National Investment in Rural Landscapes

An Investment Scenario
For
NFF and
ACF
with the assistance of LWRRDC

by

The Virtual Consulting Group & Griffin nrm Pty Ltd

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Executive summary

Summary of findings

- The degradation of Australia's natural resource base and environment is a national issue, not just a farming issue. It has profound economic, social and ecological (such as biodiversity loss) impacts, which are felt by all communities.
- The annual cost of degradation in rural landscapes is at least $2 billion annually, and this figure is rising. With no action, this could balloon to over $6 billion annually by 2020.
- Commonwealth expenditure stands at around $0.5 billion annually.
- Current and previous programs, such as the Natural Heritage Trust, have increased awareness and enhanced our understanding of the challenges ahead, but have done little to deliver strategic, long-term solutions to problems such as dryland salinity and the loss of biodiversity.
- Achieving sustainability targets and systems in rural landscapes will require major management and land use changes over the next 10 to 20 years.
- The cost of achieving ecological and economic sustainability in Australia's rural landscapes must be ascertained.
- More than 10 years after they initiated the Decade of Landcare, the ACF and the NFF have again joined forces to assess whether our management of land, water and vegetation is sustainable. In many instances the answer is no, with productive and environmental values still in decline. Meanwhile the net value added from agriculture is declining.
- A capital investment of $60 billion, with an ongoing maintenance program of $0.5 billion, will be required to implement the required changes over a 10-year period – a total investment of around $6.5 billion per year.
- Commercial benefits of improved resource management do exist (for example, to agriculture and plantation forestry) but, for several reasons, markets themselves cannot drive all of this investment. Other benefits (such as the hard-to-quantify benefits of biodiversity conservation) mostly reside in the public domain.
- For market drivers to be effectively mobilised, a significant portion of this $60 billion investment must come from the public purse through strategic partnerships with the community and the private sector.
- It is estimated that, over 10 years, the public contribution required to achieve sustainability targets will be at least $33.5 billion in capital investment, together with an ongoing maintenance program of $320 million per year. In terms of government expenditure, this represents $3.7 billion per year, over the next decade.

Introduction

Australia is facing a crisis. Our rural environment and natural resources are suffering. Problems such as salinity, river degradation and pollution, biodiversity loss, and soil degradation, show us that the way our land is used and managed is not sustainable.

These environmental issues have significant economic and social dimensions:

- the viability of farming (and, thus, our agricultural industry) is being undermined;
- rural and regional infrastructure (such as roads, railways, pipelines and buildings) is being eroded; and
- industries that depend upon our natural heritage, such as tourism, are being affected.

The issues are serious and they impact upon all Australians.

The only viable future is one that sustains the economy as well as being ecologically sustainable. It is essential that we find new ways of managing and using our land that are more in tune with the needs of our valuable environment.

The solution will require a joint effort by our governments, the public sector and, importantly, the wider community to achieve this future.

The problem

Degradation trends are alarming. Land affected by salinity, for instance (already 2.5 million hectares), is projected to increase to more than 15.5 million hectares unless we act. On current trends, 50 per cent of woodland birds may be extinct within decades.

In many areas, communities are battling increasing costs and decreasing productivity as a result of the accelerating effects of salinity, acid soils, soil erosion and associated problems. These stem from a long history of inappropriate land use, of past and present government policies, and of a failure of markets to adequately value soils, water and vegetation.

However, it is not just rural communities that are feeling the effects. The impact of land degradation is increasingly being felt in the wider natural environment and upon urban communities. Reversing these trends and finding a more sustainable future is a responsibility for all of us that, if it becomes a national goal, will reap benefits for the whole country.

The need for action

Based upon known figures alone, the cost of degradation to rural landscapes can be quantified at $1.4 billion annually.

Cost estimates of land and water degradation

Form of degradation	Estimate* ($ million per year)
Salinity	270
Acid soils	300
Sodic soils or structural decline	200
Erosion	80
Irrigation salinity	65
Water quality	450
Total	1,365

* The sources for these estimates can be found in the full report.

These figures paint a gloomy picture; however, they do not include other real but difficult-to-quantify costs such as:

- the cost of degradation of terrestrial, aquatic, estuarine and coastal ecosystems to the Australian economy;
- the extent to which industries such as tourism and commercial fishing depend upon these ecological services; and
- the environmental costs (which are difficult or impossible to quantify monetarily).

Unquantified costs

Form of degradation
Degradation to riparian, wetland and estuarine ecosystems, leading to loss of commercial and recreational fisheries, reduced current and potential tourism income, increased water treatment costs, and salinisation of irrigation water supplies.
Coastal sedimentation and nutrient influxes (for example, damage to the Great Barrier Reef and other reefs).
Loss of environmental amenity generally, and associated tourism returns.
Loss of remnants, natural habitat and species in the landscape; loss of carbon store; loss of biodiversity; damage to or loss of parks and reserves.

If we add a rough estimate of these unknown costs to those known, the annual cost is more than $2 billion – about half the net annual value of farm production ($3.9 billion in 1998–99).

If we take the ‘do nothing’ approach, indications are that this $2 billion annual cost will increase at an accelerating rate.

A solution for change

The solution is based upon implementing and achieving existing Commonwealth targets for natural resource management, factoring in the estimated costs and benefits associated with achieving these targets. The Commonwealth’s targets emphasise the need for significant change in the way Australia manages its land, water and vegetation resources.

Sustainable rural natural resources management targets

Target	
By 2005	There should be an increase to 75 per cent in the number of landholders and communities actively monitoring resource conditions.
	There should be no net loss of native vegetation within each jurisdiction.
	All stressed rivers and a significant proportion of other priority-regulated rivers should have an environmental flow regime to ensure maintenance of ecological processes.
By 2010	Fifteen per cent of all agricultural produce should be from environmental accredited properties (ISO 14000 or other).
	A majority of farms should be using a whole-farm plan, which is consistent with regional strategies.
	There should be double the number of landholders and community leaders participating in rural training and leadership courses that incorporate natural resources management. There should also be an increase in levels of participation by landholders in Landcare and other natural resources management groups.
	There should be a net gain in native vegetation cover and a net reduction in species and ecological communities listed as threatened or endangered.
By 2015	At least 50 per cent of regions should have information management systems that are comprehensive, supported and accessible, including through the Internet.
	There should be a net reduction in the area of productive land lost to acidity, salinity, sodicity, acid sulphate, soil carbon loss, structure decline and soil erosion.

Source: Managing Natural Resources in Rural Australia for a Sustainable Future, AFFA

The solution suggests a strategic approach which:

- envisages changed rural economies and production systems, which could turn around the decline in the resource base and prosper from sustainable production;
- foresees a much larger role for trees in rural landscapes in the form of:
  - forests and forest industries, with commercial plantations and agro-forestry, ranging to revegetation with indigenous vegetation, and
  - revegetation and management for biodiversity conservation under stewardship agreements;
- affords better protection to areas of high conservation value, including remnant vegetation, rivers and river corridors;
- provides for eradication of environmental weeds in high-value wetlands and for representative protection of habitat in pastoral rangelands;
- provides for improved irrigation practices and reduced nutrient and salt drainage from our major irrigation areas; and
- encourages the development and growth of robust sustainable production industries, particularly through leverage of private investment in forestry to areas where public gains in salinity mitigation add value to commercial investment opportunities.

