

Salinity Inquiry
72



Australian Government

**Department of the
Environment and Heritage**

**Department of Agriculture,
Fisheries and Forestry**

Joint submission to the

**House of Representatives Standing Committee on
Science and Innovation Inquiry into:**

The Australian Government's role in managing and
coordinating the application of the best science in relation to
Australia's salinity programs

October 2003

Opening Statement: Department of Agriculture, Fisheries and Forestry, and the Department of the Environment and Heritage

The Australian Government recognises the importance of coordinated science to meet the challenges of the nation's salinity problem, and through the Department of Agriculture, Fisheries and Forestry (DAFF), and the Department of the Environment and Heritage (DEH), the Government has made arrangements to ensure the effective management and coordination of the best science in relation to the nation's salinity problem.

The arrangements cover:

- Natural resource management planning from national to regional to local levels;
- Governance and policy frameworks operating across and between all levels of government;
- Data and information management, including data standards, collection, distribution and access;
- Communication and facilitation support networks, from scientist to scientist, and with governments, regional groups and communities;
- Scientific innovation and investigation; and
- Tools and models with arrangements for coordination, development and application.

The Government's strategies for coordinating science for salinity managed in the broader functional context of managing Australia's natural resources, and as such, engage all levels of government, communities and private enterprise, at national, regional and local levels.

The national natural resource management model incorporates:

- Policy, institutional and legislative reform
- Regional delivery and action
- Standards and targets
- Good science and information
- Strategic investment
- Monitoring and evaluation
- Community engagement
- Focus on causes not symptoms

The National Action Plan for Salinity and Water Quality is an excellent example of these elements combined, through partnership arrangements, region-based planning, targeted investment and agreed targets for improved natural resource management outcomes.

The Billabung Catchment case study demonstrates deployment of the elements at the local and catchment level. The project also demonstrates how leading edge science interfaces with catchment planning to provide reliable and accurate guidance to manage salinity.

Regional planners and land managers are ultimate beneficiaries of the well-managed and coordinated science arrangements provided through the Australian Government. The arrangements also ensure growth of the national data and information base with two-way national to local-level connections between data collection, science and land management decisions.

Key points:

1. The Australian Government, through the Department of Agriculture, Fisheries and Forestry and the Department of the Environment and Heritage, has developed and is implementing key initiatives to ensure effective coordination of best science in relation to Australia's salinity programs.
2. Nationally consistent data and information databases and standards are being developed further through the coordination activities of the National Land and Water Resource Audit in conjunction with the ANZLIC – the Spatial Information Council.
3. National coordination of salinity science is vital given that the skills resource base is not large – effective communication and operational networks are in place to achieve this.
4. Decision-makers at all levels have access to evidence provided by science-based assessments made of natural resource databases and modelling systems.
5. The Bureau of Rural Sciences and the Australian Bureau of Agricultural Resource Economics provide key services to assist the application of best science for Australia's salinity programs, including integrated salinity mapping, hydrogeological assessments, land use data, social science and economic information and models.
6. Tools and technologies are available and are being developed further to assist access to salinity data and to translate salinity science into management advice.
7. Investments made by the Australian Government have enabled innovative technologies such as airborne geophysics to be developed and applied. This technology provides a hitherto unattainable level of understanding of Australian landscapes in three and four dimensions (ie through space and time).

Introduction

The Australian Government recognises the importance of coordinated science to meet the challenges of the nation's salinity problem, and through the Department of Agriculture, Fisheries and Forestry (DAFF), and the Department of the Environment and Heritage (DEH), has made arrangements to ensure its effective coordination. Australian Government strategies for coordinating science for salinity management are placed in a broader functional context of managing Australia's natural resources, and as such, engage all levels of government, communities and private enterprise, at national, regional and local levels.

The national natural resource management model incorporates:

- Policy, institutional and legislative reform
- Regional delivery and action
- Standards and targets
- Good science and information
- Strategic investment
- Monitoring and evaluation
- Community engagement
- Focus on causes not symptoms

The arrangements are streamlined and comprehensive, covering national-level to local-level coordination, which are designed to achieve the best natural resource management outcomes for all Australians.

Aspects of salinity science coordination include:

- Communicating a better understanding of salinity and options for its management
- Linking science and scientists with regional planning groups
- Supporting targeted scientific investigation
- Fostering standards for data and information, and monitoring and evaluation
- Building the information base and systems for information access and sharing
- Supporting communication networks
- Use of scientific evidence to support management decisions
- Tools and modelling systems to translate data into information for sustainable natural resource management
- Commitment to strategic natural resource management planning
- Building capacity in all natural resource managers to apply science

Specific projects in support of salinity science include: data standards and data management systems, mapping and mapping science, models and tools, communication and knowledge networks, and systems to access and disseminate salinity data and information.

1. The Australian Government, through the Department of Agriculture, Fisheries and Forestry (DAFF) and the Department of the Environment and Heritage (DEH), has developed and is implementing key initiatives to ensure effective coordination of best science in relation to Australia's salinity programs.

The Australian Government recognises the importance of coordinated science to meet the challenges of the nation's salinity problem. To meet the challenge the Government has a comprehensive range of measures in place incorporating the best science as a key component while recognising that a wide range of other issues must be managed simultaneously to ensure success.

