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Salinity

by

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EXECUTIVE SUMMARY

Salinity refers to the presence of excessive quantities of salt in soils and water and relates to the concentration of salt on the land and its accumulation in water systems. In Australia large amounts of salt are stored in the landscape, in soils, rocks and weathered material. With European settlement in Australia, the water balance has changed. Native vegetation with a variety of deep-rooted perennial plants and trees has been replaced by large areas of shallow-rooted plants. Woodlands and forests have been replaced with crops such as wheat and clover paddocks.

The result of this tree clearing and cropping is that more water is reaching the water table, and the water table is rising. As the water table rises, it mobilises the salts stored in the landscape. In NSW salinity is generally grouped into three categories. These are: dryland salinity; irrigation salinity; and urban salinity.

Recent national estimates suggest that 2.5 million hectares of land are affected by dryland salinity. As the process of salinisation is temporal, current trends in the process of salinisation indicate that the amount of land affected by salts will increase in the future.

In NSW, the area of salt affected land is reported to be 120,000 hectares. However, this figure is likely to be an underestimate. If current patterns of land use and ground water rise continue, NSW could face up to 7.5 million hectares of salt affected land by 2050.

The major irrigation areas in NSW are all now threatened by rising water tables. Some research indicates that approximately 70-80% of all irrigated land in NSW is threatened by rising watertables and associated salinity problems. Overall, in 1995 an estimated 15% of the irrigated land in NSW had high watertables, and soil salt levels exceeded the level where salinity becomes a problem in 9% of irrigated land. Water tables are rising at the greatest rate (100-500 mm per year) in the south-eastern parts of the Murray Darling Basin.

More recently, off-farm damage by salting has become apparent, with numerous inland communities reporting the presence of high watertables and an increase in the number of salt seeps. The high watertable and increase in soil salt levels has accelerated the deterioration in public infrastructure such as roads and sewerage systems, and damaged private infrastructure.

Salinity, and especially dryland salinity, is diffuse, widespread and often has indirect impacts. As such, it is impossible to calculate its overall effect on the nation. However, it has been estimated that the capital loss of land due to salinity nationwide is approximately \$700 million, with lost production estimated at \$130 million annually.

Both the Commonwealth and State Governments, as well as local communities, have been active in the development of strategies and plans to combat salinity. These activities include a NSW government sponsored 'Salinity Summit', the outcomes of which are summarised in the paper.

1.0 INTRODUCTION

Salinity refers to the presence of excessive quantities of salt in soils and water and relates to the concentration of salt on the land and its accumulation in water systems. Salinity causes many problems, including land degradation and loss of productive capacity, damage to urban and rural infrastructure such as roads and bridges, and loss of biological diversity.

In NSW, as much as 7.5 million ha could be affected by salinity problems in the future. Other States have problems of a similar scale. Governments at all levels and communities have been active in implementing strategies to reduce or mitigate the problems of salinity. However, with the recent holding of a variety of community participatory 'salinity summits', it is now an appropriate time to review these programs and plans for combating salinity into the new millennium.

2.0 THE TYPES OF SALINITY AND HOW IT IS CAUSED

Salinity refers to the presence of excessive quantities of salt in soils and water and relates to the concentration of salt on the land and its accumulation in water systems.¹ In Australia large amounts of salt are stored in the landscape, in soils, rocks and weathered material. The salt has come from ancient ocean sediments, deposition of sea spray and rock weathering. With European settlement in Australia, the water balance has changed. Native vegetation with a variety of deep-rooted perennial plants and trees has been replaced by large areas of shallow-rooted plants. Woodlands and forests have been replaced with crops such as wheat and clover paddocks.

The result of this tree clearing and cropping is that more water is reaching the water table², and the water table is rising. As the water table rises, it mobilises the salts stored in the landscape.

In NSW salinity is generally grouped into three categories. These are:

- dryland salinity;
- irrigation salinity and;
- urban salinity.

2.1 Dryland Salinity

Dryland salinity occurs when water tables rise to between two to three metres of the surface. Capillary rise brings the water to the soil surface, and the evaporation of the water

¹ Auditor General of Victoria, *Special Report No 19, Salinity*. 1993, at 31.

² The water table is the upper surface of the zone of saturation by groundwater. Below the water table, water is free to move under the influence of gravity. The position of the water table is shown by the level at which water stands in wells.

on the surface concentrates salts to a point where they affect the environment.³ Once surface salt concentration reaches a certain threshold, some plant species will suffer and be replaced by salt tolerant species. If allowed to continue, the process will result in surface salt concentrations reaching a level where very few plant species can survive. The ground then becomes bare of vegetation and is termed a 'salt scald', which then becomes prone to soil erosion. These salt scalds, if left unattended, can erode to the extent that all topsoil, which contains all the nutrients necessary for plant growth, is eroded away. This then represents a major problem in terms of rehabilitation of the soil structure and revegetation.⁴

Salt scalds are the symptom of dryland salinity and occur in what are termed discharge areas. These are areas where the groundwater discharges onto the ground surface. The points where water enters the ground are referred to as recharge areas.