The investment

The scale and rate of change needed to arrest the trend of degradation to both our land production systems and the landscape itself will take a large and strategic investment of public and private funds.

Around $60 billion will be required over the next decade to implement the proposal, and to spark and capitalise upon the development of sustainable production systems based upon current technology. A further $0.5 billion will be required annually to support this change.

These figures are conservative. There are some major unknowns in this equation, such as the cost of reducing surface run-off and streamflow as a consequence of planting more trees across the rural landscape. Further detailed analysis will be required to quantify these trade-offs.

It must be noted that, in compiling these figures, large gaps in information were found in the relationships between land use, production systems, and the decline in our environmental and resource base. The figures are therefore presented as ‘ball park’ estimates of the work that is needed to make a significant impact upon the major natural resource management issues in Australia.

This level of investment may appear high when considered against the value of agricultural production, but such an investment is justified upon broader public grounds. Wider community benefits are anticipated in the form of clean, healthy environments and rivers, biodiversity conservation, protection of infrastructure and the development of new, viable industries, such as commercial forestry and tourism. These benefits should not be undervalued.

The management changes and investment required to meet national targets

Area of investment	Scale	Total ($ million)	Public investment ($ million)
Salinity			
Small-lot forestry	2,091,933 ha	3,138	1,569 (50%)
Plantation forestry	14,642,933 ha	21,979	10,990 (50%)
Non-commercial or biodiversity plantings	4,182,267 ha	8,365	7,110 (85%)
Perennial pastures	25,751,920 ha	4,507	901 (20%)
Fencing	2,365,863 km	5,485	1,799 (33%)
Other		2,754	1,397 (50%)
Salinity subtotal		46,227	23,765
Erosion and soil structure decline		2,235	1,222 (55%)
Soil acidification		1,215	122 (10%)
Biodiversity protection	2,365,529 ha	5,204	4,424 (85%)
Acid sulphate soils		88	69 (78%)
Riparian zone protection		1,460	718 (49%)
Land clearing controls implementation		600	600 (100%)
Rangeland retirement for biodiversity		722	722 (100%)
Environmental weed control		100	40 (40%)
Environmental flows		150	150 (100%)
Irrigation drainage control and improved practices		200	60 (30%)
Management of the change		1,796	1,674 (93%)
Total capital investment required		59,997	33,565
Annual maintenance requirement		519	321 (62%)

Note: This table does not include many of the intangibles – the cost of holding the line on species loss, habitat degradation, water pollution, wild resources stocks and so on – in areas not positively impacted upon by the biodiversity plantings, riparian zone protection, rangeland retirement, weed control, clearing controls and other measures specified. If these were included, the final figure would be significantly higher.

The benefits

With strategic investment, the natural resource management targets set by the Commonwealth would, largely, be met.

In financial terms, major potential benefits would include:

- commercial forest industry returns;
- avoidance of salinity impacts (agricultural production, roads and bridges, urban infrastructure and water treatment costs);
- perennial pasture benefits (improved productivity);
- soil health and productivity benefits;
- biodiversity and environmental amenity benefits;
- water quality benefits; and
- potential market values in carbon credits.

Many other benefits – both commercial and non-commercial – are also expected to flow from this investment. They include:

- maximising current and future tourism potential where tourism is directly linked to the natural environment (for example, the Great Barrier Reef, coastal estuaries such as Lakes Entrance or the Swan River, and national parks threatened by salinity);
- protecting or enhancing the productive value of commercial and recreational fisheries and mariculture insofar as the fisheries 'production' depends upon healthy rivers and estuaries;
- improving market access and prices for agricultural produce through cleaner production systems;
- arresting and reversing current trends in the loss of biodiversity – animals, birds and habitats that support them;
- reducing emissions of greenhouse gases that might otherwise result from clearing native vegetation, and from the loss of soil carbon associated with soil degradation; and
- arresting the decline of social amenity and cultural heritage values.

An initial cost benefit analysis comparing [investment required plus forgone agricultural production] with [commercial benefits *alone*] indicates a potential return on investment of 6.5 per cent. At a discount rate of five per cent, the investment has a net present value of $30 billion and a cost benefit ratio of one to three.

Meeting the cost

Having recognised the problems and drivers a substantial component of public investment would seem justified. However, governments can not be expected to fund all of the required changes alone. Partnerships with communities and the private sector (which will gain improved commercial benefits as a result of better resource management) are very much a part of this investment scenario.

The way forward

If Australians are serious about sustaining rural landscapes and the wide range of productive and environmental values that we tend to take for granted, then we need to get serious about investing in our future rural landscapes.

This report has, for the first time, attempted to quantify the investment needed to achieve real targets for sustaining our environmental and natural resource heritage.

This document sets the scene for discussion, debate and action about:

- the targets the nation must set for sustaining our rural landscapes;
- the way governments will make these investments; and
- the level (and mix) of investment required to do the job.

Background

The Land and Water R&D Corporation together with the Australian Conservation Foundation and National Farmers Federation commissioned The Virtual Consulting Group and Griffin NRM Pty Ltd to produce a "best estimates" account of:

- the costs of rural natural resource degradation
- the investment required to arrest the decline in the rural resource base
- the public/private components of the investment
- the likely benefits of the investment to society

This report provides a summary of the main findings. It is supported by a background paper, covering the following issues:

- The current status of land and water management
- Requirements for ecologically sustainable resource use
- The investment required
- Assessing the potential returns from improved resource management
- The role of public investment
- Case studies on natural resource management
- References and relevant background reading

The estimates provided in this summary report are ball-park figures. There is considerable knowledge about NRM within Australia to draw from, but there is a lack of information at a suitable scale for a national study. We were required, therefore, to extrapolate, draw broad assumptions across large areas, and make best estimates. We drew on the work of CSIRO, other researchers and NRM managers throughout the country. These sources are acknowledged in the References and Primary sources sections of the document.

A substantial amount of work is being carried out through the National Land and Water Audit to map and analyse current resource condition and use in rural Australia. The Audit is undertaking work in quantifying the benefits of resource use, the extent and cost of degradation and making recommendations for management strategies.

The Audit will give a significantly better picture of the costs of unsustainable resource use, and the investments and associated benefits involved in turning this around. The following outputs are expected from the Audit over the next two years and will greatly improve assessment and costing of sustainable NRM:

Issue	Reporting date
▪ Dryland salinity assessment	10/2000
▪ National Vegetation Information System	10/2000
▪ Rangeland status	11/2000
▪ Integrated rangeland monitoring proposal	2/2001
▪ Soil erosion, nutrient, acidity assessments & management	3/2001
▪ Social and economic assessment of rural land use	3/2001
▪ Estuaries assessment	5/2001
▪ Waterway assessment	5/2001
▪ Catchment health assessment	5/2001

The figures provided in this report are valid only at a national scale. The costs are those we believe would be involved in meeting the Commonwealth's draft national NRM targets (AFFA, 1999). These targets define the scenario that we have costed. Other scenarios may be more feasible and/or optimal in particular regions but for the purposes of this project, the Commonwealth targets provide a solid starting point.