Coordinated science is an important component of two major Government's investment initiatives, the National Action Plan for Salinity and Water Quality (NAP) and the extension of the Natural Heritage Trust (NHT). In order to manage natural resources effectively a landscape and catchment level of understanding and action is required. Accordingly, the major part of these initiatives is designed around region-based planning.

Operation at the regional level makes it possible to engage more people with specific knowledge and specific experience with issues such as salinity. The regional level is the most effective to get both community engagement and landscape-scale change and is the most appropriate for strategic NRM planning process. For change to be sustainable it needs to be driven from grass-roots and responsive to regional priorities.

One objective of the NAP and NHT is to attend to the causes rather than the symptoms of problems such as salinity. The symptoms are usually obvious whereas the causes require knowledge based on science, using data and information that is reliable and specific to regional issues. The NAP and NHT include purpose driven arrangements to ensure that such data and information is available to science.

At the national level, the National Land and Water Resources Audit (the Audit) works with DAFF and DEH to maintain a digital data library and an atlas of Australian natural resources. A key role of the Audit is to coordinate the science and data collected through investments of the NAP and NHT. The Audit also works with ANZLIC – the spatial information council, to ensure data standards are established and implemented consistently throughout the nation.

In order to implement these initiatives the Australian Government actively ensures appropriate governance arrangements exist, including operation through all levels of government to support the initiatives. The Natural Resource Management Ministerial Council and its supporting committees provide a structured process to identify priorities, allocate resources, and endorse coordinated action to manage Australia's natural resources.

Working through the Natural Resource Ministerial Council, arrangements have also been made to ensure that data and information are collected and managed so it is possible to gauge the effectiveness of our actions to improve our natural resource management, and

commensurately, our success with salinity and water quality outcomes through the NAP and NHT.

Working through the Ministerial Council, the Monitoring and Evaluation Working Group has developed a nationally agreed “Standards and Targets Framework” and a “Monitoring and Evaluation Framework” to guide the systematic collection and management of data and information to inform us of progress. Several components of these frameworks and associated arrangements include reference to salinity and the science that is required to fulfil management needs.

Complementing the NAP and NHT, the National Landcare Program (NLP) is building on earlier successes to ensure individuals, communities and industries engaged in natural resource management, continue to be supported in their landcaring activities.

In addition to these major initiatives, the Australian Government, through the *Primary Industries Research and Development Act*, maintains research and development corporations covering a wide range of agricultural industry sectors, and rural industries through the Rural Industries Research and Development Corporation, and land and water research and development through Land and Water Australia. Salinity research and development is major component of the programs run by the Corporations.

Communication and information sharing networks are particularly important to the effective coordination of best science in salinity management. A major network for salinity science is the National Dryland Salinity Program. The program is supported through Land and Water Australia and it maintains links with several other research and development corporations, state and territory agencies, Cooperative Research Centres, academic institutions, private industry and primary producers.

The NDSP was a key network for coordinating scientific input during preparation of the authoritative report, *Australian Dryland Salinity Assessment, 2000* by the National Land and Water Resources Audit. In its current operation the NDSP is working with regional groups to ensure that the science and information assets it has accumulated over the nine years of its operation are used for region-based planning and action.

Within DAFF, the Bureau of Rural Sciences (BRS) and the Australian Bureau of Agriculture and Resource Economics (ABARE) undertake biophysical, social and economic science assessments to inform the Australian Government with evidence to guide policy development.

A substantial part of BRS work is to investigate salinity, including advanced techniques to map salt and hydrogeological assessments to translate salt distribution into an understanding of salinity risk at the landscape scale. This information makes it possible to consider the range of viable actions needed to address the causes of salinity problems. BRS also conducts research into the factors that influence people to act and manage natural resources. Such research provides valuable insights into the motivating factors and constraints to action, such as knowledge of salinity as a problem and ability to access scientific information or advice.

The Australian Bureau of Agriculture and Resource Economics (ABARE) provides information to governments and communities about the economics of natural resource management. ABARE conducts surveys of farmers throughout Australia regarding their knowledge of natural resource management issues and their level of financial investment to address resource degradation. ABARE also operates integrated biophysical and economic models aimed to investigate the options and costs of landscape-level management interventions.

Coordinated salinity science relies on tools and models as a means to translate data into information. The Australian Government has a long history of support for tools and models development and coordination, especially where these contribute to nationally consistent natural resource assessments. Recent examples, through the NAP include: a stocktake of models used to guide salinity assessments ("PRISM"), national review of salinity mapping methods, a review of desalination technologies, guidelines for the release of salinity data and information to the public, and an investigation of airborne geophysics as a means to map salt in landscapes.

Each of the aspects of coordinated salinity science outlined above is described in more detail in subsequent sections of this submission.

National Natural Resource Management Programs – operating from national to local levels with region-based planning and action to achieve improved natural resource management outcomes

Australia's national natural resource management is supported by three major initiatives: the National Action Plan for Salinity and Water Quality (NAP), the Natural Heritage Trust (NHT) and the National Landcare Program (NLP). A joint DAFF and DEH team, the Australian Government Regional Natural Resource Management Team, run the NAP and NHT within the Australian Government.

