adoption of BMPs.

We chose to further explore aspects of the last item, a NRIF, because of its potential to address salinity mitigation and biodiversity objectives through the purchase of high priority BVT revegetation.

The two main roles of the NRIF would be to purchase public goods such as biodiversity conservation, and to attract the necessary investment to pay for these products. The NRIF could attract potential sources of funds from the Federal, State or local governments, conservation groups and trusts, industry and/or landholders. Part of the NRIF strategy could be to establish credit markets to attract additional investment. Exploring the potential capacity of such a body to attract investment was beyond the scope of available resources, including the requirement that the project was a suitable basis for an honours thesis (Hawke 2000b). The Stage 4 survey therefore focussed on the capacity of an NRIF manager to purchase the required levels of biodiversity conservation indicated in Section 2 (as well as the consequent salinity mitigation benefits). The specific questions addressed in the survey were:

- how much area would GBD_{x7} landholders be willing to revegetate with native species?

- what payments would they require to achieve this level of revegetation?
- is the revegetated area likely to meet the targets specified in Section 2?
- how much public funding might be required to secure the target levels of revegetation?

Under the proposal, the Goulburn Broken Catchment Management Authority (GBCMA) would establish a NRIF. The fund managers would advertise for tenders for the revegetation. Any GBD landholder could submit a tender. Tenders would need to specify the area to be revegetated and the price they are asking for undertaking the revegetation. The GBCMA would establish a revegetation task force, that landholders could sub-contract to do the work or alternatively landholders could undertake the work themselves.

The GBCMA would be seeking the revegetation of various BVTs, with priority being given to meet the targets detailed in Section 2. The GBCMA coordinating body would identify the successful landholders. Successful tenders will be selected based upon factors including the price asked by landholders, size of area to be revegetated and the location of the area.

Successful landholders would need to comply with management prescriptions detailed in an individual contract between the GBCMA and themselves. Management prescriptions for vegetation types would be outlined in the contract and could include: the overstorey and understorey plant species to be planted; grazing regimes; the extraction of timber products; fencing; weed and pest control; and insurance. Landholders would also be required to monitor the progress of revegetation and submit a report once every two years to the GBCMA for investors. The GBCMA will also be able to undertake spot audits. The contract between GBCMA and landholders could be reviewed as necessary.

There are several possible ownership arrangements regarding the revegetated area. The landholder could: retain full ownership and management responsibilities; lease the area to a third party who takes on management responsibilities; or sell the area to a third party. The contract would in effect prevent clearing of the revegetated area. This would be binding unless the area of BVT exceeded the target level, after which such areas could become eligible for clearing.

4. Survey development

4.1 Focus groups

Development of the survey was assisted by 3 focus groups undertaken on 19th June in Broadford, and on 20th June in Euroa and Tungamah. Benalla DNRE recruited the GBD participants. In recognition of their time and effort, participants were paid to attend. Five participants attended the Broadford focus group, 4 attended the Euroa group and 6 the Tungamah group. The Broadford group consisted of 5 males. The Euroa group consisted of 2 males and 2 females. The Tungamah group consisted of 5 males and 1 female. The ages of participants was estimated to range between 25 to 65 years.

All 3 focus groups were asked the same set of questions from a pre-prepared focus group script. The focus groups were utilised to explore the key research question, which was how much would it cost the NRIF to achieve a given level of revegetation in the GBD. Other

elements investigated included the landholder response to the policy proposal; response to a draft of the mail survey; and response to revegetation targets. The groups were also utilised to determine the key attributes that influence landholders' decisions to undertake revegetation on their properties. Useful amendments were made to the draft material resulting in an improved mail survey and understanding of issues affecting GBD landholders.

4.2 Components of the final survey instrument

The postal survey included background information, a map of the GBD, an insert explaining the policy proposal and 11 survey questions. The survey instrument questions related to:

- the importance of native vegetation values (Question 1);
- whether survey recipients were the same person that completed the 1999 survey (Question 2);
- the size of the property they owned or managed (Question 3);
- whether any government funded (conservation or Landcare) work had previously been undertaken on their property in the last 5 years, and if so what was the estimated dollar value (Question 4);
- if they intended to undertake revegetation in the next 3 years and if so how likely were they to do so (Question 5);
- choice modelling (CM) questions exploring a range of areas and payments associated with undertaken the policy proposal (Questions 6 to 9);
- the level of difficulty involved in completing the CM questions (Question 10); and
- the preferred area and payments associated with the policy proposal that landholders may not have been able to express in the CM questions (Question 11).