A number of key components to the national NRM accounts are difficult to deal with in a conventional analysis of costs and benefits. Biodiversity in particular is problematic in that it primarily involves non-monetary benefits and costs. We have attempted to cost appropriate responses to the targets for biodiversity eg:

- by 2005-no net loss of native vegetation in any jurisdiction;
- by 2005-no additional ecological community threatened by agriculture;
- by 2005-a net gain in native vegetation cover and a net reduction in species and ecological communities listed as threatened and endangered.

However, we stress that the benefits are very difficult to value and that there is a persistent risk that they are overlooked and undervalued in optimised approaches to NRM.

Why invest in NRM?

Natural resources play a vital role in the Australian economy. The employment of almost 0.5 million Australians (5.8% of the workforce) is directly linked to the natural resource base. During 1998/99 over 56% of Australia's total exports were derived from the farm, forest, fisheries and resource sectors.

Australia's 115,000 agricultural establishments use 466 million ha or 60% of Australia's total land area, generating a gross production valued at $28 billion during 1998/99. After allowing for input costs, the net value of Australian farm production from the 1998/99 season was only $3.9 billion, or an average of only $33,500 per farm enterprise.

Much of the stock of Australia's biodiversity resides in rural regions and on agricultural land. Australia is committed as a nation and under international agreements to invest in biodiversity conservation. Biodiversity conservation is a fundamental tenet of ecologically sustainable development, which underpins current Australian policy for management of natural resources.

The past decade in particular has seen substantial investment to address the decline in the rural resource base. This includes public investment through the Decade of Landcare initiatives, the Natural Heritage Trust, research and development bodies and the State and Territory programs, which commonly invest dollar for dollar with Commonwealth initiatives. There has also been significant private investment by farmers, primary industry groups and farm forest industries.

The investment in rural natural resource management to date has produced a remarkable level of public awareness, particularly in rural areas, and has resulted in development of a wide range of technologies to combat the problems. A large number of on-ground projects were also carried out through a range of community group grant programs.

Further investment is required to capitalise on the awareness raising, technological and other achievements to date. The problems are challenging in scale and extent. Tackling them will require a concerted effort on the part of governments to address externalities and policy, market and institutional failures, and to leverage appropriate levels of private investment where it will count. For instance, most of the recent private investment in forest industries is not located in the areas where substantial salinity, water quality and other resource base benefits could be achieved. Incentives will be required to leverage these types of private investment to areas where multiple benefits can be gained.

The major resource base problems are currently estimated to cost in the order of $1.4 billion annually (Table 1.1). This is around one third of the net value of all agricultural production ($3.9 billion 1998/99); a substantial loss considering that agricultural products currently make up 20% of total export earnings.

Table 1.1a: Summary of estimates of the current costs of various forms of land degradation

Form of Degradation	Source	Estimate ($ million pa.)
Salinity	Hayes (1997)	$270
Acid Soils	CSIRO (1990)	$300
Sodic Soils/ Structural Decline	LWRRDC (1993)	$200
Erosion	LMTF (1995)	$80
Irrigation Salinity	IC (1998)	$65
Water Quality	LWRRDC	$450
Total		**$1,365**

Table 1.1b: Unquantified costs

Form of degradation
Riparian, wetland and estuarine pollution (nutrients, salt etc) and degradation- higher water treatment costs, loss of commercial and recreational fisheries, reduced flows
Coastal sedimentation and nutrient influxes- eg damage to Great Barrier and other reefs
Loss of environmental amenity and tourism returns
Loss of remnants, natural habitat and species in the landscape; loss of carbon store, loss of biodiversity, parks and reserves

The effects of the key resource base problems on production, water quality and environmental values tend to accelerate over time so that If there is no further targeted investment; ie the "do nothing scenario", the costs outlined in Table 1.1 will increase at a compounding rate. Based on NDSP and MDBC Salinity Audit estimates the annual cost of dryland salinity alone could increase to $670 million in 2020 and to $2 billion by 2100.

While these estimates provide an indication of the magnitude of the problem, they do not indicate the return that might be generated on any future investment. In many cases investment will be directed towards avoiding further degradation rather than remedial action to recover existing losses.

Targets for sustainable NRM

Views on what is needed to achieve sustainable NRM are many and varied but to date there are few documented targets available. Given the current magnitude of the problems and the potential for further acceleration of degradation it is evident that the changes will need to be significant. The farming systems of the future will need to be dramatically different at least in some areas in order to halt increases in salinity, acidity, erosion, loss of habitat and pollution of freshwater resources, and to generate greater economic viability at farm and regional levels.

The recently released, *Managing Natural Resources in Rural Australia for a Sustainable Future; A discussion paper for developing a national policy* (AFFA, 1999, pp20-21) provides an indication of the potential targets over the next ten to twenty years (Table 1.2). While these targets are not seen as fixed, they do provide benchmarks for scenarios of change.

In the following section, we attempt to set out the types of changes in land use and practices that are likely to be required in order to meet these targets. The changes outlined are not necessarily those currently proposed, or those seen as optimal, or those included in current catchment management plans, but are those required to meet the ten to twenty year targets set out in the discussion paper (Table 1.2).

Table 1. 2: Sustainable Rural NRM Targets

Target
By 2010, 15% of all agricultural produce should be from environmental accredited properties (ISO 14000 or other)
By 2010, a majority of farms using a whole farm plan which is consistent with regional strategies
By 2010, double the number of landholders and community leaders participating in rural training and leadership courses that incorporate NRM; An increase in levels of participation by landholders in landcare and other NRM groups
By 2005, an increase to 75% in the number of landholders and communities actively monitoring resource condition
By2010, a 50% increase in research and development in ecologically sustainable natural resource management
By 2015, at least 50% of regions should have information management systems that are comprehensive, supported and accessible including through the net
By 2015, a net reduction in the area of productive land lost to acidity, salinity, sodicity, acid sulphate, soil carbon loss, structure decline and soil erosion
By 2005, no net loss of native vegetation within each jurisdiction
By 2005, all stressed rivers and a significant proportion of other priority regulated rivers should have an environmental flow regime to ensure maintenance of ecological processes
By 2010, a net gain in native vegetation cover and a net reduction in species and ecological communities listed as threatened or endangered

Source: AFFA, 1999

What will it take to achieve the targets?

The measures required to achieve the sustainable NRM targets were estimated from a range of sources, including literature and discussions with NRM researchers and managers throughout Australia. This body of knowledge is far from complete. It will be added too and improved substantially by the work of the National Land and Water Resources Audit over the next year or two. For the purposes of this study, we have assembled the best estimates based on current knowledge.

The changes in land use and practices, and other measures likely to be required to meet the sustainable rural NRM targets in Table 1.2 are detailed in Annex 1. These are, of course, generalised assumptions and are constructed in this way to enable us to draw very broad estimates of the levels of investment likely to be required in the next ten years.

The estimates are based on current technology and conventional wisdom. They do not take into account the possibility that new sustainable technology and farming systems could deliver a higher return than we are assuming for sustainable NRM in Australia. We note this possibility but can not factor it in to the estimates at this stage.

How much will it cost?

