SUBMISSION FROM ANSTO TO THE HOUSE OF REPRESENTATIVES SCIENCE & INNOVATION COMMITTEE INQUIRY ON MANAGING, CO-ORDINATING AND IMPLEMENTING THE BEST SCIENCE TO COMBAT SALINITY

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Introduction

The Australian Nuclear Science and Technology Organisation (ANSTO) is Australia's national nuclear organisation and the centre of Australian nuclear expertise. It undertakes research to advance the understanding of nuclear science and applies resulting technologies and capabilities. While its work is nuclear-based, it is applied to a very broad range of environmental, medical, social and industrial matters.

ANSTO has an international reputation for the application of nuclear-based techniques to the analysis and solution of diverse problems in environmental systems, including salinity. Nuclear science and technology can provide solutions that enable farmers, land managers and communities to maintain sustainability of groundwater extraction and address salinity problems.

The key to ANSTO's research in this area is the use of radioactive tracers, which are chemical elements that emit radioactivity. They do so because they are naturally radioactive or have been irradiated in ANSTO's research reactor. ANSTO is also developing tools to activate elements such as chloride *in situ*.

Tracers can be monitored as they move in the shallow subsurface. This enables ANSTO to calculate the rates of water flow. ANSTO can also use the fact that radioactive elements decay over time—that is, they lose radioactivity and change to a different element or a different isotope of the same element—to verify the age of water in a flowpath. Some elements are suitable for relatively old water supplies because they decay slowly, while others are used to analyse relatively young water supplies.

Salinity science at ANSTO

Current research projects

ANSTO is conducting research into groundwater management to identify processes responsible for salt build-up, the source of salt and the paths of water flow that transport the salt to the land surface. This enables the identification and quantification of recharge or potential drainage areas, where appropriate remedial action can be implemented to lower the water table and prevent salt mobilisation.

ANSTO is currently working on the application of innovative salinity mapping methods and salinity characterisation. The tools used are Electrokinetic Sounding (EKS), which maps the flow paths of saline groundwaters, and isotopic and geochemical techniques, which characterise the salinisation processes. In showing salt mobilisation, EKS differs from standard airborne geophysical methods that just show salt stores. The Organisation is undertaking this work in several sites including the Shepparton Region of Victoria (Honeysuckle Creek and Broken River Catchments) and Riverland region of South Australia around Loxton.

Data obtained by ANSTO, particularly using EKS, is useful for defining details of broad features detected by airborne electro-magnetic data, necessary for salinity mapping and potential drainage schemes. This is a focus of funding under the National Action Plan (NAP) for Salinity and Water Quality.

Comment: stands for?

ANSTO is investigating potential methods of improving movement of salt in saline soils, which could potentially return some affected land to productivity as damaging salts are moved deeper into the subsurface. The enhanced rate of movement of salt in Australia's new hydrologic equilibrium could be a critical area of future salt and water management.

ANSTO is also investigating urban salinity in Western Sydney, where it is applying isotopic and geochemical methods to characterise urban salinity and processes caused by urban development. These represent a major issue that will cost Australians millions of dollars over the coming years. ANSTO's work in Western Sydney could have major implications on Australian building codes.

Some other applications of ANSTO's capabilities in this area are as follows:

- Research on groundwater extraction for cotton irrigation and tree decline in the Liverpool Plains region established a clear dependence of trees on shallow groundwater.
- The NSW Department of Land and Water Conservation is using ANSTO research to manage groundwater and water entitlements in the Lower Macquarie Valley.
- ANSTO's research in the Great Artesian Basin is providing data and information necessary for sustainable management in this region.

Coupled with climate modelling (another area in which ANSTO is active), isotopes provide a basis for predicting the impact that climate change has on effective groundwater recharge. ANSTO participates in a number of international climate change programs. It is also examining the use of radon emanation rates to measure soil moisture accurately and quickly, because large-scale soil moisture variability is a major cause of variability in weather and climate systems.

National Research Priorities implementation

ANSTO has begun implementing the National Research Priorities (NRPs). Two priority goals in the "An environmentally sustainable Australia" NRP are relevant to salinity research: "Overcoming soil loss, salinity and acidity" and "Water – a critical resource".

Under the former priority goal, ANSTO is planning to use its expertise in radioactive and isotopic tracers to investigate new techniques for salt mobility and determining the water cycle, and to contribute to national programs on prediction of salinity risk. ANSTO will also continue to develop its work on tracing and measuring salinity.

Under the latter priority goal, ANSTO intends to enhance use of radioactive and isotopic tracers to quantify water resources and solve water resource management issues, in particular hydraulic conductivity and movement of salt, groundwater recharge and residence time, and catchment scale water balance.

Linkages in salinity science

ANSTO's research and services related to salinity are often undertaken in collaboration with other Australian and overseas institutions, as they form part of more broadly based solutions. ANSTO's collaborators in its groundwater research include CSIRO, the NSW Department of Land and Water Conservation, the Bureau of Rural Sciences, the Murray Darling Basin Commission, the Cooperative Research Centre for Landscapes, Environment and Mineral Exploration (CRC LEME), the Bureau of Meteorology, the University of New South Wales,

the University of Wollongong, the University of Sydney, Latrobe University and Monash University.