The collection of data on demographics and other relevant variables was not necessary because these were available from the Stage 2 survey (Curtis *et al*. 2001). Identifying whether the respondent was the same person who completed the Stage 2 survey was important to determine the validity of combining the two sets of survey data.

Ascertaining landholder values for native vegetation as well as being of interest in itself, can help validate responses to the revegetation questions. Identifying the size of the property owned or managed by landholders was important, to enable an understanding of what percentage of their property they would be willing to revegetate. Determining if there had been government funded work undertaken on landholder properties was of interest in that past involvement may be correlated with a willingness to engage with the policy proposal. Identifying if landholders intended to undertake revegetation on their properties was important, as a level of revegetation will be gained irrespective of whether landholders expressed an interest in the policy proposal.

Potentially, the CM questions could enable the estimation of the amount of public investment that would be needed to achieve a given level of revegetation. Landholders were also asked in an open-ended question to express their preferred area and payments to undertake revegetation. If a valid CM model was not able to be developed from landholder responses, Question 11 provided a 'back-up' question that, though less powerful, would

enable some conclusions to be drawn about the potential area of native revegetation and the investment required to achieve it. In the event, a valid CM model could not be developed from the data. It appeared that the amount of payment did not have a significant influence on whether landholders increased the area that they would revegetate. However, this may also have been a consequence of the particular CM design used in the survey. This report only presents results from Question 11.

4.3 Population sample

A total of 6,449 rural properties were identified in the GBD. Stage 2 of the project involved a random mail survey of 1,640 of these landholders. Of the 1,640 landholders, incomplete surveys and properties smaller than 4 ha were removed from the sample, resulting in 494 completed surveys returned from the final sample of 1,027 (Curtis *et al.* 2001).

The Stage 4 survey was mailed to the 409 GBD_{x7} landholders who had previously completed the Stage 2 survey. To enable extrapolation of the Stage 4 survey data across the GBD_{x7}, several assumptions and simplifications were required.

1. The apparent lack of interest in the initial survey by non-respondents was assumed to indicate that they would not be interested in undertaking conservation activities. To the extent that a non-response was due to factors unrelated to their likelihood of undertaking revegetation, such as poor reading and comprehension skills, the results presented in this report will underestimate the area of revegetation.
2. The pool of respondents from the Stage 2 survey was assumed to be a representative sample of those landholders who are likely to respond positively to revegetation initiatives.
3. To calculate the number of landholders in the GBD_{x7}, it was assumed that:
   (No. landholders in GBD_{x7})/(No. landholders in GBD) = (Area GBD_{x7})/(Area GBD).
4. While all strata over 5,000 ha were sampled, no respondents were obtained for most of the strata less than 5,000 ha. Revegetation rates for these small unsampled strata were estimated, where possible, using the data from a stratum with the same BVT and salinity priority. Where this was not possible, the estimation was done based on a stratum with only the same BVT.
5. The surveys concerned only landholders with properties greater than 4 ha. However, the limitations of the available GIS data meant that it was not possible to exclude the urban areas and smaller properties from the various area calculations presented in this report.

4.4 Mail out procedure

The survey mail out was undertaken based on the recommendations of Dillman (1979). Mail out procedures intended to be used in the research included hand-signed letters, the use of two mail outs and a reminder card, and the inclusion of pre-paid and return addressed envelopes. A mail out package consisted of a covering letter, a survey and survey insert, and a pre-stamped return addressed envelope.

The first mail out occurred on the 10th July 2000. A reminder card was sent to survey participants on 21st July 2000. Coinciding with the time the reminder cards were sent to survey participants, a letter instigated by survey participant enquires/confusion received by the GBCMA, was sent to clarify to landholders the purpose of the survey; and the results of the 1999 survey were also sent to landholders. The second mail out to those who had not responded after the receiving the reminder card was not undertaken. Given the good response rate after the first mail out and reminder card, and the fact that survey participants had already received a lot of correspondence related to the project, a further mail out was considered an unnecessary burden on landholders.