While it is difficult to accurately quantify the investment needed to achieve the targets set out in Table 1.2 through the changes indicated in Annex 1, broad estimates can be made of the key investments which may be required. These estimates are contained in Table 1.3. The assumptions underlying them are detailed in Annex 1.

Several of the management responses in Table 1.3 would have multiple benefits. Establishment of trees to control salinity for instance will also combat soil erosion, nutrient and sediment runoff to creeks and rivers, soil structure and carbon decline and soil acidification, as well as having the potential to contribute to biodiversity conservation. We have attempted to eliminate double counting by taking these multiple benefit streams into account in regions where they are likely to be significant.

The estimates in Table 1.3 indicate that the capital investment required may be in excess of $60 billion. If this capital investment is made over ten years, an annual investment of $6 billion will be required. The implementation of measures to bring about sustainable NRM involves not only capital investment but also substantial institutional, education and regulatory programs to encourage and coerce the scale of change required in many areas.

These programs will incur ongoing costs (Table 1.4). We have based the estimates of these costs on existing programs, in some cases scaled up to reflect the degree of change required in a relatively short timeframe as defined by the national targets. Adding in annual support and maintenance programs brings the total to around $6.5 billion per year for 10 years.

Table 1. 3: Estimated investment required in order to meet sustainable NRM policy targets

	Area	Unit	$/unit	Total ($ million)	Annual Investment ($million)
Salinity					
Small Lot Forestry	2,091,933	ha	1,500	3,138	314
Plantation Forestry	14,642,933	ha	1,500	21,979	2,198
Non Commercial / Biodiversity Plantings	4,182,267	ha	2,000	8,365	836
Perenial Pastures	25,751,920	ha	175	4,507	451
Salt Tolerant Vegetation	845,000	ha	200	169	17
Salt land Agronomy	5,000,000	ha	200	1,000	100
Fencing	2,365,863	km	2,000	5,485	548
Other				1,585	159
Salinity Sub Total				**46,227**	**4,623**
Erosion & Soil Structure Decline				2,235	224
Soil Acidification				1,215	122
Biodiversity Protection				5,204	520
Acid Sulfate Soils				88	9
Riparian Zone Protection				1,460	146
Land Clearing Controls Implementation				600	60
Rangeland Retirement for Biodiversity				722	72
Environmental Weed Control				100	10
Environmental Flows				150	14
Irrigation drainage control and improved practices				200	20
Management of the Change				1,796	180
Total Investment Required				**59,997**	**6,000**

Table 1. 4: Annual maintenance requirements

Ongoing Investment	% of farms	farms	Annual Hours	Total ($ million)
NRM Group Participation (hrs)	90%	63,588	24	31
Active NRM Monitoring	90%	63,588	48	61
NRM Training	90%	63,588	24	31
Extra R&D	50%	274	million	137
Management of Retired Rangelands		2	/hapa.	66
Management of Non commercial/Biodiversity Plantings		15	/hapa.	78
Management of Riparian Zone		15	/hapa.	41
Annual Liming	10%	943,820	ha	76
Total		**-**	**-**	**519**
Total Annual Investment Required Over Ten Years				**6,518**

How much is a public cost?

Investment in NRM demands contributions from the public and private sectors. Almost all NRM issues involve components of public and private interest and many stem partly from market failure, public policy inadequacies etc.

There are numerous examples of partnerships and investment sharing approaches between governments and landholders to tackle NRM issues. In Table 1.5, some of these examples are provided to illustrate the types of partnerships likely to be involved in meeting the targets in Table 1.2. They could range from 100% public funding to protect high biodiversity value wetlands in Western Australia, through the mid ground cost sharing programs to deliver public and private benefits in farm forestry, to the higher proportion of private investment likely to be involved in addressing soil structure and fertility decline.

In estimating the public/private contributions likely to be required to meet the NRM targets, we have attempted to draw on examples of existing and likely cost sharing and investment partnership arrangements, which could deliver the required outcomes. Some examples are provided in Annex 1.

Investment sharing

Table 1.5 provides estimates of potential investment sharing partnerships on the basis of the principles outlined above. The rationale is described in the Table. These figures should be viewed as estimates of the order of magnitude of public involvement, rather than as hard and fast investment sharing rules.

On the basis of the potential investment sharing estimates in Table 1.5, around $28.4 billion of public investment would be required to achieve the NRM targets set out (Table 1.6). Over a 10 year investment program, the estimated public cost including the ongoing commitment would be $3.2 billion per year.

Table 1. 5: Indicative cost sharing assumptions

Management Change	Public Share	Comment
Commercial Tree establishment	50%	Public funds used to establish develop commercial environment Farmers contribute where there are integrated agroforestry options eg alley farming Private investment schemes used to establish commercial scale forestry plantations
Non Commercial/ biodiversity plantimgs	85%	Government meets the costs of establish protected areas. Some minor private investment may be attracted eg eco tourism
Perennial Pastures	20%	Primarily a public benefit in terms of productivity. Public funds used as an incentive to facilitae adoption.
Living with salt options	50%	Partnership between landholders, communities and government to cope with problems
Fencing	50%	Will range from up to 100% for biodiversity protection to an estimated 20% where there is significant private benefit. Eg perennial pastures.
Erosion	50%	Major expenditure is in landholder extension and education provided by government. Landholders meet costs of on farm changes
Acidity	10%	Lime will only be applied to areas where there is an economic return and as such farmer beneficiaries should pay. Public funds may be used to offset the initial outlay.
Acid Sulphate Soils	80%	Partnership to protect at risk areas and control future development
Riparian Zone	50%	Partnership to protect and manage riparian zone
Land Clearing Controls	100%	Government compensation for the lost agricultural opportunities
Rangeland Biodiversity	100%	Government meets the cost of protecting biodiversity for the good of the wider community.
Irrigation Drainage	30%	Partnership to control salt flows and improve water use efficiency
Management of Change	95%	Primarily public responsibility to manage change and take responsibility for the adjustment process.
Ongoing Commitment	60%	Public management of public assets and an on going partnership with landholders in management and monitoring

Table 1.6: Estimated public cost in achieving NRM targets

	Total ($ million)	Annual Investment ($million)
Salinity		
Small Lot Forestry	1,569	157
Plantation Forestry	10,990	1,099
Non Commercial / Biodiversity Plantings	7,110	711
Perenial Pastures	901	90
Salt Tolerant Vegetation	85	8
Salt land Agronomy	500	50
Fencing	1,799	180
Other	812	81
Salinity Sub Total	23,765	2,376
Erosion & Soil Structure Decline	1,222	122
Soil Acidification	122	12
Biodiversity Protection	4,424	442
Acid Sulphate Soils	69	7
Riparian Zone Protection	718	72
Land Clearing Controls Implementation	600	60
Rangeland Retirement for Biodiversity	722	72
Environmental Weed Control	40	4
Environmental Flows	150	15
Irrigation drainage control	60	6
Management of the Change	1,674	167
Ongoing Commitment		**321**
Total Investment Required	**33,565**	**3,678**

What are the likely benefits of this investment?