Each initiative includes components that ensure complementary national, regional and local outcomes for natural resource management. Within the NAP and NHT major components are based on region-based planning and action. This recognises that the regional level is the most effective level to engage communities and to effect the necessary landscape-scale changes to manage Australia's natural resources.

Fifty-six 'regions' are identified covering all of Australia, and natural resource management plans are being developed for each. Plans will consider environmental, social and economic impacts of natural resource decisions on a regional basis.

The \$1.4 billion *National Action Plan for Salinity and Water Quality* and the \$2.7 billion *Natural Heritage Trust* are the biggest action programs directed to environmental, social and economic sustainability in Australia's history. They are based on partnerships between all levels of community and Government, working together to protect our environment and natural resources, and sustain our agricultural industries and regional communities.

The Australian Government and State/Territory governments have negotiated arrangements that contain the agreed framework for the administration and delivery of the NHT and/or the NAP. The intergovernmental agreement is a broad in-principle agreement, followed by

the bilateral agreement which sets out details about State/Territory-specific arrangements for regional bodies, accountability and administrative arrangements.

The regional plan, partnership agreement and investment strategies are developed by the relevant regional organisation and are approved by the Australian Government and respective State/Territory Government leading to investment (funding) for those regions.

Community and individual land manager involvement is essential to achieve sustainable landscape-level changes. Such change needs to be driven from the ground up and must be responsive to regional priorities. Region-based planning through the NAP and NHT is ensuring that regional priorities are identified, which includes an inventory of what is known and what needs to be known about a region's landscapes and management challenges. Such an understanding must be soundly based and requires the support of good information, best science and scientific expertise. Some of this support will exist within a region but much more benefit will be obtained by drawing on science and expertise that exists elsewhere. Specific components of the NAP and NHT are directed to building the capacity of communities to access and entrain such information and expertise.

The National Landcare Program also provides complementary functions to regional planning. For example, the NLP fosters the landcare 'movement' which has been growing for more than a decade, it provides landcare facilitators and coordinators to connect communities to information sources and services, and it supports Landcare groups and landcare-minded individuals to implement on ground actions for natural resource management. Landcare is also supported by the NHT through which it operates with other well-established groups, Bushcare, Rivercare and Coastcare.

Attachment 1 provides additional detail for the NAP, NHT and NLP.

2. Nationally consistent data and information databases and standards are being developed further through the coordination activities of the National Land and Water Resource Audit in conjunction with the ANZLIC – the Spatial Information Council.

The National Land and Water Resources Audit

The Natural Heritage Trust also supports the National Land and Water Resources Audit. The first phase of the National Land and Water Resources Audit (NLWRA or 'the Audit') (1996-97 to 2002-02) drew together scientific expertise from researchers throughout Australia, involving Australian Government scientists from CSIRO, Bureau of Rural Sciences (BRS), and the Australian Bureau of Agriculture and Resource Economics (ABARE), state and territory government agency scientists, university academics and expertise from private enterprise. The Audit's major theme reports provide a compilation of scientific knowledge about Australia's natural resources at a national scale.

The first published report of the Audit was the Australian Dryland Salinity Assessment 2000 and it is the current and authoritative statement on salinity in Australia. The report presented maps of the extent and future risks of salinity, including maps of salinity risk in 2000 and maps of salinity risk projected to 2050.

The report also introduced the Groundwater Flow Systems framework (GFS) and its practical application to managing groundwater in Australia's landscapes. The GFS characterised and mapped Australia according to the geographical extent and management timeframes for local, intermediate and regional aquifer systems. The GFS framework is now being extended to include more detailed regional and local catchments assessments as a basis for management planning.

Both the Australian Natural Resources Data Library and the Australian Atlas of Natural Resources were developed in conjunction with the Audit to provide nationally consistent overviews of Australia's natural resources, including the relative condition and importance of resource management issues. The value of such national consistency is that the data provide regionally relevant information showing the relative magnitude of salinity issues in local to regional to state or basin contexts. Therefore, the national-scale information and data are used in different but consistent ways.

The Audit commenced a second phase of operation in July 2002 and it is continuing to build the nation's natural resource information assets. In its second phase the Audit is ensuring salinity data and information is accessible and consistent, including support for the development and implementation of region-based monitoring and evaluation strategies for salinity. The Audit also promotes development of spatial information systems and metadata standards. Public access to these assets is through the Australian Natural Resources Data Library, which has more than 170 datasets, and the Australian Atlas of Natural Resources, which has interpretive products from existing Audit and NHT-supported projects.

The Audit is working in conjunction with ANZLIC – the Spatial Information Council to facilitate easy and cost effective access to the wealth of spatial data and services provided by the public and private sectors. ANZLIC develops nationally agreed policies and frameworks aimed at achieving "best practice" in spatial data management, which it supports through its promotion of the Australian Spatial Data Infrastructure (ASDI).

A key task of the Audit is ensuring that salinity data continue to be collected and managed in a nationally consistent manner. This will occur through a Salinity Data Infrastructure Project being conducted by the Bureau of Rural Sciences. The project will provide a specification for salinity data and information quality, which includes a set format (architecture) for salinity spatial data and data fields (attributes), including metadata (descriptions of datasets). The project will have input from all jurisdictions.