Recent national estimates suggest that 2.5 million hectares of land are affected by dryland salinity. As the process of salinisation is temporal, current trends in the process of salinisation indicate that the amount of land affected by salts will increase in the future. Predictions of the growth in salt affected land are difficult as the appearance of salt damage takes time.⁵

In NSW, the area of salt affected land is reported to be 120,000 hectares. However, this figure is likely to be an underestimate due to low levels of awareness and quality of mapping. If current patterns of land use and ground water rise continue, NSW could face up to 7.5 million hectares of salt affected land by 2050.⁶

In NSW the land that is affected by salinity is mainly west of the Great Dividing Range, in the rainfall zone that receives between 400 and 850mm of yearly rainfall. Dryland salinity is a major problem in the central west of NSW, as the following points demonstrate:

- Macquarie River at Dubbo shows a median salt load of 206 tonnes per day, whilst Lachlan River at Forbes shows a median salt load of 348 tonnes per day. Both rivers show a rising trend in salinity concentration and load;
- Lachlan River is unsuitable for human consumption and irrigation at certain times;

³ Wooldridge,A. "Salinity: We are all in this together", in Langtry J (Ed) *Rising Water Tables and Salinity in Yass River Valley*, Murrumbidgee Landcare Association, Wagga Wagga NSW 1999, at 22. Mr Wooldridge is a Salinity Extension Officer with the NSW Department of Land and Water Conservation.

⁴ Franklin,J. "Dryland salinity: a Land Management Issue – not a Disaster." In Langtry J (Ed) *Rising Water Tables and Salinity in Yass River Valley*, Murrumbidgee Landcare Association, Wagga Wagga NSW 1999, at 36.

⁵ Eberbach,P "Salt affected soils: their cause, management and cost" in Pratley J and Robertson A (Eds) *Agriculture and the Environmental Imperative*, CSIRO, 1998, at 80.

⁶ Wooldridge,A. "Salinity: We are all in this together", in Langtry J (Ed) *Rising Water Tables and Salinity in Yass River Valley*, Murrumbidgee Landcare Association, Wagga Wagga NSW 1999, at 22.

- In the Boorowa River catchment, 101 of 109 properties surveyed had salinity problems, with saline sites at these properties expanding in size at an average rate of 17% per year. Water tables in the Boorowa River catchment are rising at 10% per year, with the Boorowa River contributing 100,000 tonnes of salt to the Lachlan River per year.⁷

2.2 Irrigation Salinity

Most of the irrigation in NSW is within the Murray Darling Basin, so it is no surprise that most of the land affected by irrigation salinity lies within that region. Irrigation can lead to salinity by two pathways: over application of irrigation water, directly recharging the aquifer beneath the irrigation area causing groundwater levels to rise; and by the addition of salts dissolved in irrigation water to land where insufficient leaching occurs to remove excess salts.

The area affected by irrigation salinity can be determined by two criteria:

- Where the watertable is within 2 metres of the land surface;
- Where soil salt levels, measured as electrical conductivity, exceed 2 deciSiemens per metre (dS/m).⁸

Detrimental effects on plant growth and crop yield have been noted when electrical conductivity levels in the top 30 cm or so of soil exceed 2 dS/m. When watertables rise to a critical depth – around 2 metres below the land surface, the upward movement of water by capillary action, coupled with evaporation on the soil surface can accumulate salts in the root zone causing plant damage.⁹

Estimates of the current and predicted area affected by high watertable and salted soil refer to formal irrigation areas and districts in the Murray, Murrumbidgee and Lachlan River valleys, and some private irrigation areas in the Lower Macquarie and Murray – Darling catchments, and the Liverpool Plain.

The major irrigation areas in NSW are all now threatened by rising water tables. Some research indicates that approximately 70-80% of all irrigated land in NSW is threatened by rising watertables and associated salinity problems. Overall, in 1995 an estimated 15% of the irrigated land in NSW had high watertables, and soil salt levels exceeded the 2 dS/m

⁷ Wooldridge, A. "Salinity: We are all in this together", in Langtry J (Ed) *Rising Water Tables and Salinity in Yass River Valley*, Murrumbidgee Landcare Association, Wagga Wagga NSW 1999, at 20.

⁸ Electrical conductivity is a measurement of salt concentration in soil or water, it measures the property of the substance to transfer an electrical charge in microSiemens or deciSiemens per centimetre or metre.

⁹ Environment Protection Authority, *New South Wales State of the Environment 1997*, 1997 at 138.

in 9% of irrigated land. Water tables are rising at the greatest rate (100-500 mm per year) in the south-eastern parts of the Murray Darling Basin.¹⁰

2.3 Urban Salinity

More recently, off-farm damage by salting has become apparent, with numerous inland communities reporting the presence of high watertables and an increase in the number of salt seeps. The high watertable and increase in soil salt levels has accelerated the deterioration in public infrastructure such as roads and sewerage systems, and damaged private infrastructure. In a 1994-95 survey in the Murray-Darling Basin, 52% of local councils reported that salt was causing off farm damage in urban areas.¹¹ In the Central West of NSW most towns show obvious signs of salinity, including:¹²

- Dead and dying trees;
- Salt tolerant grasses appearing in gardens and recreation areas;
- Bare patches in lawns and sporting fields;
- Road surfaces breaking up;
- Damage to structures – deterioration of bricks and mortar;
- Rising damp in buildings – public and private;
- Salt crusting on bricks, concrete and pavers;
- Deterioration of house foundations, reduced life of concrete slabs;
- Corrosion of underground services – pipelines and cables.

Although the recharge (ie, water entering the ground) in the urban context may in part be derived from recharge of adjacent rural holdings, land practices in the urban environment are also likely to be major contributors. For example, in 1994 the NSW Supply and Sewerage Performance comparison survey, found that in most cases leakage of town water supply was underestimated by the local authority. The survey found that from 40 water supply systems in NSW leakages varied from 7 to 35% of the total supply. Other urban recharge sources are also important. In Wagga Wagga, investigations found important

¹⁰ Environment Protection Authority, *New South Wales State of the Environment 1997*, 1997 at 137.