5. Survey results

5.1 Response rate

From the 409 landholders, 284 completed surveys were received, 11 surveys were not deliverable to the addressee and two were deleted from the sample as they were focus group participants, giving a response rate of 71.7%.

5.2 Data utilised from the Stage 2 survey

To use data from the Stage 2 survey, and correlate this data with that from the Stage 4 survey, we needed to be sure that the same person answered both surveys. Respondents to the Stage 4 survey were asked whether they had previously completed the Stage 2 survey. A high proportion of respondents were the same landholders who had answered the Stage 2 survey (Table 5). The 9 landholders who had not previously completed the Stage 2 survey, the 26 not sure if they had/had not, and the 2 surveys with this question unanswered were not incorporated into the results reported in this subsection.

Table 5. Stage 4 survey respondents that had previously completed the Stage 2 survey (N = 284)

Response	n	% Respondents
Yes	247	86.7%
Not sure	26	9.1%
No	9	3.2%
Blank	2	0.7%

Grazing was the predominant enterprise, followed by dryland cropping (Table 6). Female respondents made up only 10.2% of the sample. Over 40% of respondents were between 41 and 55 years of age and about 20% of respondents were over 65 (Table 7).

About 55% of respondents described their main area of paid/unpaid work as being a farmer. Respondents worked on average 32.9 hours per week on farming related activities over 1999/98. About 43% of respondents had paid, part or full-time off-farm employment that lasted a minimum of 3 months during 1999/98. Forty-two percent of respondents that received an on-farm profit (the amount of on-property income which exceeded all expenses before tax) for the 1999/98 financial year. Nearly half of these respondents only made an on-farm profit up to $10,000 for the 1999/98 financial year and less than 10% had a profit greater than $50,000 (Table 8). Eighty-two percent of respondents (and/or respondents partners combined), received a net off-farm income (after expenses and before tax), for the 1999/98 financial year (Table 9).

Table 6. Enterprise mix (N = 247)

Enterprise/enterprise	n	Area (ha)
Sheep/goat grazing	124	32,547
Beef cattle grazing/feedlots	151	22,996
Dryland cropping (not lucerne)	56	9,238
All remaining native bush	80	1,860
Other (horses, deer, alpacas, orchards, vegetables, residential/domestic, gardens, wetlands)	22	3,198
Other trees (not farm forestry)	68	904
Dryland lucerne	25	632
Dairy	7	394
Farm forestry	26	259
Irrigated cropping (not grapes)	8	147
Grapes	10	97
Total		72,271

Table 7. Age (N = 247; n = 239)

Years of age	% Respondents
<40	9.6
41-55	43.1
56-65	27.2
>65	20.1

Table 8. Respondents on-property profits, 1999/98 financial year (N = 247; n = 98)

Dollar range	% Respondents
up to $10,000	45.9
$10,001 to $20,000	19.4
$20,001 to $30,000	15.3
$30,001 to $40,000	5.1
$40,001 to $50,000	5.1
$50,001 to $60,000	2.0
above $60,000	7.1

Table 9. Respondents approximate net off-property income for the 1999/98 financial year (N = 247; n = 200)

Dollar range	% Respondents (and/or respondents partners combined)
up to $10,000	26.0
$10,001 to $20,000	20.0
$20,001 to $30,000	11.0
$30,001 to $40,000	11.0
$40,001 to $50,000	12.0
$50,001 to $60,000	4.5
above $60,000	15.5

5.3 Importance of native vegetation

The relative importance to landholders of various native vegetation values is indicated in Table 10. The importance of native vegetation as a means of preventing salinity and erosion prevention rated the highest, followed by nature conservation. Native vegetation as a timber source was rated as the least important of the listed categories.

Other values for native vegetation offered by respondents included: habitat for native fauna (non-avian); to increase property value; to prevent rain runoff; habitat corridors; stock feed and honey production; the protection of local ecosystems; buffer from highway traffic noise; greenhouse gas prevention; to repair European environmental damage; and to assist the drying of water saturated areas.