The NLWRA has also funded the development of a 'Regional Profiling Tool' so that each region can access geographically correct and region-specific natural resource information via the Internet, extracted from the digital Australian Atlas of Natural Resources. The Australian Natural Resource Data Library is also scoping the development of a similar tool to allow access to the data sets on a defined regional area.

The NLWRA has also supported the development of a 'Regional Reporting Tool' so that each region can access geographically correct and region-specific natural resource information via the Internet, extracted from the digital Australian Atlas of Natural Resources and Australian Natural Resource Data Library.

3. National coordination of salinity science is vital given that the skills resource base is not large – effective operating and communication networks are in place to achieve this.

Salinity science coordination

Salinity science coordination and communication networks are established between the Australian Government and all State and Territory governments, supported primarily through committees and working groups under Natural Resource Management Standing Committee (NRMSC), which reports to the Natural Resource Management Ministerial Council (NRMMC).

Complementary operation and support are provided through Primary Industries Ministerial Council and Murray Darling Basin Ministerial Council (MDBMC). Government involvement in these groups extends through networks and project activities that include the Bureau of Rural Sciences of DAFF, Research and Development Corporations, CSIRO, Cooperative Research Centres and private industry.

The Programs Committee of NRMSC is responsible for several working groups, including two with a direct role in coordinating aspects of salinity science, the Science and Information Working Group, and the Monitoring and Evaluation Working Group.

The Science and Information Working Group has identified national priorities in five categories: sustainable agriculture and land use, biodiversity conservation, climate variability and change, natural resource monitoring and indicators and managing knowledge for change. The Working Group is currently developing investment proposals for projects to address the priorities.

The Monitoring and Evaluation Working Group is developing indicators with data collection and management protocols to guide region-based monitoring and evaluation of the effectiveness of on-ground investment and action made through regional natural resource management plans. As a part of regional planning, each region is identifying the key issues and priorities it needs to address in order to achieve improved natural resource and environmental outcomes.

In order to measure performance, regional plans accredited through NAP and NHT include performance and achievement targets, requiring an assessment of current conditions to determine a baseline, and specific goals which are set as a means to record achievement.

Protocols for each indicator provide standardised and consistent guidance so baselines and targets can be assessed and recorded consistently within and between regions. In so doing, the protocols also ensure data are collected that are reliable and comparable, and in a form that when merged with other similar data, contribute to build national data assets. By ensuring consistency, data collected through out Australia at paddock level, catchment level and regional level, can be compiled and compared, allowing reliable evaluations to be made of issues and priorities.

Specific to the impacts of salinity, indicators are being developed on the area of land threatened by shallow or rising water tables, and in-stream salinity. Indicators directly relevant to salinity include:

- Depth to groundwater
- Groundwater salinity
- Location and size of salt affected areas
- Total Dissolved Solids (TDS) + flow
- Electrical conductivity (EC) + flow

The National Natural Resource Management Monitoring and Evaluation Framework agreed by NRMSC in October 2002 and draft indicator protocols are available at: <http://www.deh.gov.au/nrm/monitoring/evaluation/framework.html>.

Also under NRMSC, the Land Water and Biodiversity Committee (LWBC) oversees discipline-based working groups such as the Working Group on Land Resource Assessment, the Executive Steering Committee on Vegetation Information, Executive Steering Committee on Land Use Mapping, and the Executive Steering Committee on Rangelands Information. These committees and groups provide an advisory role on salinity issues, where relevant, and the National Land and Water Resources Audit coordinates the various group activities with respect to indicator development and data collations.

Operating arrangements made under Ministerial Councils also ensure inter-governmental coordination of salinity science research and development. Networks and operational project links extend from government departmental and agency staff to Research and Development Corporations, Cooperative Research Centres and CSIRO. Examples of such arrangements include:

- The Commercial Environmental Forestry project, a 3-year collaboration between CSIRO Forest and Forest Products and DAFF Fisheries and Forestry Division with support from the National Association of Forest Industries (NAFI) and the MDBC. The project aims to develop a farm forestry investment framework to underpin sustainable land use change for commercial and environmental outcomes. It will include commercial outcomes for the low to medium (500-800 mm pa) rainfall zone based on species selection, location in the landscape, plantation management, product decisions and the assessment of environmental values. The project will also develop tools to predict the impact of farm forestry expansion on salt interception.
- An annual report by CSIRO and the Bureau of Meteorology that reviews and publishes information on the effectiveness of NRM program implementation, and the scientific and technical robustness of NRM program strategies and plans during their implementation. The report will also identify opportunities for new or emerging scientific and technical advances appropriate to natural resource management.

Research and Development Corporations

Research and Development Corporation networks for salinity science are operated principally through the programs and projects of Land and Water Australia (LWA), and Rural Industries RDC (RIRDC). Of these the main salinity-related programs are:

- National Dryland Salinity Program (by LWA)
- Grain and Graze (by LWA with Grains RDC and Meat and Livestock Australia);

- Sustainable Grazing of Saline Lands (by LWA with Australian Wool Innovation);
- Joint Venture Agroforestry Program (by RIRDC with LWA, Forest and Wood Products RDC). The Grains R&D Corporation, the Cotton R&D Corporation, the Murray Darling Basin Commission and the Natural Heritage Trust also contribute to this and several other programs.