¹¹ Eberbach, P "Salt affected soils: their cause, management and cost" in Pratley J and Robertson A (Eds) *Agriculture and the Environmental Imperative*, CSIRO, 1998, at 80.

¹² Wooldridge, A. "Salinity: We are all in this together", in Langtry J (Ed) *Rising Water Tables and Salinity in Yass River Valley*, Murrumbidgee Landcare Association, Wagga Wagga NSW 1999, at 23.

sources of recharge from rainfall (diffuse recharge and household stormwater drainage via rubble pits), over irrigation of house gardens and public areas, as well as leakage from water supply and sewage pipes.¹³

3.0 THE COST OF SALINITY

Salinity, and especially dryland salinity, is diffuse, widespread and often has indirect impacts. As such, it is impossible to calculate its overall effect on the nation. However, it has been estimated that the capital loss of land due to salinity nationwide is approximately \$700 million, with lost production estimated at \$130 million annually. The impacts are being felt mainly in the grains, wool and grazing industries of the more intensive land use zones of temperate Australia.¹⁴

Road and bridge damage caused by shallow saline groundwater is a major cost to local governments. It is believed that in south-western NSW, about 34% of the State roads and 21% of national highways are affected by high water tables, and damage costs \$9 million per year. The town of Wagga Wagga sustains a cost of about \$500,000 per year from salinity induced damage to roads, footpaths, parks, sewage pipes, housing and industry.¹⁵ A study by the NSW Department of Land and Water Conservation estimated that urban salinity for Wagga Wagga will cost the community \$95 million over the next 30 years, assuming that saline damage as seen at present continues and that no action is taken to ameliorate the problem. Of this amount, road maintenance was estimated to cost \$56 million and damage to private homes \$19 million.¹⁶

Rising water tables and increasing salinity have serious impacts on native vegetation and biodiversity. Riparian vegetation, which is critical to stream bank stability, as well as wetland areas is already damaged and under increasing threat.

4.0 WHO SHOULD PAY FOR DRYLAND SALINITY SOLUTIONS

One of the problems of dryland salinity is its spatial nature – recharge and discharge areas are typically geographically remote and occur within a catchment, often on land owned by different landowners. Should one landholder curb their agricultural practice, such as annual cropping, and replace it with a potentially lower value enterprise, such as perennial pastures, for the benefit of a neighbour? If so, should the beneficiary pay reparations to the

¹³ Eberbach, P "Salt affected soils: their cause, management and cost" in Pratley J and Robertson A (Eds) *Agriculture and the Environmental Imperative*, CSIRO, 1998, at 84.

¹⁴ Prime Minister's Science, Engineering and Innovation Council, *Dryland Salinity and its Impact on Rural Industries and the Landscape*, 7 January 1999, at 5.

¹⁵ Prime Minister's Science, Engineering and Innovation Council, *Dryland Salinity and its Impact on Rural Industries and the Landscape*, 7 January 1999, at 6.

¹⁶ 'Urban salinity – the cost and who pays.' In *Focus*, A Newsletter of the National Dryland Salinity Research, Development and Extension Program, Issue 14 July 1999 at 3.

donor farmer?¹⁷

Whilst it is occasionally argued that agricultural producers have caused the problem and therefore should be responsible for fixing the problem and paying the costs, this ignores the historical background of government support to clear land and encourage agriculture to increase food production.

Given current commodity prices and the international nature of agricultural trade, it is impracticable to expect that farmers alone can effect a change in trends in dryland induced salt damage. On this basis, it is argued that the risk and cost of salt damage should be shared between the three major stakeholders – the government, consumers and landholders.¹⁸

Whilst governments and landholders, through programs as discussed in the next section, have contributed funds to combat salinity, some argue an environmental levy on food could be used to support restorative work, upgrade irrigation infrastructure and education and training programs. However as Eberbach notes, the introduction of a new tax is normally distasteful to the Australian public, and the role for the government would be to market the concept not as a tax but as a contribution to the sustainability of our natural resource base.¹⁹

5.0 RESPONSES TO DRYLAND SALINITY

Both the Commonwealth and State Governments, as well as local communities, have been active in the development of strategies and plans to combat salinity. Below is a summary of a statement by the Prime Minister's Science, Engineering and Innovation Council. An appraisal of the major programs that deal with salinity on both a Commonwealth and State basis is then presented.

5.1 The Prime Minister's Science, Engineering and Innovation Council

The Prime Minister's Science, Engineering and Innovation Council (PMSEIC) commissioned a paper on dryland salinity in May 1998. The paper was subsequently presented to the Council on 4 December 1998, and a summary is presented below.

¹⁷ Eberbach, P "Salt affected soils: their cause, management and cost" in Pratley J and Robertson A (Eds) *Agriculture and the Environmental Imperative*, CSIRO, 1998, at 89.

¹⁸ Eberbach, P "Salt affected soils: their cause, management and cost" in Pratley J and Robertson A (Eds) *Agriculture and the Environmental Imperative*, CSIRO, 1998, at 91.

¹⁹ Eberbach, P "Salt affected soils: their cause, management and cost" in Pratley J and Robertson A (Eds) *Agriculture and the Environmental Imperative*, CSIRO, 1998, at 92.

Dryland Salinity and its Impacts on Rural Industries and the Landscape²⁰

Salinity affects regions across Australia:

- In Western Australia, 1.8 million ha are affected at present, and this could double within 20 years, and double again before equilibrium is reached;
- In South Australia, all agricultural districts exhibit some degree of dryland salinity, and at least 20% of surface water resources are above recommended salinity limits for human consumption;
- In Victoria, there are extensive impacts in western regions, which are likely to increase substantially as mapping continues;
- In NSW, as much as 7.5 million ha could be affected in the future as groundwater rises;
- In Queensland, severe salting affects 10,000 ha, and dryland salinity is an emerging threat;
- In Tasmania, about 18,000 ha, or about 2% of cleared agricultural land is affected by salinity.