Table 10. Importance of native vegetation (N = 284)

Native vegetation values	n	Importance				
		Mean	% Respondents			
			NI	SI	I	VI
Salinity & erosion prevention	278	3.6	2.2	6.8	23.4	67.6
Conservation for the future	280	3.4	1.8	6.8	38.9	52.5
Native bird habitat	279	3.4	2.5	8.2	39.4	49.8
Other reason	36	3.4	11.1	2.8	25.0	61.1
Stock protection	276	3.3	4.3	9.4	42.0	44.2
Biodiversity conservation	279	3.2	3.2	16.5	37.6	42.7
Scenic attraction	275	2.8	9.5	25.1	37.8	27.6
Timber source	275	2.5	16.7	29.8	35.6	17.8

1 = not important (NI); 2 = slightly important (SI); 3 = important (I); 4 = very important (VI)

5.4 Property size

The mean size of properties owned or managed by respondents was 311 ha and the total area of all properties was 88,420 ha. The maximum property size was 7,128 ha and the minimum was 4 ha.

5.5 Conservation activities

Half the respondents had government funded conservation or Landcare work undertaken on their properties in the last 5 years. The average government contribution to respondents' on-property conservation works was $2,736 and the total dollar value estimate for all properties was $317,430.

Approximately 65% of respondents had some intention to revegetate on their properties in the next 3 years, irrespective of the policy proposal. The mean estimated area respondents had some intention to revegetate was 11.4 ha and the total area was 2,115 ha (N = 284; n = 185). Over 30% of respondents were 'one-hundred percent' certain they would undertake revegetation on their properties in the next 3 years. Assuming that 'Very likely' converts to a revegetation probability of 0.8 and 'Some chance' converts to a revegetation probability of 0.3, the total area that is likely to be revegetated in the next 3 years is 1,811 ha.

Several respondents also commented that they had already undertaken substantial revegetation:

This property was purchased by us in 1989. The previous owners since 1880's had run 100 merino wethers fixed grazing. The block was regarded as the worst in the district. Why did we buy it? Creek flats were bare and white with salt in summer. Dam dug was too salty for the garden. About 1/2 the total area has been replanted and natural regrowth have occurred, the change has been amazing.

5.6 Extent and cost of revegetation

Participants were asked whether they would revegetate more area than they currently intend if they were paid both for establishing the revegetation and for ongoing management. The additional area that respondents indicated they would revegetate was 4,434 ha (N = 284; n = 144). The average was 29.4 ha at an average price of $401/ha to establish the plantings in the first year, and an average annual payment of $74/ha. Over five years, this would be a total public cost of $2,720,174 at an average of $643 per ha.

Most of the respondents who indicated that they would revegetate more of their properties under the policy were those who were already intending to undertake some revegetation (Table 11). The proposal attracted a relatively small proportion of those respondents who currently have no intention to undertake revegetation.

Table 11. Responses to the proposal relative to current intentions

	Will revegetate (more) with policy	Will *not* revegetate (more) with policy	Total	Percentage adopting the policy initiative
Currently intend *no* revegetation	28	73	101	27.7%
Currently intend to revegetate	116	67	183	63.4%
Total	144	140	284	

Several respondents indicated that they thought quite a lot about how much the price they would ask for revegetation. One respondent offered the following comments:

On recent agroforestry week, total costs to establish …, spraying etc at $1000 per hectare = $1000 plus fencing and this depends on slope of area etc. The amount needs to reflect opportunity cost of lost land and cost of extra work this area. ... This is likely to be higher initially (especially weed control) and lower as plants become established. At the moment, there is no annual payment and this is probably a limiting factor. You need to ensure that not just the worst land (least productive) is revegetated as well.

The NRIF arrangements were supported by focus group participants, and there was little evidence in the survey responses that participants objected to them. Generally if there is a problem with credibility or acceptability of a proposal, at least some respondents will let the researcher know by writing additional comments on their survey - no such comments were made on the Stage 4 surveys, apart from one respondent who indicated that he did not want to be bound by a contract. Four respondents may have misunderstood the proposal in that they objected to any compulsory revegetation - of course, our proposal was voluntary.