Specific information about these programs and project products is available from the websites of the organisations involved.¹

The principal Cooperative Research Centres (CRCs) with links to aspects of salinity science are:

- CRC Catchment Hydrology;
- CRC Landscape Environments and Mineral Exploration;
- CRC Plant-based Management of Salinity; and
- CRC Spatial Information.

With CSIRO, the principal linkages are with the Divisions of Land and Water, Sustainable Ecosystems and Exploration Geophysics.

National Dryland Salinity Program (NDSP)

Land and Water Australia provides support for Australia's major government-based salinity network and information resource, the National Dryland Salinity Program (NDSP). The NDSP provides a major communication network for disseminating salinity science and information in Australia.

Over the past nine years of operation the NDSP has helped to raise awareness of salinity through regular newsletters and media articles (such as the 'Silent Flood' series screened on ABC television), supported research and development into the causes of salinity, and along with others, supports regular national forums to share information and insights into salinity and means for its management. The substantial salinity science and information resource products of the NDSP are maintained and made accessible through its web site at www.ndsp.gov.au.

In 2003-04, NDSP will improve access to its resources through the 'Enhanced Communication Year', which provides links between NDSP resources and with NAP and NHT regional planning groups. In order to establish linkages the NDSP is producing customised scientific information products for regions based on NDSP salinity science and other sources. This will be the final year of the NSDP and future arrangements have yet to be made.

The Audit's Salinity Data Infrastructure Project will identify on-going requirements for the collection and collation of salinity-related information. The Audit will be assisting the Program identify arrangements for the data and information collected during the program to remain publicly accessible.

¹ www.lwa.gov.au, www.ndsp.gov.au, www.rirdc.gov.au, www.rirdc.gov.au/programs/aft.html

The products of the Enhanced Communication Year are designed to answer questions at a regional level including:

- What is the current extent of dryland salinity? What are the trends?
- What are the causes? And risks?
- What are the impacts (triple bottom-line)? And costs?
- What will/can we do?
- How do I integrate my salinity investment plan with other issues/plans?
- Where do I get help?

Productive Use and Rehabilitation of Saline Lands (PUR\$L)

The Productive Use and Rehabilitation of Saline Lands group (PUR\$L) receives support from the Australian Government and includes representatives from all Australian States, several industry groups, and private enterprise, including farmers. For more than a decade PUR\$L has promoted a vision that saltland is also potentially useful for profitable industries in agriculture, forestry, horticulture, aquaculture, minerals and energy.

PUR\$L operates through convened conferences which have been held in widespread localities covering major regions of salinity in Australia: Tatura, Victoria 1990; Adelaide, South Australia 1992; Echuca, Victoria 1994; Albany, Western Australia 1996; Tamworth, New South Wales 1998; Naracoorte, South Australia 1999; Launceston, Tasmania 2001; Fremantle, Western Australia 2002; and Yeppoon, Queensland 2003.

The 2003 conference, opened by the Hon Minister Warren Truss, was held in the Fitzroy Basin of sub-tropical Queensland and carried the theme 'Salinity under the Sun – investing in the prevention and rehabilitation of saline lands in Australia'. The conference showcased the investment behind the science, including the planning, policies, and community partnerships behind preventing and rehabilitating the effects of dryland salinity.

4. Decision-makers at all levels have access to evidence provided by science-based assessments made of natural resource databases and modelling systems.

5. The Bureau of Rural Sciences and the Australian Bureau of Agricultural Resource Economics provide key services to assist the application of best science for Australia's salinity programs, including integrated salinity mapping, hydrogeological assessments, land use data, social science and economic information and models.

Bureau of Rural Sciences

The Bureau of Rural Sciences (BRS) is a scientific agency within DAFF, operating at the interface between science and policy. Three BRS programs contribute directly to the application and coordination of high quality science-based information: Integrated Water Sciences, Landscape Sciences and the Social Sciences Program. The outputs of the programs guide a range of functions, including national policy and program development and science in support of region-based action.

The **Integrated Water Sciences Program** provides scientific assessments of landscape process, function and characteristics to inform investments of the NAP, NHT and NLP. The Program has developed the application of airborne geophysics integrated with hydrogeological assessments, field measurements and land use information to map and predict salinity.

As a guide to regional planners the Bureau has also recently published "*Five Steps to Tackling Salinity*", in its '*Science for Decision-makers*' series ([Attachment 2](#)). In brief the steps are:

1. Consult with the community to specify salinity management objectives,
2. Map salt stores and identify areas likely to be at risk from salinity,
3. Consult with land users and professional agencies to identify feasible management options,
4. Work with the community to develop and implement an action plan, and
5. Monitor and review effectiveness.

The **Landscape Sciences Program** provides scientific advice on land use and land management issues to government and other clients. The program produces spatial models of natural resource processes (e.g. the impact of land clearing) and develops decision support tools, providing advice to policy makers and rural industries on land use management and climate change. The Program also applies advanced remote sensing to analyse agricultural landscapes (using multiple sensors: Landsat, hyperspectral, radar imagery and MODIS) and predicts the consequences of land use and management change using land quality and landscape process information.

The Landscape Science Program also coordinates continent-wide coverage with regional and catchment-scale digital land use data sets, which provide a basis to develop cost-

effective options for natural resources management. Further information about catchment-scale land use mapping is provided under Section 5 of this submission.