The time scales over which salinity establishes itself, spreads and has its effects can be long. Once established it can be very difficult or impossible to contain or reverse. The consequence of this is that salinity must get worse in Australia due to the land use decisions already made.

In some places the cause of the problem and the resultant salt scalds are at the bottom of hill slopes on the one property. In other cases the cause of the problem may be hundreds of kilometres from where the symptoms become obvious.

Much of the effort devoted to addressing salinity has been focussed on the symptoms of the problem rather than the causes. If the water balance of a catchment is not restored, the symptoms will simply keep recurring. While much is being achieved by the improvement in the water use of current farming systems, this may still be insufficient to change the water balance on a catchment scale. Changes in land use must be considered, either by restoring water balance (eg, farm forestry) or living with the symptoms because reversal is not an option.

The issue of salinity has shown that there are clear market failures in that the cost of degradation to downstream users and to the environment are not borne by those who are benefiting from the upstream exploitation of the landscape. In many cases the cost will be borne by future generations.

²⁰ Prime Minister's Science, Engineering and Innovation Council, *Dryland Salinity and its Impact on Rural Industries and the Landscape*, 7 January 1999.

Salinity is a complex issue and there are no remedial plans that can be universally applied across the country. Region based analysis is needed to clarify the degrading processes in particular areas, and the most cost effective approach to combating them. There is a major leadership role for Federal and State governments in identifying and supporting management strategies that develop responses on appropriate scales. Salinity is an overwhelming issue for many rural communities, which are already demoralised and dispirited by a number of factors. Government leadership in acknowledging the seriousness of the problem, and committing to useful solutions, is a precondition to the private investments that will be needed if the situation is to change.

The PMSEIC made 12 recommendations, which are reproduced below:

- 1: The Prime Minister should make a statement on dryland salinity acknowledging the seriousness of the problem and supporting a range of activities to address the problem on a regional level. The biodiversity impacts, water quality issues and damage to infrastructure and urban areas needs to be acknowledged, along with the consequences for agriculture. Any effective response to the salinity crisis must be in partnership with the States, and the Council of Australian Governments framework would be an appropriate mechanism to achieve this.
- 2: Blanket recipes on how to deal with dryland salinity are likely to be inappropriate. Comprehensive analysis is required to identify those areas which would benefit from public and private investment, and those where such investment is likely to be totally ineffective. Dependent on the value of the areas under consideration, and on the costs and benefits of treatment, the emphasis should move from treatment of symptoms to treatment of causes. Support from federal programs should be dependent on such planning.
- 3: There are a variety of reasons to protect native vegetation, and we applaud Government endeavours in this direction. Land clearing should only be allowed after (among other considerations) a thorough analysis of regional water balances has been undertaken and there can be clear assurances that such clearing and the new land uses will not exacerbate future dryland salinity problems. This is largely an issue for the States and it is important to draw it to their attention.
- 4: Further research is needed in farming systems and land use systems suitable for Australia which will have benefits in a range of areas, including dryland salinity. We need: more information on the water using capacity of various types of vegetation; experimentation with new farming systems that are adapted to the Australian climate; more cost-effective survey techniques; socio-economic R&D to create an enabling environment; and improved analysis techniques to quantify the aggregate impacts of land use patterns on the landscape. Much of this research must be at a larger geographic scale that has characterised much past research, and must be focussed on management solutions within the context of economic and social conditions. CSIRO has made a start on this important work, and it needs to be accorded higher funding priority.

- 5: Three or four initiatives at the scale of large elements of the landscape and/or large catchments should be developed to demonstrate and evaluate integrated approaches to handling dryland salinity. This development should be undertaken in consultation and collaboration with communities which are prepared to take part. The Minister for Agriculture, Fisheries and Forestry should consider this proposal.
- 6: There is a need to encourage the development and use of small teams of well qualified and experienced professionals in the range of disciplines involved with dryland salinity, to provide rapid assessment and advice to those dealing with salinity issues. The involvement of producers and community groups with these teams is essential, and must be funded to allow their participation in designing and developing management solutions. The Minister for Agriculture, Fisheries and Forestry should explore this idea with the States, and consider funding support to implement it.
- 7: There is a clear need for ongoing funding of research, planning and on-ground works, and there are major public benefits as well as the obvious benefits to landholders. We urge the Government to commit to ongoing financial support of community groups and agencies to facilitate implementation of those plans developed and accredited under earlier programs, such as the Decade of Land Care and the Natural Heritage Trust. This will be addressed by the Minister for Agriculture, Fisheries and Forestry in the forthcoming statement on Natural Resources Management.²¹
- 8: Regulatory and market-based instruments need to be used to influence the ability to address dryland salinity. A number of innovative approaches are being developed in various States. We recommend that the various approaches be documented and evaluated. This will provide guidance, and ensure lessons are carried beyond state borders. The Land and Water Resources Research and Development Corporation is undertaking this review.
- 9: The development of a carbon credit trading system has the potential to be a complementary tool in addressing dryland salinity. We urge the Government to ensure that the Australian Greenhouse Office, in developing the system, consider the need for appropriate types of trees, and their location in the landscape, that can help regional water balance issues.
- 10: Federal and State governments should continue to alert local governments to the extent and implications of dryland salinity. The development of a manual on *Best Practice Planning Policies for Local Governments* would be valuable, to help ensure that development applications or proposals or land use practices will not contribute to the ongoing dryland salinity problem. Disciplines involved in local government planning, such as town planners and shire engineers should also be influenced through conferences and professional associations. The Minister for Transport and Regional Services should be asked to address this issue.