A landscape level change of the nature discussed in this report will have major impacts on the Australian economy and environment. Just as the investment required is difficult to quantify, scientifically and economically, so are the potential benefits. However, the conservatively estimated potential benefits on the basis of research to date and our opinions might include:

- The development of major plantation and agroforestry industries in Australia;
- Implementation of higher value land uses, leading to significant regional economic development;
- Profitable farm businesses with the capacity to reinvest in their natural resource base;
- Improvements in river condition and drinking water quality, and avoidance of the cost of desalination and other treatments to provide drinkable water for major cities;
- The positioning of Australia at the leading edge of international industries in tackling degradation of land and water resources, securing long term land productivity and water availability and quality, and sequestering greenhouse gases;
- The preservation and enhancement of major environmental assets such as the Great Barrier Reef, tropical rainforests, monsoonal wetlands and largely unmodified vast landscapes in the arid zone, which are already highly significant in earning tourism income and contributing to Australia's international image, and will become more so;
- Enabling Australia to exceed its international obligations to reduce net greenhouse gas emissions, to the extent that it is able to sell sequestration services on international markets;
- Maintenance of biodiversity, or at least stopping the loss and fragmentation of habitat which has caused record extinction rates

Our estimates of the potential benefits are outlined in Table 1.7. Where possible, these benefits have been given a dollar value in order to assess the potential returns and evaluate the economic viability of investment in NRM.

A 100 year discounted cash flow budget was prepared to assess the benefits of a 10 year investment program in NRM. This budget included those environmental benefits, which could be valued as well as the potential returns from commercial forestry operations.

The key assumption behind our attempt to estimate the magnitude of potential benefits is that achievement of the targets set out in Table 1.2 will be sufficient to halt any further increase in the level of resource degradation.

Table 1. 7: Estimated benefits of investment in NRM

Issue	Potential Benefits	$ Value
Salinity	Without investment the area of land visibly affected is expected to increase to in excess of 12 million ha by 2100.	$1 million pa. of avoided productivity and infrastructure costs per 5000ha of visibly affected land
Water Quality (Salinity)	River Murray EC levels are expected to rise by 330 units over the same period. (We have assumed this represents half of the national impact on rivers)	$100,000 pa. per unit EC rise
Biodiversity	Nature based tourism opportunities Environmental control of pests and disease Cleaner water Genetic improvement of agricultural crops Potential for new pharmaceutical drugs	Unknown, but conservatively could be at least half of the benefits expected from salinity management.
Soil Erosion	Decrease soil drift, improved soil nutrient levels and better agricultural performance. Less air and water pollution	Unknown, but conservatively estimated that with improved soil management and liming agricultural production in the wheat sheep and high rainfall zone could be improved by in excess of 5%
Acidity	Without lime applications production on these 9.4 million ha will fall dramatically over the next 10+ years.	As above
Water Quality (salt and nutrients)	The establishment of significant areas of trees, protection of riparian zones, liming of acid soils and revegetation of riparian zones will have a major impact on the quality of water supplied to urban areas. Algal blooms will also decrease Less fish kills and improved fish habitat	Unknown, estimated at 45% of the $450 million estimated cost of water treatment (200 million pa.) Unknown
Riparian Zone	Major water quality benefits. Stock health benefits Significant ecosystem services, bioderversity and amenity benefits	As above Unknown Unknown

Issue	Potential Benefits	$ Value
Forestry production	Production of significant wood resources suitable for commercial harvest	Forest product sales of $15,000/ha each 25 years
Perennial Pastures	Increased stocking rates as a result of improved pasture species and grazing management.	In excess of 15% increase in gross production of perennial areas.
Carbon Credits	Establishment of major carbon sinks which will be produces credits which can be marketed to carbon producers	$30/ha of trees established

A summary of the present value of these benefits as compared to the present value of costs is shown in Table 1.8. An investment of $60 billion in NRM over the next 10 years has the potential to generate a return of 6.5% pa. over the next 100 years. At a discount rate of 5% the benefits outweigh the cost by a ratio of 1:1.3 and the investment has a net present value of $30 billion.

The returns from the costed environmental benefits alone (carbon, salinity, acidity, biodiversity and water quality), only have a net present value (NPV) of $33 billion. In conventional accounting terms, this would be insufficient to justify the $86 billion net present value of the initial tree planting requirements, environmental works and forgone agricultural production. The final analysis would be highly dependent on how biodiversity, healthy environment and tourism benefits were valued. In the current climate, it is perhaps unlikely that the investment would be considered economically viable on environmental benefits alone.

The majority of the benefits from the investment will accrue through the sale of forestry products. The potential future sales have a net present value of $83 billion. It therefore follows that if future investment in NRM is to achieve significant economic returns it must be based on the development of a commercial forestry industry. This implies a major change in the way in which many land managers, farmers, policy makers and society in general currently think about land use and rural industries. It also raises a number of questions about the way in which government investment might be targeted, including the role of government in developing a forestry industry of the scale implied in these estimates. The level of forestry production implied in these estimates is of the order of 15-20 times Australia's current annual gross value of forestry production.

Table 1. 8: Breakdown of Net Present Value of costs and returns from investment in NRM.

Breakdown of NPV	$ billion
Forestry Returns	83.3
Carbon Credits	10.6
Salinity Impacts Avoided	8.2
Perennial Pasture Benefits	7.4
Erosion/Acidity Impacts Avoided	7.6
Biodiversity Benefits	4.1
Water Quality	2.7
PV Benefits	**124.0**
Commercial Plantings	20.4
Commercial Replanting	8.3
Non Commercial/Biodiversity Plantings	6.8
Maintenance Cost	13.4
Perennial Pastures	3.7
Fencing	3.8
Erosion & Soil Structure Decline	1.8
Soil Acidification	1.0
Ongoing Commitment	10.8
Lost Agricultural Production	17.6
Other Costs	6.3
PV Costs	**93.9**
NPV	**30.1**
B:C Ratio	**1.32**
IRR	**6.5%**

Annex 1: Key Assumptions and Data Sources

Current Land use by agroecological zone

Current agricultural land use by state and agroecological zone has been used as the basis for accessing the likely scale of management change required. The area of land under each land use in each AEZ within each State is shown in the table below. The land use categories used are defined as follows:

State	AEZ	Pasture	Residual	Crops	Horticulture	Agroforestry	Unallocated	Total
WA								
	1	2.93	19.91	0.00	0.00	-	0.74	**23.59**
	8	0.49	0.79	0.08	0.01	-	0.33	**1.69**
	10	5.98	7.06	7.87	0.01	0.01	2.23	**23.16**
	11	8.86	57.48	0.16	-	-	22.09	**88.59**
Qld								
	2	4.96	13.06	0.00	0.00	-	1.77	**19.80**
	3	0.25	14.90	0.01	0.01	-	4.03	**19.19**
	4	0.11	0.42	0.17	-	-	0.31	**1.01**
	5	10.22	39.34	0.08	-	-	3.09	**52.72**
	6	6.91	14.63	1.68	0.02	0.00	4.36	**27.59**
	7	0.66	2.04	0.20	0.01	-	1.00	**3.92**
	9	0.40	0.31	0.01	0.00	-	0.12	**0.84**
	11	3.17	18.34	-	-	-	0.91	**22.41**
Vic								
	8	1.91	1.29	0.08	0.02	0.00	0.49	**3.79**
	9	0.25	0.25	0.01	0.00	0.00	0.19	**0.70**
	10	2.43	3.35	2.21	0.02	0.00	1.30	**9.31**
Tas								
	8	0.42	0.31	0.01	0.01	-	0.33	**1.08**
	9	0.38	0.17	0.02	0.00	-	0.17	**0.73**
SA								
	8	1.54	1.19	0.70	0.02	0.00	0.47	**3.92**
	10	1.61	3.39	2.45	0.02	-	0.83	**8.30**
	11	1.63	11.94	0.04	-	-	31.93	**45.53**
NT								
	1	5.16	13.93	-	-	-	0.86	**19.95**
	2	3.02	8.84	-	-	-	1.51	**13.37**
	5	2.33	6.44	-	-	-	0.43	**9.20**
	11	5.93	19.25	0.00	-	-	8.38	**33.55**
NSW								
	5	1.69	10.42	0.50	0.00	-	0.32	**12.94**
	6	1.89	7.72	2.14	0.00	0.00	1.38	**13.12**
	7	0.62	1.96	0.05	0.01	-	1.05	**3.69**
	8	0.04	0.11	0.00	-	-	0.09	**0.24**
	9	1.99	2.75	0.16	0.00	-	1.76	**6.67**
	10	4.72	12.33	2.19	0.02	-	2.34	**21.60**
	11	0.66	5.85	-	-	-	0.19	**6.70**
Australia		**83.16**	**299.76**	**20.82**	**0.19**	**0.01**	**94.99**	**498.94**

Minimal change required

Target	Minimal change required
By 2010, 15% of all agricultural produce should be from environmental accredited properties (ISO 14000 or other)	ISO 14000 or other environmental accreditation of 15% of properties
By 2010, a majority of farms should be using a whole farm plan which is consistent with regional strategies	90% of total properties using a whole farm plan which is part of a regional strategy compared with current 10%
By 2010, double the number of landholders and community leaders participating in rural training and leadership courses that incorporate NRM; An increase in levels of participation by landholders in landcare and other NRM groups	Ongoing commitment to provision of rural training Ongoing commitment to community based grants program to catalyse participation in groups
By 2005, an increase to 75% in the number of landholders and communities actively monitoring resource condition	Based on estimate of landholders now involved in monitoring @ 5%- investment of a further 70% of landholders in monitoring @ around 1 hour per week
By2010, a 50% increase in research and development in ecologically sustainable natural resource management	Increase expenditure from current levels of $274m pa to $411 pa
By 2015, at least 50% of regions should have information management systems that are comprehensive, supported and accessible including through the net	Around 5% of regions now have access to such systems- a further 45% of regions need to develop them
By 2015, a net reduction in the area of productive land lost to acidity, salinity, sodicity, acid sulphate, soil carbon loss, structure decline and soil erosion	See text below
By 2005, no net loss of native vegetation within each jurisdiction	See text below
By 2005, all stressed rivers and a significant proportion of other priority regulated rivers should have an environmental flow regime to ensure maintenance of ecological processes	Water reallocation/purchases for environmental flows- taking into account less water available in the 20-30% of the arable region to go under trees
By 2010, a net gain in native vegetation cover and a net reduction in species and ecological communities listed as threatened or endangered	See text below

Data sources, issues and assumptions

Data used to cost Table 1.3 are based on estimates with varied specifications and rigour. They should be regarded as approximate figures for ascertaining the order of magnitude of land degradation regionally. Estimates of spatial extent of land degradation issues are derived from a range of reports ranging from SOE reports, to State of River reports, Situation Statements, Salinity Management Manual of Queensland, catchment plans and web pages of Government agencies (AgWA, WA Environment Dept, Tas DPIWE, PIRSA).

Riparian zone lengths were derived from estimates of % of stream lengths in various conditions. Estimates for poor and very poor condition for a number of streams in similar agroecological zones were used to arrive at a general % to apply to the estimates of stream length based on figures given in the reports. Stream lengths in three broad regions in Western Australia were given by the Water & Rivers Commission and are seen as reasonable approximations only. An attempt at putting constraints on the dimensions was made by checking estimates against the NLWRA land use estimates (NLWRA website).

Considerably more is known in Australia about the spatial extent of NRM problems than about best management responses and their probable impacts. We have generalised the responses to various NRM issues across regions and States. In reality, there will be much more diversity than we have been able to depict. However, a lack of better information makes it necessary at this point in time to generalise to obtain national estimates and to comply with the scenario set out by the national targets.

Current land use by agroecological zone

Current agricultural land use by state and agroecological zone was used as the basis for accessing the likely scale of management change required.

Salinity

For each state an estimate was made of the percentage of land, within those AEZ's where salinity is an issue, which would require revegetation with trees and perennial pasture. These estimates, shown in the table below, were then applied to the land areas shown in the table above in order to derive an estimate of the area of revegetation required. The general principles behind these estimates include:

- Establishment of trees on 25-30% of the land currently under improved and unimproved pasture and the unallocated areas.
- Establishment of trees on 10% of the cropping land
- The remainder of improved pasture areas sown to deep rooted perennial species
- An increase in the perennial pasture phase of cropping land to 1/3 of the remaining cropping land.
- The requirements in Queensland were assumed to be of a much lower order of magnitude.

Tree Requirements						
Current Use	**Pasture**	**Residual**	**Crops**	**Horticulture**	**Agroforestry**	**Unallocated**
WA (AEZ 10)	30%	30%	10%	0%	0%	30%
Vic (AEZ 8 & 10)	25%	25%	10%	0%	0%	25%
SA (AEZ 8& 10)	25%	25%	10%	0%	0%	25%
Qld (AEZ 6 & 7)	5%	0%	0%	0%	0%	0%
NSW (AEZ 6, 9 & 10)	25%	25%	10%	0%	0%	25%
Perennial Pasture Requirements						
Current Use	**Pasture**	**Residual**	**Crops**	**Horticulture**	**Agroforestry**	**Unallocated**
WA (AEZ 10)	75%	0%	30%	0%	0%	0%
Vic (AEZ 8 & 10)	75%	75%	30%	0%	0%	0%
SA (AEZ 8& 10)	75%	0%	30%	0%	0%	0%
Qld (AEZ 6 & 7)	5%	0%	0%	0%	0%	0%
NSW (AEZ 6, 9 & 10)	75%	0%	30%	0%	0%	0%

Non commercial/biodiversity plantings

It has been assumed that up to 20% of the areas requiring trees will be non-viable for commercial forestry plantations. It has been assumed that these areas will be taken out of production and planted to trees and managed so as to maximise biodiversity benefits.

It has also been assumed that 10% of the pasture and crop areas outside of those AEZ's affected by salinity would be plated to trees in order to maintain and protect biodiversity. This equates to 2.4 million hectares of tree plantations for purely biodiversity reasons.