The **Social Science Program** is working with regional catchment groups to assess landholder understanding and responses to dryland salinity. Surveys provide information about landholder awareness and their knowledge of the processes that lead to dryland salinity. The surveys also provide information about landholders' confidence in the science and practices currently recommended to address salinity, and include data on their adoption of such practices to ameliorate or avoid its impacts.

BRS analyses of survey findings are provided to regional groups to assist them to identify priority issues, particularly regarding effective communication with landholders and selecting initiatives most likely to achieve catchment targets for dryland salinity. This work has included studies in three states (Queensland, New South Wales and Victoria) and has been supported by funding from the National Component of the Natural Heritage Trust. It is proposed to extend the work into the remaining states.

Catchment scale land use mapping for Australia

Land uses and land management practices have a major impact on the state of Australia's natural resource base through their effects on the movement of water, soil and nutrients (including carbon, nitrogen and salt) through the landscape. It is now generally agreed that changes to land uses and land management practices will be required if we are to move towards sustainable agricultural systems, reduce the present rates of degradation of ecosystem services, manage land-based greenhouse emissions and establish carbon sinks.

High quality land use mapping is a key input to salinity management planning and targeted investment. The Bureau of Rural Sciences, with State agency partners, has now achieved 80% coverage of Australia with catchment-scale land use mapping. The NHT, NAP, NLWRA and the Murray-Darling Basin Commission provided funding support, and an additional 15% area will be completed by February 2005 with support from the NLP.

As the lead agency in the development of nationally consistent catchment scale land use datasets, BRS is working with other Australian Government and State/Territory government agencies to establish agreed national land use mapping standards and specifications. This work includes ensuring land use information is available to support natural resource management and policy needs, including the NAP and NHT.

A nationally agreed classification scheme, the '*Australian Land Use and Management (ALUM) Classification*', and other agreed procedures dealing with coding and attribution, data structure, spatial referencing and accuracy, underpin the production of land use maps across Australia. These standards are reviewed regularly and refined using experience gained in Australian Government and state land use mapping programs. National compliance standards for land use data, including the ALUM Classification, are maintained as part of Australian Spatial Data Infrastructure (ASDI).

Catchment scale land use maps have wide-ranging application because the data have been put together in a way that meets the requirements of national, state and regional users. At the national level, catchment-scale land use maps help to target investments and to monitor

the effectiveness of natural resource management programs such as the NAP and NHT. At the regional and catchment scale, land use maps are a key input to salinity and water quality modelling and planning, and at the farm level, the land use data help landholders to understand how their farm is placed in a catchment context and to identify opportunities for diversification.

BRS has produced '*Science for Decision Makers – Land Use Mapping at Catchment Scale*' (Attachment 3), a publication outlining the progress, mapping methods and application of land use mapping for region-based planners.

A CD-ROM is also available to explain how to access the data, with digital samples of the mapping, mapping coverage, and technical support information. The CD helps regional planning groups to get easy access to land use mapping. 'Catchment scale land use mapping for Australia – Information for catchment solutions', is available from the Australian Land Use Mapping Program via the website: Catchment scale land use mapping program².

Australian Bureau of Agriculture and Resource Economics

The Australian Bureau of Agriculture and Resource Economics (ABARE) provides information to governments and communities about the economics of natural resource management issues including salinity control options to support prioritised investments in salinity control. ABARE's recent research on the economics of salinity control and related policy issues provides unique economic insights to the problem of salinity control and these are being used to inform regional plans developed by the NAP.

In 2001-02, ABARE applied NHT funds to survey around 75 per cent of Australian broadacre and dairy farm businesses, which accounts for about 98 per cent of Australia's agricultural production. The survey was designed to investigate awareness and management of land degradation and influences on its management, including participation in Australian Government NRM programs.

The survey found that just over half of Australia's farmers (52 per cent) reported signs of degradation on their farms, with just under a quarter (23 per cent) saying the problems were significant. However nearly all farmers are responding to land degradation, with 93 per cent of those who said they had a problem having already changed farm management practices to address it, or intending to do so in the following year.

The survey also found that Australian Government natural resource management programs play an important role helping farmers recognise and manage emerging degradation issues and adopt sustainable farming practices. Participants in government-sponsored NRM initiatives were more likely than non-participants to have undertaken training, and more likely to have a farm plan which contained information about salinity management, areas of conservation value and land capability. Most farmers adopting changes to farm management in response to significant degradation problems focused on the long-term productive capacity of their land, even if this meant lower short-term profits.

² (<http://www.affa.gov.au/content/output.cfm?ObjectID=A6017D2C-816C-47B3-8F9374A32A8D6AB9>)

The benefits identified by farmers from their involvement in Australian Government NRM programs include skills and information (85%), on-ground works on their farm (47%), improved community interaction (54%) and a better understanding of land degradation and the environment (56%). From analysis of the survey, ABARE concluded 'Landcare and other Australian Government NRM programs can therefore play an important ongoing role promoting the early recognition and management of emerging degradation issues and the adoption of sustainable farming practices to prevent future degradation'.