²¹ The Minister for Agriculture, Fisheries and Forestry the Hon Warren Truss MP released the discussion paper *Managing Natural Resources in Rural Australia for a Sustainable Future* on 6 December 1999.

- 11: Governments and individuals are not going to make appropriate investment decisions without good long-term data. Our data networks have been cut back in recent years. We need to ensure we have appropriate data on streamflow and quality, groundwater depth and quality, vegetation cover and salinised land areas. We also need to ensure effective monitoring of the interventions that are funded to assess whether they provide the expected benefits. The National Land and Water Resources Audit²² should be asked to advise on appropriate monitoring and evaluation strategies.
- 12: In view of the magnitude of this problem, and the reviewing of key strategies and programs that are now under way, we recommend that the Prime Ministers Science, Engineering and Innovation Council commission another report in the year 2000 to evaluate the new approaches and the need for further actions.

5.2 The National Dryland Salinity Program

This program was established in 1993 to address the lack of opportunity for the research community to cooperate across disciplines, organisational boundaries and state borders to address the management of dryland salinity. The first phase of the program was completed in 1998, and conclusions reached in this phase included that intervention on a massive scale is required to achieve any significant improvement in dryland salinity, and that we may have to learn to live with it.²³

A second phase of the program commenced in July 1998 and is due to run until 2003. The second phase was established in response to the need to address more fully the issues of dryland salinity, and to hasten the communication and adoption of the lessons learnt from the first phase.²⁴ In addition, the second phase will be developing ways of managing and developing new industries within the constraints of salinity and the protection and rehabilitation of lands. The program has funded a project that is taking a new look at options for those forced to live with salinity. The project 'Options for the Productive Use of Salinity' (OPUS) will identify and assess innovative approaches to the use of saline land and water resources. To date, the more popular uses of saline land, such as saltland pasture systems and agroforestry, have attracted most of the research effort. However, other industries, such as the potential to generate heat and electricity from solar ponds, growing opportunities to expand the inland saline aquaculture industry, and establishing salt harvesting facilities based upon the evaporation of saline groundwater, are all activities that deserve attention.²⁵

²² See section 5.3 for an explanation of the Audit.

²³ "Dryland salinity, the sleeping giant is waking." In *Australian Landcare*, December 1999 at 40.

²⁴ Prime Minister's Science, Engineering and Innovation Council, *Dryland Salinity and its Impact on Rural Industries and the Landscape*, 7 January 1999, at Appendix B.

²⁵ Bolt, S. 'Options for the Productive Use of Salinity (OPUS)' in *Focus*, A Newsletter of the National Dryland Salinity Research, Development and Extension Program, Issue 15 October 1999 at 4.

Partners in the program include the: Land and Water Resources Research and Development Corporation (LWRRDC); Murray Darling Basin Council; Department of Primary Industries and Energy; Environment Australia; Grains R&D Corporation; Rural Industries R&D Corporation; National Land and Water Resources Audit, Commonwealth Scientific Industrial Research Organisation; and the State Governments of NSW, Queensland, Victoria, South Australia and Western Australia.

5.3 The National Land and Water Resources Audit

The Audit is one of the programs of the Natural Heritage Trust, with funding of \$29.4 million budgeted for the Audit over four years concluding June 2001. The aim of the Audit is to provide a comprehensive national appraisal of Australia's natural resource base. The Audit will contribute to addressing dryland salinity through predictive research and development, involving data collation and modelling on the extent and trends of salinity. It is hoped the Audit will:²⁶

- Quantify the physical extent of the environmental and social impact of the problem of salinity;
- Provide a broad cost-benefit analysis of remediation alternatives; and
- Predict the extent and costs of the problem and how these would vary if best management practices were being followed.

5.4 The Murray Darling Basin Commission

The Commission is a partnership of six governments formalised by the Murray Darling Basin Agreement.²⁷ The Agreement enables institutional arrangements for integrated catchment management. In 1988 the Commission first released a Salinity and Drainage Strategy to reduce the salinity of the Murray River through a combination of engineering (eg salt interception works, ground water pumping and drainage) and non-engineering works such as land and water plans. The Strategy is being reviewed and a new Strategy is due to be completed by June 2000.

5.5 Australian Landcare

The Australian Conservation Foundation and the Australian Farmers Federation in 1988 first put Landcare as a concept to the Commonwealth Government. Landcare is a partnership between land holders and land managers, industry and all levels of government. The aim of Landcare is to manage all natural resources sustainably, through a process of

²⁶ Prime Minister's Science, Engineering and Innovation Council, *Dryland Salinity and its Impact on Rural Industries and the Landscape*, 7 January 1999, at Appendix B.

²⁷ The six governments are: Queensland, New South Wales, Australian Capital Territory, Victoria, South Australia and the Commonwealth.

education of community groups and acting upon projects to arrest land degradation. Landcare groups do not restrict their activities to salinity problems alone. However, they may and invariably do have a very important role in the development of strategies and implementation of solutions to combat salinity in their respective catchment areas. For instance, in Yass the local Landcare group has:

Been active in terms of education of members via field days, guest speakers, acquiring technical reports and relevant mapping. Local Landcare groups and individual Landcare members have been involved in much of the on-ground work involving tree planting, structural works and saline discharge area rehabilitation in the Valley.²⁸

The number of Landcare groups in NSW has increased from 54 in 1989 to 1004 in August 1996.²⁹

5.6 Land and Water Management Plans³⁰

Land and Water Management Plans (LWMPs) are required for each of the large scale irrigation areas in NSW. The plans are district based action plans developed by a community elected working group, and negotiated with government for implementation. The focus of each plan is to develop strategies that will improve the well-being of the rural and urban community in the short and long-term, by preserving or improving the condition of the natural resource base and improving farm productivity. The groups identify the major issues at the farm and district level and try to produce an integrated strategy to deal with land, water and other natural resource issues, and community needs.