Fencing requirements

The lengths of fencing required for the establishment of plantations and perennial pastures have been estimated on the following basis:

- 4km per 1km^2 (100ha) of small plantations
- 1km per 1km^2 of large plantations
- 10km per 1km^2 of non commercial/biodiversity plantations
- 8km per 1km^2 of perennial pasture establishment
- 4km per 1km^2 of slat tolerant pasture establishment

Erosion/acidity

- Much of the revegetation undertaken for salinity control reasons will also have benefits in terms of soil erosion, acidity and soil structure decline. Where possible allowances to estimates for erosion and acidity have been adjusted to account for the land already included in the salinity estimates.
- Conservation tillage/soil management practices will be implemented on all land which continues to be used for crop production.
- Estimates of the requirements for lime & gypsum applications, perennial pasture establishment, acid tolerant agriculture, grazing management and the retirement of land to non-commercial/biodiversity plantations have been based on estimates prepared by Webbnet Land Resources Services for CSIRO Land and Water. These estimates were collated from various regional Natural Resource Managers.

Riparian management

- Estimates of the requirements for stream side fencing, revegetation and weed control were also prepared by Webbnet Land Resources Services for CSIRO Land and Water as above.
- These estimates are based on fencing those areas of streams which are currently in poor condition.
- It has been assumed that a remote watering point will be required for each 4 kilometres of stream fenced.

Rangeland stability and biodiversity

- 10% of the land in the pastoral/rangelands area of Australia will need to be destocked and managed as rangeland reserves- in order to control land degradation and conserve biodiversity at current levels.
- 1km of fencing will be required for each $10km^2$ (1000ha) destocked.

Structural changes

Changes in NRM management of the magnitude indicated in the estimates in this document will have significant impacts on the viability of farm businesses. The removal of large areas of land from current farming systems to forestry plantations will move some farms out of agriculture; for others, it will mean that agriculture will produce a smaller proportion of their income. For those that remain the magnitude of the investment required to meet these targets will required significant changes to management practices and a commitment to training and monitoring.

In order to estimate the potential impact on farm numbers we have used the ABARE farm surveys data estimates of the farm population. On the basis of the data shown in the table below we have made the following assumptions:

- If the majority of the tree establishment occurs in the Wheat sheep and high rainfall zones then the 20 million hectares of plantations would be the equivalent of approximately 15,000 farms (17% of the population).
- Assuming 15,000 farms adjust out of agriculture, the target audience for ISO accreditation and farm planning would be the remaining 71,000 farms.
- Assuming uniform adjustment across industries, approximately 28,700 farms with cropping or mixed cropping businesses would form the target audience for a conservation tillage program.
- A grazing management program would be targeted at the 4000 pastoral zone managers.

Zone	**Farms**	**Av. Size**	**Total Area**
Pastoral zone	4,079	80,438	328,106,602
Wheat Sheep	25,651	1,155	29,626,905
High Rainfall	42,059	1,941	81,636,519
Dairy Farms	13,815	200	2,763,000
Total	**85,604**		**442,133,026**
		Average Farm Size	**5,165**
		Wheat Sheep/ High Rainfall & Dairy average	**1,399**
		Potential Farms Lost	**14,951**
		Total Farms Remaining	**70,653**
	Farms	**Av. Size**	**Total Area**
Wheat & other crops	15,800	1,495	23,621,000
Mixed livestock - crops	18,997	1,794	34,080,618
Sheep	12,203	5,560	67,848,680
Beef	16,426	16,057	263,752,282
Sheep - Beef	8,362	6,002	50,188,724
Dairy	13,815	200	2,763,000
Total	**85,603**		**442,254,304**
		Average Farm Size	**5,166**
Conservation Tillage Program	**28,720**		
Grazing Management Program	**4,079**		

A number of State and regional natural resource managers contributed to the estimates of land use/practices required for sustainable NRM (CSIRO Land and Water, 2000)

Estimates of costs

Item	Cost	Unit	Comment
Plantation Forestry Establishment	1,500	ha	Woodhill 1999 - $2,000; VCG 1999 - $800, Private company prospectus $3,000+; GBCMA grants figures $1,100
Non Commercial / Biodiversity Plantings	2,000	ha	Allowance of $500/ha to allow for species selection for biodiversity and forgone productive potential
Fencing	2,000	km	
Perennial Pastures	175	ha	
Salt Tolerant Vegetation	200	ha	GBCMA small areas $224/ha
Salt land Agronomy	200	ha	Guesstimate based on salt tolerant vegetation
Drainage/Runoff control	80,000	km	$30/m community drain, $180/m regional drain, average $80/m. 10m required per ha.
Groundwater Pumping	100,000		Range from 50-100,000 depending on size and public/private ownership.
Town Protection	1,000,000	no	Unknown, but conservatively estimated at $1mill
Gypsum	100	ha	
Grazing Management	5	ha	Unknown, but expected to be less than 25% of land value (approx $20/ha)
Lime	80	ha	1.5--2t/ha at $40-50/t spread.
Acid Tolerant Agriculture	200	ha	Guesstimate based on salt tolerant vegetation
Alter Drainage Patterns	800	ha	As for drainage/runoff control
Install floodgate controls	20,000	no.	
Riparian Revegetate	7,500	km	Assuming 50m wide strip (5ha per km) at $1500/ha
Riparian Weed Control	100	km	
Remote Watering Points	5,000	each	

Item	Cost	Unit	Comment
Queensland Land clearing Controls	$500 mill		
Western Australia Land Clearing Controls	$100 mill		Expected to be less than 20% of Qld requirement
Environmental Flows	$150 million		15 major drainage areas requiring $1 million pa. each for 10 years
Rangeland Retirement	20	ha	ABARE - average pastoral zone property of 80,000ha with capital value of $1.8 million
Readjustment	100,000	no	Estimate of cost of relocating a farm family to a rural/urban area.
Farm Plans	3,000	/plan	
ISO 14000 Accreditation	5,000	/accredit	
Regional information Management Systems	$30 mill		An investment of a similar magnitude to the Audit to generate regional information and data management
Conservation Tillage Program	$23 mill		$1,000 per cropping farm targeted by an extension and demonstration program
Grazing Management Program	$4 mill		$1000 per pastoral zone farm targeted by an extension and demonstration program

Estimated Investment Required

		Area	Unit	$/unit	Total
Salinity					
	Small Lot Forestry	2,091,933	ha	1,500	3,137,900,025
	Fencing	83,657	km	2,000	167,314,668
	Plantation Forestry	14,642,933	ha	1,500	21,979,400,175
	Fencing	146,429	km	2,000	292,858,669
	Non Commercial / Biodiversity Plantings	4,182,267	ha	2,000	8,364,533,400
	Fencing	418,227	km	2,000	836,453,340