ABARE has also developed the Salinity and Landuse Simulation Analysis (SALSA) model to integrate catchment scale hydrological and hydrogeological relationships with an economic model of land use. For example, SALSA was applied to analyse the long run implications of increasingly saline irrigation supplies in the Murray Darling Basin's main rivers for grape yields and producer returns in the viticulture industry. The report also analyses the evidence about farmers' understanding and actions to manage salinity.

6. Tools and technologies are available and are being used to access salinity data and to translate salinity science into management advice.

In addition to the work of the National Land and Water Resources Audit and the Bureau of Rural Sciences, several projects of the National Action Plan for Salinity and Water Quality are providing improved information and better access to salinity tools and technologies, including:

- Review of salinity mapping methods (including a user-guide);
- Guidelines for Best Practice in the Public Presentation of Salinity Data and Mapping Products;
- Stocktake of salinity tools and technologies; and
- Review of desalination technologies.

National review of salinity mapping methods

At its 5 September 2003 meeting, the Natural Resource Management Standing Committee endorsed a project to review salinity mapping methods in the Australian context. The need for a review was apparent because of confusion created by salinity hazard and risk maps generated by different methods to serve different purposes. Notable were the differences between regional hazard maps produced by the Queensland Government for the northern part of the Murray Darling Basin and more localised hazard mapping from airborne geophysics in the St George area. Both were maps of 'salinity hazard' but the meaning of the information contained and the appropriate use of each was unclear.

This national review evaluates the range of methods available in Australia for mapping the extent and severity of salinity in Australian landscapes. The review provides an independent and authoritative assessment of the value and reliability of the range of salinity mapping methods so investors in mapping can be confident about their options and the products they can expect to receive. The review outlines what each method is capable of producing, the costs and benefits, and how the products can be used to inform catchment-based interventions to manage salinity. The review also provides plain language definitions of salinity terminology such as 'hazard' and 'risk'. These products will be summarised in a

practical user-guide for region-based planners which is due for completion in late November 2003.

DAFF and DEH have coordinated technical input to the review through Land and Water Australia and the National Dryland Salinity Program, with support from the Academy of Science and the Academy of Technological Sciences and Engineering. Attachment 4 provides the terms of reference for the review.

The project is supported through the National Action Plan for Salinity and Water Quality to a total of \$90,000; half provided by the Australian Government and half shared by the New South Wales, Victorian, Queensland, South Australian and Tasmanian governments. Western Australia provided in-kind support through the expertise of two senior officers.

The Academies convened a public forum 17 October 2003 to receive and critique draft review products. The Draft Review Report and User-guide are available via the Internet at: http://www.ndsp.gov.au/80_airborne/airborne.htm. The review provides clear definitions and guidance to non-specialist users on the various mapping methods and their products.

The review outputs are designed to meet the needs of a range of potential investors in mapping, including catchment and regional natural resource managers, state, territory and Australian Government agencies, scientists, and vendors of mapping methods and systems. Final review products will be available in late November.

Guidelines for Best Practice in the Public Presentation of Salinity Data and Mapping Products

The Australian Government, working through the Science and Information Working Group, has developed nationally agreed 'Guidelines for Best Practice in the Public Presentation of Salinity Data and Mapping Products'.

Large amounts of data are collected and interpreted to investigate land degradation processes in catchments but some data and interpreted products are commercially sensitive. For example, data might reflect adversely on a property-owner's land management skills, or could affect the perceived value of a property at sale.

Application of the guidelines for best practice in the public presentation of salinity data and mapping products helps to maximise the usefulness and availability of data while minimising negative consequences from the public release of salinity and other natural resource management data and interpreted products. In summary the guiding principles are:

- Target the material to the intended audience
- Build confidence that material presented is credible
- Use language style most appropriate for audience
- Clearly name the information product
- Clearly explain all terminology used
- Describe the product and its purpose
- Explain methodology used in collecting and interpreting data
- Describe the intended use and limitations of the information

- Describe the stage of development of information
- Identify linkages to other relevant information
- Describe the scale appropriate for using the information
- Use consistent graphical presentation styles
- Limit secondary use of material where misrepresentation is a risk
- Develop strategies for data and information release

The following principles apply to information presented or reported to the public:

- Employ sound Quality Assurance procedures
- Follow best practice data collection and interpretation techniques
- Gain appropriate approval for data collection
- Identify data ownership and access rights and establish intellectual property.

Adoption of the guidelines helps to minimise misuse or misinterpretation of salinity information data and products.

The guidelines will be progressed through SIWG in conjunction with the findings of the review of salinity mapping methods. The guidelines are provided in full at Attachment 5.

Practical Index of Salinity Models (PRISM)

There are many salinity models supported by government agencies and private industry. A national project investment of the NAP has collated information about each of these models into a single compendium, PRISM – Practical Index of Salinity Models. The resource was prepared for the National Action Plan by URS Australia with support from Australia’s National Dryland Salinity Program (NDSP) and Land & Water Australia.

PRISM provides information on over 90 tools, models and frameworks that can assist natural resource management planning and is a valuable resource for individuals, agencies and organisations involved in natural resource management planning at the regional scale. The resources of PRISM are presented in an MS Access database or Excel spreadsheet format. The accompanying PRISM User’s Guide describes the tools, models and frameworks and how these can be applied to assist regional planning processes. PRISM is provided on a CD-ROM available from Land and Water Australia.