The first Plans to be implemented have focussed on the formerly government owned irrigation areas such as those in the Murray Valley, containing the Irrigation Districts of Berriquin, Deniboota, Denimein and Wakool. The implementation of the Plans is a licence requirement of the former state-owned irrigation areas and districts. The major issue addressed in the plans is on-farm sustainability and downstream water quality. Each of the plans identifies the current extent of land and water problems, including salinity, and then predicts what the extent may be in 30 years time if no action is taken.

LWMPs identify pressures that may lead to further increases in water tables and develop responses to prevent further degradation occurring. The responses identified for farm and district level include:

²⁸ Franklin, J "Dryland salinity: a land management issue – not a disaster." In Langtry J (Ed) *Rising Water Tables and Salinity in Yass River Valley*, Murrumbidgee Landcare Association, Wagga Wagga NSW 1999, at 43.

²⁹ Environment Protection Authority, *New South Wales State of the Environment 1997*, 1997 at 129.

³⁰ See Environment Protection Authority, *New South Wales State of the Environment 1997*, 1997 at 145.

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- Improved on-farm irrigation management and farm productivity;
 - Provision of surface drainage;
 - Water quality monitoring;
 - Groundwater pumping;
 - Sealing of supply channels.

The Plans assess the economic, social and environmental benefits and costs incurred from implementing each of these response strategies.

The state government provides funding of \$8 million each year (matched equally with Commonwealth funds through the Natural Heritage Trust) for joint development and implementation of the Plans with the local communities.

5.7 The NSW Department of Land and Water Conservation ³¹

The Department notes that the role of managing the growing problem of salinity is a responsibility that must be shared by the community and government. The Department, in partnership with other state agencies and the community is managing salinity in a number of ways as follows:

- Implementation of the water reforms and vegetation reforms, and the maintenance of the cap on water diversions in the Murray-Darling Basin, all of which play a major role in addressing the causes and symptoms of salinity.
- Community-government management committees for NSW river and groundwater systems will advise on how to achieve a better balance in sharing water between the environment and water users. The committees will need to agree on actions to meet the river salinity levels contained in the National Water Quality Management Strategy Guidelines.
- The Native Vegetation Conservation Act³² is aimed at increasing and improving vegetation cover and assisting landholders to conserve and manage native vegetation on their properties. The focus of native vegetation management has been to address the concerns of rural communities. Concerns relevant to salinity include protecting water quality, maximising the potential for rural industries, replanting and rehabilitating sites to address rising water tables.
- The NSW Salt Action program has been in place for nine years with \$3 million funding each year from the state and federal governments. The funding has enabled community-based projects aimed at: investigating salinity; raising awareness and assisting

³¹ See the Department of Land and Water Conservation's Internet site at <http://www.dlwc.nsw.gov.au/care/salinity>.

³² See: *Native Vegetation in NSW: An Update*. NSW Parliamentary Library Briefing Paper No 6/99.

landholders to undertake activities which help minimise salinity.

- Research, education and awareness activities within DLWC. Research has focused on understanding processes (water and salt balance), adaptive cropping and grazing systems (including species selection) and electromagnetic survey techniques.
- The Natural Heritage Trust, DLWC and NSW Agriculture all assist with recurrent funding directed at dryland salinity research, investigations, monitoring and extension.
- Commitment to the Murray-Darling Basin Salinity and Drainage Strategy, which includes the operation of salt interception schemes.
- State input and support of the National Dryland Salinity Program.

5.8 The Community Salinity Summit

On February 3 and 4th this year a community salinity summit was held at Wagga Wagga. The summit was organised by four organisations in partnership. These were the: Nature Conservation Council of NSW; NSW Farmers' Association; NSW Aboriginal Land Council; and the NSW Council of Social Service.

A summary of recommendations as provided by the summit organisers is as follows:³³

- Strategic framework is needed to address salinity on a national, state, local and farm level, focussing on priorities such as recharge areas;
- Salinity levy – all Australians need to accept responsibility for salinity;
- Salinity skills need to be increased within regional communities; employment and training needs must be resourced;
- Research is needed to quantify problems, identifying when and where salinity may arise in the future;
- Adaptive management – learning what works and what doesn't and sharing salinity stories;
- All governments and the wider community must recognise and include, early in the process, indigenous communities as equal partners in solutions to salinity and broader natural resource management;
- Clear and consistent advice from all NSW Government agencies on avoiding, managing and solving salinity within a strategic framework;
- Structural adjustment fund should be established for those experiencing salinity induced hardship;
- Resources are needed to establish sub-catchment scale salinity programs to demonstrate benefits;

³³ Nature Conservation Council of NSW, NSW Farmers' Association, NSW Aboriginal Land Council, and the NSW Council of Social Service, *Community Salinity Summit Solutions to Salinity*. February 3rd and 4th 2000, Charles Sturt University Wagga Wagga.

- A joint Federal – State Ministerial Council to be formed to progress solutions to salinity supported by the appointment of a Parliamentary Secretary for Salinity.