Extrapolating across all landholders in the GBD_{x7}, given the assumptions indicated in Section 4.3, results in the estimates shown in Table 12. The figures in Table 12 are overestimates to the extent that they include urban and rural residential properties (see the assumptions listed in Section 4.3). The price for revegetation varies considerably between the strata. Given the differences between LMUs identified by Curtis *et al*. (2001) in relation to on-property profit, total net income, property size, proportion of respondents who identified themselves as farmers, and time spent on farming activities, some variation is expected. However, some of the variation is also probably due to the small sample sizes for some strata. These fluctuations based on inadequate sampling will be less significant when the data are aggregated for each BVT (last column in Table 12).

We estimate that landholders in the GBD_{x7} would revegetate about 19,756 ha at a cost to NRIF investors over five years of $18,471,079 ($935 per ha). This is additional to the 7,624 ha of native vegetation that we estimate would be re-established without the proposal (Table 13). The Plains Grassy Woodland is the BVT that would most benefit from the policy, increasing from 2.8% to 6.2% cover on private land in the GBD_{x7}. Overall, however, the extent of revegetation would not be sufficient to meet the biodiversity conservation targets outlined in Section 2 (Table 14). The target level for Valley Grassy Forest, that has only a small area in the GBD_{x7}, would almost be achieved if respondents' stated intentions to revegetate under the current policy framework are carried out. There are major shortfalls in the revegetated areas of Plains Grassy Woodland, Herb-Rich Woodland and Box Ironbark Forest, even with the policy proposal.

The contribution of the proposal to salinity mitigation is indicated in Table 15. Again, there is a marginal improvement to the amount of tree cover in the very high and high priority LMUs that, while undoubtedly useful, is unlikely to be sufficient to have a major impact.

Table 12. Estimated area of revegetation and associated average prices for GBD_{x7} strata

LMU Priority	Very High				High				Low				Total	Total
Forestry Potential	No		Yes		No		Yes		No		Yes			
BVT	Area (ha)	Price[1] ($/ha)	Area (ha)	Price[1] ($/ha)	Area (ha)	Price[1] ($/ha)	Area (ha)	Price[1] ($/ha)	Area (ha)	Price[1] ($/ha)	Area (ha)	Price[1] ($/ha)	Area (ha)	Price[1] ($)
Plains Grassy Woodland	5,974	596	29	596	2,750	1,859	187	1,859	2,154	1,859	786	210	11,879	13,203,492
Herb-Rich Woodland	462	1,110	3	1,110	23	1,110	2	1,110	19	1,110	28	1,110	538	596,863
Valley Grassy Forest	20	302	30	302	3	242	6	242	2	242	0	0	61	17,708
Box Ironbark Forest	907	1,030	14	1,030	1,495	757	8	281	674	355	0	0	3,098	2,322,500
Inland Slopes Woodland	8	322	1	322	1	322	2	322	56	322	1	322	68	21,825
Riverine Grassy Woodland	4	242	0.5	0	0	0	0	0	0	0	1	242	5	1,200
Dry Foothill Forest	334	218	833	378	46	202	43	202	157	1,532	1,632	343	3,045	1,205,885
Moist Foothill Forest	11	486	36	1,143	0	0	39	1,143	159	486	817	1,143	1,062	1,101,606
Total	7,720		946		4,318		286		3,221		3,264		19,756	18,471,079

Table 13. Comparison of the extent of native vegetation across the GBD_{x7} with and without the policy proposal

	Extant native vegetation	Revegetation without policy	Revegetation with policy		NV on private property with policy	NV on private property without policy	NV on private & public land with policy
BVT	Area (ha)	Area (ha)	Area (ha)	Price[1] ($)	%	%	%
Plains Grassy Woodland	6,262	3,730	11,879	13,203,492	6.2	2.8	11.8
Herb-Rich Woodland	3,803	411	538	596,863	5.9	5.2	18.7
Valley Grassy Forest	2,330	8	61	17,708	16.6	16.2	30.1
Box Ironbark Forest	13,652	1,432	3,098	2,322,500	9.2	7.6	34.5
Inland Slopes Woodland	3,548	4	68	21,825	17.8	17.5	35.0
Riverine Grassy Woodland	640	92	5	1,200	10.3	10.2	17.7
Dry Foothill Forest	36,854	1,392	3,045	1,205,885	19.1	17.7	35.7
Moist Foothill Forest	16,385	555	1,062	1,101,606	27.0	25.4	51.8
Total	83,475	7,624	19,756	18,471,079	11.6	9.5	27.7