Desalination technologies

*Introduction to Desalination Technologies in Australia*³ is a summary of a more detailed report *Economic and Technical Assessment of Desalination Technologies in Australia*. These reports provide a compilation of information about available desalination technologies and their potential to provide a cost-effective salinity and water quality management tool, particularly in the National Action Plan for Salinity and Water Quality (NAP) regions. The reports also present a ‘desalination decision tree’ to help communities, particularly in the NAP regions, determine whether desalination is an appropriate tool and which technologies could be best applied to the salinity problems they face.

³ (Web link - <http://www.affa.gov.au/content/publications.cfm?ObjectID=AD7668EF-0BA2-492B-AB47C41D49BD810E>)

7. Investments made by the Australian Government have enabled innovative technologies such as airborne geophysics to be developed and applied. This technology provides a hitherto unattainable level of understanding of Australian landscapes in three and four dimensions (ie through space and time).

Salinity Mapping

Salinity mapping in a landscape can mean different things to different people. Salt mapping may refer to human-induced or natural salt stores. The range of techniques can include ground-based or airborne electromagnetics, air-photo interpretation, satellite imagery, soil surveys, borehole and stream monitoring, and on-ground mapping of salinity outbreaks. A common product of such mapping is a “Salinity Hazard” map – a map of where salt occurs with a potential to move and cause damage.

‘Salinity Hazard’ Mapping

Salinity hazard maps have been produced for NAP catchments in Queensland and are also being produced for NSW catchments. The overlay of three datasets produces these maps: regolith salt-store, recharge potential and discharge sensitivity. The resulting maps indicate the potential for salt to accumulate in a particular part of a landscape sometime in the future. The major advantage of Salinity Hazard maps is that they are cheap to produce because they rely solely on existing datasets. Salinity hazard maps are primarily designed to target areas for future, more detailed investigation.

Airborne Geophysics

Airborne geophysics is a commonly used technique in the minerals exploration industry. The potential to apply airborne geophysics to natural resource management was investigated in a jointly funded project of the Australian Government and the State Governments of Western Australia, New South Wales, Queensland and Victoria: the *National Airborne Geophysics Project: Evaluation of Airborne Geophysics for Catchment Management*, 1998. The project reported that:

‘... the knowledge and services offered to the community for managing salinity would be considerably improved if airborne geophysical data were added to the existing data sets for use in developing management strategies.’

‘The overwhelming benefit of airborne geophysics technology is its ability to produce images of features in the surface and sub-surface of the catchment, which provide significant information about the soils, geological structure, groundwater processes, and salt distribution. It does this in a way that no other system can do.’

‘Maximum value is obtained when used with complementary information drawn from conventional sources like bore hole data, air photo interpretation and the analysis of satellite images. Catchment managers now have access to a powerful tool for use in development of management plans and for broad scale reconnaissance.’

‘Amongst other considerations it is recommended that national standards and guidelines be developed, a comprehensive education program be implemented, further detailed analysis of the recently acquired datasets be continued and the cost of

alternative datasets be evaluated as a basis for comparison with airborne geophysics products.'

The full national report is available via the Internet at:
http://www.ndsp.gov.au/NAGP/nagp_nr.htm.

Improvements in Airborne Electromagnetic Surveying

AEM is a relatively new technology that is being continuously up-graded and refined by intensive and ongoing research. Australia and Canada are the world leaders in AEM research. Significant improvements have been made as recently as over the past 12 months.

A recent important breakthrough occurred during the calibration of the Lower Balonne AEM survey. Previously the algorithm used to produce CDI and LEI slices assumed non-conductive basement at the depth of investigation of the system, 100 to 150 metres. This assumption was invalid in the Lower Balonne survey area (as it is over most of Queensland) and a much better fit between modelled and measured data was achieved by applying 'constrained inversion' algorithms to the data. The constrained inversion also produced greater resolution of conductivity – depth information. These improved processing techniques have substantially altered the salinity mapping products produced from raw airborne data, which in turn has significantly altered the interpretation of the AEM data and has considerably expanded the geological settings where AEM is suitable.

The earth is naturally variable and the properties of the materials that make up the upper 100 metres or so of the Earth's crust vary enormously. While it is theoretically possible to fit the data gathered from one AEM survey and apply it to another area in practice even modern computers struggle with the task. However, the future availability of increasingly powerful computers will mean that such complex layered earth models can be solved.

Attachment 6 discusses technical aspects of salt mapping.

On ground calibration

AEM can provide a three-dimensional snapshot of 'where the salt is', 'where the clay is' or 'where the groundwater is'. However, this must be supported by on-ground calibration, principally down-hole conductivity logging, although pore fluid analysis and ground-based geophysics are also used. All EM surveys, whether on ground or airborne, require calibration.

List of attachments

- Attachment 1: Overview of the NAP, NHT and NLP
- Attachment 2: Five-step process to guide actions to tackle salinity
- Attachment 3: Land use mapping at catchment scale
- Attachment 4: Terms of Reference for the National Review of Salinity Mapping Methods
- Attachment 5: Guidelines for Best Practice in the Public Presentation of Salinity Data and Mapping Products
- Attachment 6: Technical aspects of salt mapping

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