5.9 The NSW Salinity Summit 2000

On 16 and 17 March 2000 the NSW Government organised the NSW Salinity Summit in Dubbo. The Summit was attended by over 200 hundred people including Parliamentarians, environmentalists, landholders, natural resource management community groups, scientists and local government representatives. The Summit held eight working groups covering the following themes:

- Sustainable use of natural resources;
- Constructing a policy framework;
- Delivering the actions;
- Communities adapting to change;
- Understanding the problem – Building skills to overcome it;
- Developing market based solutions;
- Encouraging business initiative;
- Urban salinity solutions.

The Summit released a general Communique and recommendations from the eight working groups. The Communique and recommendations are reproduced in Appendix 1. Below is a summary of the outcomes of the Summit.

The Communique

The Summit agreed that salinity should be viewed in the context of over-all management of natural resources, including water, soil, vegetation, biodiversity as well as consideration of social and economic factors.

The Summit noted that whilst there are already many programs that are dealing with salinity, their administration and delivery can be better coordinated and targeted.

The Summit recommended that the Council of Australian Governments, under the leadership of the Prime Minister, should develop and adopt a national strategy on salinity as a matter of urgency. Other key recommendations arising from the Communique include the following:

- The NSW Government should develop an integrated Salinity Strategy. The process should be led and coordinated by the Premier;
- The Strategy should encompass a suite of solutions aimed at continuing agricultural productivity, conserving biodiversity, and protecting the built environment;
- An expert group of leading financiers and economists should be established to advise the Government on market based solutions to salinity;
- Innovative commercial solutions to salinity should be facilitated. Some ways to achieve

this include streamlining regulations, promoting commercial opportunities, developing markets;

- The NSW Government should help the whole community to understand and tackle the issue of salinity, through education, research and education;
- The NSW Government should examine ways to provide better coordinated natural resource management;
- Catchment plans and other environmental planning instruments should incorporate salt targets which reflect what people want from their landscapes.

Working Group A: Sustainable Use of Natural Resources

This Working Group contributed four pages of recommendations, including a summary statement as reproduced below:

The NSW Salinity Strategy should:

- Develop a hierarchy of plans which share the following characteristics:
 - Concerted actions to secure common goals;
 - Incorporate environmental, social, economic and productive land issues into salinity plans;
 - Clear directions, accountabilities, commitments, partnerships and links to other natural resource and planning processes.
- Central to this hierarchy should be a whole of catchment or regional level directive plan focussed on salinity, incorporating related nature conservation and water quality issues, which needs to be translated into local implementation plans at the subcatchment and farm level;
- Provide facilitating and empowering mechanisms, such as:
 - A conservation trust and/or a revolving fund for the rehabilitation of specific, priority areas;
 - Nature conservation credits.

Working Group B: Constructing a Policy Framework

This working group developed 32 recommendations as well as a flowchart of a model regional policy framework.

The group noted that salt must be viewed in the context of landscape management. Valley based salinity targets should be implemented, and the State, basin and catchment levels should have a direct role in setting these targets. The targets need to be given effect through a catchment strategy.

Catchment management strategies must have legal effect, and other environmental planning instruments should be compatible with these strategies. The catchment strategy should be

developed by a catchment management board within a State framework, and be subject to formal consultation and approval. The strategies need to be built around achieving the targets in priority and at risk areas, and incorporate clear and precise accountability levels.

National leadership is required, as is long term funding responses to salinity using various means, such as levies and 'market' solutions. Natural resource management focus should shift from grant to investment based programs, to be based on outcomes rather than targets.

Indigenous communities are an important part of the solutions to salinity and must be considered as equal partners.

Structural adjustment measures for landholders in recharge areas and those affected by salinity should be considered. These measures should incorporate a suite of options.

Program delivery should be through a mix of private, community, and all government levels. Accountability for delivering salinity outcomes should be clearly defined at both State and catchment landscape levels.

Working Group C: Delivering the Actions

This working group delivered four recommendations. The first recommendation outlined the broad objectives and principles underlying an action strategy. These included enhancing a sustainable agricultural base and protecting high conservation areas at a landscape scale.

The group recommended that the priorities for action be:

- For information and awareness – collate available information and fill identifiable gaps, improve standardisation of information, raise whole of community and government awareness of the salinity issue;
- For developing a framework – enunciate roles and responsibilities of different levels of government and catchment bodies;
- For setting targets – catchment management boards, with appropriate funding and empowerment, in partnership with government, are the primary bodies to facilitate community consultation for the setting of targets and implementation of natural resource management programs.

The group recommended that the following tools be considered:

- Encouragement – especially Landcare as a primary support and delivery mechanism for the improvement of natural resource management;
- Market/economic incentives;
- Direct regulation.

In using these tools the group recommended that the following principles should be applied in selecting the most appropriate one:

- Identify the potential salinity risk and develop a community driven regional plan which identifies key problems and then select the most appropriate suite of tools to deal with them;
- Use the appropriate mix of tools to encourage changes in land use and management, which should be matched with land capability;
- In choosing the most appropriate suite of tools, the environmental, economic and social impacts must be assessed with a view to maintaining sustainable communities;
- Where possible, tools based on market/economic incentives and encouragement should be preferred.

Working Group D: Communities adapting to Change

This group presented four categories of recommendations as follows:

1/ Awareness, education and knowledge building. Amongst other things, this recommendation included the recognition that the nature, extent and impact of salinity and solutions varies across the State, and that government agencies should develop a joint and consistent response to salinity.

2/ Communication. This included the recommendation to develop a communication package: with a targeted focus; which gives a clear, consistent message; which uses existing community networks; which builds on community achievement; and recognises the needs of various audiences. Information technology should also be effectively utilised and a public relations strategy developed.