ANSTO is encouraging the enhanced use of isotopes in an Australia-wide assessment of groundwater recharge and basin-wide hydrology. Examples of studies under way are in the Great Artesian Basin and Murray Darling Basin.

In its linkages with CRC LEME, ANSTO:

- has a major role in technical development under a CRC LEME project on aquifer parameterisation;
- is part of an intensive program applying airborne and ground geophysics to solve acute groundwater flow problems, in collaboration with the South Australian government; and
- has undertaken fieldwork in the South Australian Riverland where the State Government will build salt interception schemes at Bookpurnong and Loxton over the next 12–18 months, costing approximately $50 million. These schemes can be optimised using the work of ANSTO and CRC LEME.

Support for salinity research is mostly provided by State agencies and, in NSW at least, is done through salinity extension officers in each region. State agencies provide the most effective way for scientists and on-the-ground salinity managers to communicate.

ANSTO's main international linkages in climate change research are coordinated by the World Climate Research Program, the International Geosphere Biosphere Program, the Intergovernmental Panel on Climate Change and the International Atomic Energy Agency (IAEA). ANSTO is the primary contact in Australia for the IAEA for climate change research, and leads Australian research in stable and radioactive isotopic analysis. Recognising the importance of isotope techniques, the IAEA has embarked on a major program developing a global network of isotopes in rivers (the GNIR database). ANSTO is contributing recent data from the Darling River, which complements previous work in the Murray River system.

Challenges in coordinating salinity science

Collaboration in research is vital in resolving complex issues such as salinity, but it also presents challenges. These challenges include the following

- Salinity research is currently uncoordinated.
- There is no national repository or database for groundwater / salinity data. Recipients of government salinity funds are not compelled to divulge information and enable better scientific assessment of the effectiveness of remedial programs.
- Researchers face difficulties identifying the 'big picture' to which they should be contributing.
- Because ANSTO tends to work in conjunction with other scientific research agencies that usually take the lead role on salinity projects, there is little scope currently for ANSTO's valuable work to reach those who aim to implement salinity solutions, or relevant decision-makers.

- NAP funds tend to be directed to a few key organisations. ANSTO does not gain recognition for its work within the NAP and is less likely to be funded directly by the NAP. However, ANSTO's work is more likely to be in keeping with the scale required by local stakeholders (such as farmers and Catchment Management Committees) than some other recipients of funding.

- Federal organisations find it difficult to access data held by States—even when they are working for or with State departments.

- Agencies are reluctant to share data, which hinders coordination of solutions for salinity.

Solutions to Australia's salinity problems will also depend on input from social sciences and humanities (SS&H) disciplines as well as science, engineering and technology (SET). For example, ANSTO environmental researchers can use isotopes to identify sources of rising groundwater and salinity in towns, but communities themselves must determine how they want to address those sources, which may present major cultural quandaries for communities. The questions involved in this extend beyond SET, and draw on the expertise of researchers from SS&H disciplines.

Improving linkages

ANSTO has recently commented on ways to improve collaboration between research-performing organisations in its submission to the Review of Closer Collaboration Between Universities and Major Publicly Funded Research Agencies. Some relevant aspects of that submission are as follows:

- Collaboration brings costs, such as the costs of communication and of offsetting the risks involved in working with external parties.

- Trust is built over time and through experience. Once built, it reduces the transaction costs in collaboration and opens up new opportunities for collaboration.

- Parties work together best when they identify and appreciate their mutual dependencies.

- Collaborations flounder when researchers fail to ensure buy-in at more senior levels of their organisations or when the value of a linkage to multiple parts of the organisation are not appreciated.

- Different approaches to commercialisation of capabilities across different organisations can produce tension in collaborations. These approaches are reflected in structures of intellectual property ownership and participants' perspectives on potential return on investment.

- It is important to recognise that the types of collaborations involved in a research program typically evolve over the long term. A research project from its start should involve stakeholders who are interested in research outcomes, and an understanding of the appropriate collaborations that will be needed to deliver those outcomes. As research proceeds, barriers may well arise, and other parties are brought in to help address them. As outcomes are produced, new potential stakeholders emerge in the form of other organisations that can benefit from the solutions being developed or who might be engaged in delivery. Fixing linkage relationships at the start of a project is not a true

reflection of the nature of scientific research, although many competitive funding programs seek to do this.

Conclusion

ANSTO welcomes the decision of the House of Representatives Standing Committee on Science and Innovation to inquire into the management, co-ordination and implementation of the best science to combat salinity. Salinity is a critical issue for the environment with major financial implications. ANSTO believes that there is considerable scope to gain greater value from the excellent and innovative salinity science that is being undertaken at ANSTO and other organisations around Australia, through improved sharing of data, access to resources and stronger communication between scientists and the users of research.

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