[1]**The prices presented in Tables 11 and 12 are for a five-year program, comprising establishment costs and four years of annual costs**

Table 14. Extent of revegetation relative to biodiversity targets

BVT	GBD_{x7} target (ha)	Total without policy (ha)	Total with policy (ha)
Plains Grassy Woodland	56,589	9,992	21,871
Herb-Rich Woodland	13,981	4,214	4,752
Valley Grassy Forest	2,646	2,338	2,399
Box Ironbark Forest	82,248	15,084	18,182
Total	155,464	31,628	47,204

Table 15. Extent to which the proposed policy addresses salinity mitigation priorities

		Native vegetation on private land in the GBD_{x7}	
Priorities for salinity control	**LMU**	**Without policy (ha, %)**	**With policy (ha, %)**
Very high priority	6, 7a, 10, 13	36,691 (6.4)	45,357 (7.9)
High priority	1, 2, 3, 5	14,075 (12.1)	18,679 (16.0)
Low priority	4, 8, 9, 11, 12	40,333 (15.2)	46,818 (17.6)
Excluded	7		

5.7 Influences on respondents' revegetation choices

Correlations with various Stage 2 and Stage 4 variables were undertaken to gain insights into some of the influences on landholders' revegetation choices. Significant correlations between the area respondents would revegetate under the proposed policy and other variables available from the two surveys are given in Table 16.

Table 16. Significant correlations between revegetation area and other variables

Variable	Value	Significance[1]
Importance NV for scenery	0.1268	0.0488
Importance NV for native birds	0.1265	0.0480
Area of property	0.3540	0.0000
Farm forestry fits well with my existing lifestyle	0.1857	0.0118
Farm forestry fits well with my existing enterprises	0.1457	0.0467
Concern about rising water tables reducing local production	0.2075	0.0014
Concern about rising water tables reducing my property productivity	0.1975	0.0025
Concern about rising water tables reducing my pasture production	0.1697	0.0095
Concern about rising water tables reducing local economic viability	0.1594	0.0151
Concern about rising water tables reducing my on-farm income	0.1584	0.0155
Concern about rising water tables reducing my property value	0.1370	0.0366
Willing to work with government	0.2463	0.0002
Local people must work together to combat rising water tables	0.1242	0.0635
Age	-0.1761	0.0063
Farming hours	0.1717	0.0082
Farm profit	0.3647	0.0000
Total income	0.2570	0.0000

[1]All correlations in this table are significant at better than 95% confidence ($p<0.05$).

Larger areas of revegetation are likely to be undertaken by younger respondents with larger properties, higher on-farm profit and total income, who are concerned about the impacts of rising water tables, consider important the nature conservation and scenic values of native vegetation. Also of significance were landholder views about how tree planting fitted in with their current enterprise mix and lifestyle, and their willingness to work in partnership with government and other local landholders.

6. Conclusions

Analysis of the distribution of high priority BVTs and LMUs showed that there are limited opportunities for using commercial plantations or agroforestry to meet salinity objectives in the GBD_{x7}. On the other hand, revegetation of very high and high priority BVTs such as Plains Grassy Woodland and Box Ironbark Forest, which have been extensively cleared, would address both salinity mitigation and biodiversity conservation objectives.

Financial capacity is a major impediment to landholders undertaking revegetation. Almost half of respondents received an on-property profit of less than $10,000 for the 1999/98 financial year and less than 10% made an on-property profit above $50,000. Fifty thousand dollars is considered the minimum threshold to sustain and provide sufficient funds to maintain the natural and capital assets of a property (Curtis *et al.* 2000). Only 55% of respondents identified themselves as being farmers. On average, respondents worked less than 35 hours per week on farm related activities in 1998/99. Many landholdings are lifestyle-farming enterprises for retirees and people with off-property incomes.