3/ Creating relationships. This section included seven recommendations including the following:

- Build a vision of NSW as a leader in finding community based salinity solutions;
- Establish effective long-term working partnerships between communities and Government, based on respect, trust and certainty;
- Provide a range of incentives and solutions to mobilise community and business activity;
- Find ways to demonstrate and share success in managing salinity;
- Recognise the fact that addressing salinity benefits all sectors of the community;
- Implement a review mechanism for community and government to monitor;
- Promote a multi-disciplinary and intergenerational approach to salinity management.

4/ Delivery. A State Salinity Strategic Plan must recognise three levels of response: statewide government coordination; regional action; local delivery. The group also recommended building the capacity within the community to respond to the social, economic and environmental challenges of salinity, and to identify and pursue opportunities to meet resourcing and funding needs.

Working Group E: Understanding the Problem – Building Skills to Overcome it.

This Group first identified the barriers to adoption of management solutions, and then recommended ways to overcome these barriers. Barriers identified included:

- Lack of community understanding regarding salinity issues;
- Financial limitations of implementing change;
- Need for state and local based strategies;
- The community and all levels of government have failed to accept that the environment should be a core business of government in line with health, education and welfare.

Recommended actions to overcome these barriers included:

- Government investigate cost-sharing options that provide additional funding for salinity management;
- A package of measures including incentives, disincentives, purchase and regulation should be considered to facilitate commitment from all land managers;
- The Department of Land and Water Conservation co-ordinate detailed mapping of salinity hazard areas and salt donor catchments;
- Testing, quantifying and communicating known salinity solutions in the field to manage recharge and discharge areas. For example, commercial forestry, farm forestry, crop rotation, new plant species and saline aquaculture;
- Industry and government partnership is needed to develop and demonstrate innovative schemes that have co-benefits such as trees for milling, charcoal and biodiversity credits;
- The Premier raising the issue of funding at the next meeting of the Council of Australian Governments.

The Working Group also provided recommendations on education and training, communication, information exchange, trials and demonstrations, employment and the formation of a Salinity Research and Development Coordinating Committee for the State.

Working Group F: Developing Market Based Solutions

This Group noted in a preamble to its recommendations that market based approaches, by providing market signals aimed at reducing salinity, can be used to encourage individual landholders, businesses and households to determine what action is best to reduce salinity according to their unique circumstances.

The Group made ten recommendations, as summarised below. That the NSW Government should:

1. Recognise that a market based approach, that is supported by the community, is one of the key sustainable long term solutions to salinity;
2. Establish salinity trading scheme(s), including salinity control credits and targets for salinity remediation;

3. Recognising the wide variation of catchment salinity issues, select and implement the most appropriate trading schemes;
4. Identify the most effective trading unit to ensure the effective operation of the trading scheme;
5. Develop a special purpose investment vehicle designed to attract private sector and other funds, for salinity remediation purposes;
6. Advocate the market based approach within the framework of the COAG;
7. Explore the synergies between the carbon sequestration market mechanism and a potential biodiversity credits market for planted forests and other salinity remediation measures;
8. Consider the use of other mutually compatible economic instruments including taxation incentives, levies and subsidies for regional rehabilitation, bubble trading for catchments³⁴, stewardship payments, differential local rates;
9. Establish an Expert Group to assess existing activity within the National Dryland Salinity Program and design the salinity trading scheme, to provide a report to Government by September 2000;
10. Host a salinity trading roundtable to provide recommendations to the best way to implement market based approaches as identified by the Expert Group.

Working Group G: Encouraging Business Initiative

This Group made three recommendations followed by 22 initiatives that could 'action' the recommendations. The three recommendations are:

- Governments review tax and legislative arrangements with a view to ensuring that investment in research and development and in salinity business solutions are attractive;
- The development of partnership programs involving government, financial institutions and industry, to support information, education and research leading to new business opportunities;
- A recognition that the solutions (opportunities) are interrelated, and that they should be treated as a whole rather than separately.

Working Group H: Urban Salinity Solutions

This Group made 12 recommendations, highlights of which are as follows:

- Strongly endorse the establishment of a natural resource committee of Cabinet to drive

³⁴ With bubble licences, an appropriate authority such as the Department of Land and Water Conservation or the Environment Protection Authority sets the limit on the aggregate salt load generated by all operators in the group or 'bubble', rather than controlling discharges from individual operators. The EPA identifies two main advantages in this approach over conventional pollution licences: the operator is given flexibility in finding cost-effective solutions to meeting target discharge limits; environmental gains can be achieved at lower overall cost because there will be greater reductions from sources where the costs of discharge control are low.

issues of salinity and resource management;

- Develop comprehensive regional (catchment) environmental and local environment plans to achieve coordination between agencies, data collection and sharing, integration between catchment management and local government infrastructure development, and sharing between state/local government and community;
- Complete the mapping of catchments to identify the recharge/discharge areas and lands affected and under threat at a scale suitable for land use planning;
- Undertake local education programs about urban salinity problems;
- Prepare a model action plan based on Wagga Wagga and other centres' experiences to demonstrate the 'total water cycle' approach to control salinity;
- Develop market incentives to encourage all local councils and residents to use water more efficiently;
- Develop demand management policies for urban areas (for example, pricing of water, use of water tanks).

6.0 CONCLUSION

Salinity and its associated problems will confront Australians for decades to come. The amount of land affected by salinity is expected to expand in the future, even if communities start actively managing it now. Recent solutions for salinity involve moving from the treatment of symptoms to recognition of the problems by stakeholders, and working towards cooperative solutions between landholders within a catchment. Community summits are relatively new events in natural resource management, and should help focus all stakeholders into common lines of thinking on how to manage salinity. The challenge now is to harness the momentum gained by these summits into active participation by governments and communities alike to manage salinity.