		Area	Unit	$/unit	Total
	Perennial Pastures	25,751,920	ha	175	4,506,585,978
	Fencing	2,060,154	km	2,000	4,120,307,180
	Salt Tolerant Vegetation	845,000	ha	200	169,000,000
	Fencing	33,800	km	2,000	67,600,000
	Salt land Agronomy	5,000,000	ha	200	1,000,000,000
	Drainage/Runoff control	19,049	km	80,000	1,523,942,582
	Groundwater Pumping	32	no	100,000	3,200,000
	Town Protection	50	no	1,000,000	50,000,000
	Other	8,000,000	$	-	8,000,000
Erosion & Soil Structure Decline					
	Conservation tillage/soil management	13,690,053	ha	-	-
	Gypsum	250,000	ha	100	25,000,000
	Non Commercial / Biodiversity Plantings	990,000	ha	2,000	1,980,000,000
	Perennial Pasture	482,000	ha	175	84,350,000
	Grazing Management	29,157,500	ha	5	145,787,500
Soil Acidification					
	Lime	9,438,200	ha	80	755,056,000
	Acid Tolerant Agriculture	1,950,000	ha	200	390,000,000
	Perennial Pastures	400,000	ha	175	70,000,000
Biodiversity Protection					
	Biodiversity Plantings	2,365,529	ha	2,000	4,731,058,610
	Fencing	236,553	Km	2,000	473,105,861
Acid Sulfate Soils					
	Lime	28,300	ha	80	2,264,000
	Alter Drainage Patterns	50,300	ha	800	40,240,000
	Install floodgate controls	2,280	no.	20,000	45,600,000
	Bio-remediation	10,300	ha	-	-
Riparian Zone Protection					

	Area	Unit	$/unit	Total
Streamside Fencing	546,030	km	2,000	1,092,060,000
Revegetate	20,000	km	7,500	150,000,000
Weed Control	144,850	km	100	14,485,000
Remote Watering Points	40,608	no	5,000	203,037,500
Land clearing controls implementation				
Queensland	500,000,000	$	-	500,000,000
Western Australia	100,000,000	$	-	100,000,000
Rangeland Retirement for Biodiversity				
Land Retirement	32,810,660	ha	20	656,213,204
Fencing	32,811	km	2,000	65,621,320
Irrigation drainage control	-	$	-	200,000,000
Environmental weed control		$		100,000,000
Environmental Flows				150,000,000
Land Management Sub Total				58,201,175,012
Management of the Change				
Readjustment	14,951	no	100,000	1,495,088,949
Farm Plans	63,588	no	3,000	190,763,398
ISO 14000 Accreditation	10,598	no	5,000	52,989,833
Regional information Management Systems				30,000,000
Conservation Tillage Program	22,976	no	1,000	22,975,714
Grazing Management Program	4,079	no	1,000	4,079,000
Management Subtotal				1,795,896,894
Total Investment Required				**59,997,071,906**

	Area	Unit	$/unit	Total
Ongoing Investment	%offarms	farms	Annual hours	total
NRM Group Participation (hrs)	90%	63,588	24	30,522,144
Active NRM Monitoring	90%	63,588	48	61,044,287
NRM Training	90%	63,588	24	30,522,144
Extra R&D	50%	274	million	137,000,000
Management of Retired Rangelands		2	/hapa.	65,621,320
Management of Non commercial/Biodiversity Plantings		15	/hapa.	77,584,001
Management of Riparian Zone		15	/hapa.	40,952,250
Annual Liming	10%	943,820	ha	75,505,600
Total		-	-	**518,751,746**

Principles of public investment

Public investment in NRM must be justified, appropriately focussed, effectively utilised and efficiently applied if it is to serve the national interest. A range of principles can be suggested to achieve these objectives.

- **Partnership approach.** All Australians are stakeholders in NRM and have both rights and obligations as a result. Partnerships need to be formed to facilitate effective public investment in NRM and to maximise the ‘free riding’ on private investment. (Public investment should reduce the risk to private investors as a means of increasing private investment)
- **Multifunctionality.** Management of natural resources generates a range of outputs (multi-functionality) and all these outputs (positive and negative) need to be counted/valued
- **Public benefit.** All public investment in NRM should pass a ‘public benefit’ test.

- **Cost-effective interventions.** It is in the national interest to achieve society's goals for NRM at least public cost. This requires that public investment is designed to:
  - develop and apply market solutions wherever possible
  - facilitate and encourage investment in NRM by industry and the private sector particularly through R&D, strategic plans and other information but also through other instruments, concessions etc
  - directly address those remaining negative aspects of NRM that result in net social costs and are not amenable to other actions
- **National targets.** There needs to be an agreed transparent process to develop public investment priorities that are based on the national interest. This must include the means to set targets and to monitor performance in pursuit of the targets.
- **Strategic approach.** The investment should comprise an integral part of a strategic approach developed for application at regional, landscape and paddock scales.
- **Outcome focus.** The investment should be directed to specific outcomes rather than processes. Amongst other things, this reduces the moral hazard of public investment. The outcomes should be integrated with agreed (national/regional) targets.
- **Landscape scale.** The public investment should be directed to change at the level of landscapes and communities rather than farms and individuals
- **Devolution to regions.** Responsibility and resources for implementation needs to be devolved to those at the regional level where the capacity exists and efforts are needed to strengthen the capacity at this level where necessary. This should reduce transaction costs and allow public choice while allowing links with regional economic development.
- **Innovative approaches.** The process of implementing the investments should be contestable to encourage innovation and to mobilise community resources.
- **Monitoring of performance.** There needs to be simple and effective monitoring and evaluation systems used to assess performance and provide a basis for responses by management.

Riparian management

Riparian zone management will involve capital investment in fencing, revegetation and establishment of off river watering points, as well as ongoing costs in maintenance and feral animal control. The ongoing costs are likely to be prohibitive for governments and the up front capital investment will be unattractive to many landholders. Viable investment sharing partnerships could involve devolved grants, subsidies or levees to fund fencing, off river water points and revegetation as part of catchment management initiatives under agreements with landholders to carry out ongoing maintenance. A further government initiative may be the enactment of development controls to protect the riparian zone in future and to ensure revegetation.

Salinity management

Salinity, particularly dryland salinity, involves significant externalities such as salting of freshwater and damage to freshwater ecosystems. The government has a substantial role in encouraging and investment in the solutions. This can range from close to 100% public investment to protect high value biodiversity areas to cost sharing to re-establish trees in threatened landscapes. In addition to extension, grants and other incentives to encourage private landholders to establish trees, the government's role in farm forestry can include investment in transport, R&D and even processing in order to attract private investment to areas where multiple benefits (commercial, salt, erosion, riparian, biodiversity) are likely. The government may also subsidise farm forestry where it wants to capture land reclamation benefits along with carbon benefits.

Soil erosion

Soil erosion, like salinity, has substantial offsite impacts. Governments have a role in extension, RD, incentives, property planning, drought management etc to encourage landholders to avoid soil erosion. Landholders also benefit, particularly from conservation tillage technology in some regions. Governments would look to landholders to comply with best practice in most instances.

Acidification

Accelerated acidification is largely a private issue in terms of amelioration benefits. However, there is evidence of potential irreversibility through deep acidificiation and there are related issues such as the difficulty in establishing perennial pastures to address salinity in acid soils areas. The government may have a role in providing assistance and incentives in such areas, in addition to extension programs. The Audit is currently working with agribusiness to document soil fertility and there may be opportunities for further partnership with agribusiness towards better fertiliser application processes.

Rangelands stability and biodiversity

In Western Australia, the government is buying back leasehold properties and de-stocking to allow rehabilitation. This is seen as a strategy for improving biodiversity and also for sequestering carbon for greenhouse credits. It is likely that the main long term strategy for improved/sustained biodiversity outcomes in the rangelands is partial de-stocking and stewardship.

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