These characteristics suggest that there may be a substantial number of landholders who would be willing to revegetate part of their properties if a large financial incentives were available. We tested the idea that, if landholders were asked to name their price for revegetating at least part of their properties with native species, and if the arrangements regarding administration of the scheme and their obligations under it were acceptable to them, then both biodiversity and salinity mitigation objectives could be achieved.

An NRIF scheme was suggested by the expert panel, and specific aspects of its operation were developed with the assistance of landholder focus groups. The proposed tender and contractual processes would help minimise the public expenditure required and secure the required outcomes by accepting tenders based upon factors including: the price asked by landholders, size of area to be revegetated, and whether high it was located in high priority BVTs and/or LMUs. Outcomes would be secured by requiring landholders to comply with management prescriptions include: the overstorey and understorey plant species to be planted; grazing regimes; the extraction of timber products; fencing; weed and pest control; and monitoring.

There was considerable interest in the proposal (51% of respondents indicated that they would revegetate some of their property, at a price). Most of the landholders who responded positively to the proposal already intended to undertake some revegetation, with the additional financial incentives enabling them to revegetate a larger area. Across the $GBD_{x7,}$ we estimate that landholders would revegetate about 19,756 ha at a cost of $18,471,079 ($935 per ha) over five years. This is additional to the 7,624 ha of native vegetation that would be re-established without the proposal. However, the total revegetation would not be

sufficient to meet biodiversity conservation targets for three high priority BVTs: Plains Grassy Woodland, Herb-Rich Woodland and Box Ironbark Forest. Similarly, the proposal is likely to achieve only a marginal improvement to the amount of tree cover in the very high and high priority LMUs.

While the NRIF would make a useful contribution to achieving biodiversity conservation and salinity mitigation objectives in the GBD_{x7}, it would at best only provide a partial solution. There are several possible means by which DNRE and the GBCMA could further intervene to improve these outcomes.

An attempt could be made to change the extent to which current landholders would respond to NRIF-style tender opportunities. Variables significantly correlated with the area that respondents would revegetate under the proposal could point the way to possible for intervention to increase the revegetation area. Concern about the impacts of rising water tables and the importance of nature conservation and scenic values could be used as the foci for eduction programs. More could also be done to foster a strong sense of local community and further build positive relationships between government agencies and landholders. However, other significant variables - property size, landholder age, on-farm profit and total income - do provide ready targets for intervention.

Another potentially significant factor, not assessed in this research, is the extent to which farmers are not economically rational in their response to incentive opportunities. Self-image, lifestyle and peer-group expectations may mean that some farmers would not take up payments to supply biodiversity rather than agricultural commodities, even if they could make more money by doing so. If this is the case, marketing the potential financial benefits to landholders and helping early adopters to have a high positive local profile may enhance uptake of biodiversity payments.

Governments could also try to bring about a change of ownership across a significant portion of the land in those strata that are high priority for both biodiversity conservation and salinity mitigation. The objective of such intervention would be to increase the proportion of landholders who are willing adopting BMPs. There has been a high rate of land turnover in the GBD and the Stage 2 survey showed that this is likely to continue (Curtis *et al*. 2001). Furthermore, anecdotal evidence suggests that destocking is widespread throughout the GBD. The dominant enterprises, sheep and cattle grazing, are in decline. Though improvement in wool and meat prices may cause a reversal of this trend, destocking could give rise to opportunities for achieving substantial land use change through natural regeneration and land purchase.

A revolving fund could be established to purchase properties, place covenants that restrict their future management, and re-sell them to new owners. These new owners, given the covenant, are more likely to be supportive of and have the capacity to adopt best practice land management. It is our view that the use of a revolving fund to purchase land in the high priority BVTs and LMUs may represent one of the most effective (both in terms of cost and land management outcomes) and least divisive policy options. Establishing and managing a revolving fund could be added to the functions of the NRIF manager.

As is widely acknowledged, a mix of policy instruments is required to successfully address biodiversity and salinity issues in the GBD. An NRIF that includes both a revolving fund and a tender system for native vegetation would be a useful component in this mix. However, economic incentives will not, by themselves, enable biodiversity conservation targets to be achieved. Regulations are important to secure the cover of extant native vegetation. Continued community development, education and marketing of revegetation opportunities are also crucial elements.

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