





















A checklist of suggested actions

Question 1 – What is the current extent of dryland salinity and its risk of spread?

Section	No.	Action	Cost	Time	Confidence
NLWRA (1997–2002)	#1.1	Review data, information, reports and maps on the current extent of dryland salinity and its risk of spread compiled by the Audit relevant to your catchment, but with due consideration to work that has taken place since.			
	#1.2	Review data, information and reports on groundwater flow systems compiled by the Audit (www.nlwra.gov.au)			
Groundwater Flow Systems Framework	#1.3	Read the six-page summary of the <i>Groundwater Flow Systems Framework</i> , and understand its strengths and limitations in guiding your salinity management planning.			
	#1.4	Use the 'Tools' information packages, 'Rapid Catchment Appraisal' findings or 'Catchment Management handbook' for your region (or review them as a model for developing your own information) as a guide for assigning salinity risks to each of your major groundwater flow systems.			
	#1.5	Access the best available groundwater flow systems map for your region, and consider investing in the development of smaller-scale maps at 1:250,000 and 1:100,000 for more detailed identification of risks.			
Data	#1.6	Consult the guide on salinity mapping methods to refine your thinking on future regional investments in salinity mapping, prediction, monitoring and risk management.			
	#1.7	Explore the various geophysical techniques (ground and airborne) available for locating catchment salt stores and undertake a cost-benefit analysis to guide effective investment in your region.			
	#1.8	Use the results from assessments on the extent and hazard of dryland salinity to inform your decision-making processes with due consideration to the level of confidence in the underlying data sources applicable to your area.			
	#1.9	Consider the results of specific studies on the extent and hazard of dryland salinity in cropping areas to inform your decision-making processes with due consideration to the level of confidence in the underlying data sources applicable to your area.			
	#1.10	Take into account climate variability (rainfall and evapotranspiration), where possible, when determining the risk of dryland salinity spread.			
	#1.11	Review the 'status report' for your region and State in the <i>Groundwater Status Report for the Murray–Darling Basin</i> (or as a model for developing your own in other parts of Australia) and use the CD-ROM to tailor your own regional maps.			
	#1.12	Consider the concept of representative bores and the associated hydrographs for each groundwater flow system, and use this approach to guide future investments in bore installation and monitoring.			
	#1.13	Investigate salinity risk in more detail before proceeding with conversion of native vegetation to pasture or irrigated agriculture in the rangelands of the Murray–Darling Basin, especially north of Wilcannia.			
Modelling capability	#1.14	Read the paper <i>An overview of modelling techniques and decision support systems and their application for managing salinity in Australia</i> , and consult the PRISM CD-ROM and 'Catchment Modelling Toolkit' (www.catchment.crc.org.au) to help refine existing information on the extent and risk of dryland salinity in your region.			

Where to from here?	No.	R & D Tips
NLWRA	#1.1	Review the strategic plan for the National Land & Water Resources Audit Phase II (www.nlwra.gov.au) and/or speak with Audit staff to ascertain the extent to which the planned program of activities will meet your particular needs.
Groundwater Flow Systems Framework	#1.2	For information on further development of <i>groundwater flow systems</i> visit the NLWRA (www.nlwra.gov.au) and Bureau of Rural Sciences (www.brs.gov.au), and for the Murray–Darling Basin (www.mdbc.gov.au), as well as at individual State and regional levels.
Data	#1.3	Consider the <i>National Airborne Geophysics</i> project (www.affa.gov.au) to keep up-to-date with activities and advances in airborne geophysics mapping and research.
	#1.4	The <i>Groundwater Status Report for the Murray–Darling Basin</i> is likely to be updated periodically while accessibility of groundwater and other natural resource management information for the Basin will be progressively improved (www.mdbc.gov.au).
	#1.5	Contact State agencies, NLWRA (www.nlwra.gov.au) or CSIRO Land & Water (www.csiro.au) for further information on development of programs or activities to collect data for salinity management in rangelands environments.
Modelling capability	#1.6	Visit the CRC for Catchment Hydrology web-site (www.catchment.crc.org.au), which is developing a 'Catchment Modelling Toolkit' and consider the program of the 'Catchment Modelling School' for training model users.

Question 2 – What are the causes and processes of dryland salinity?

Section	No.	Action	Cost	Time	Confidence
NLWRA (1997–2002)	#2.1	Recognise that there is no one single approach to dryland salinity management, and start to understand the differences and similarities between each groundwater flow system in your region by reviewing the relevant fact sheets produced by the National Land & Water Resources Audit (www.nlwra.gov.au).			
	#2.2	Evaluate the availability of local data for each groundwater flow system in your catchment, and assess the likelihood of gathering additional data and the extent to which you will need to draw on understanding of like systems elsewhere to inform management decisions.			
Groundwater flow systems	#2.3	Identify whether any of the groundwater flow systems in your catchment are of the same type as the 10 case study catchments investigated by the Audit and the 'Catchment Classification' project. If so, review the relevant technical reports for more detailed information.			
	#2.4	Refer to the 'Tools Information Packages', 'Healthy catchment guide', 'Salinity management handbook' and 'Rapid Catchment Appraisal' program to better understand the causes and processes of dryland salinity (or use them as a model), and consider developing conceptual diagrams for each major groundwater flow system using the <i>Wimmera Regional Information Package</i> as a guide.			
Salt and water transport & movement	#2.5	Use airborne geophysics in a strategic way to help understand the process by which salts move through the landscape where the available information supports its application.			
	#2.6	Consider the relevance of the sub-catchment scale approach used in the 'Salt Delivery' project and the <i>Heartlands</i> initiative to understanding hydrological function and the mechanisms of salt transport within parts of your region.			
	#2.7	Be aware that using the outputs of one-dimensional models for dryland salinity planning and management and water allocation in hilly terrain has limitations and that decision-making processes should take reasonable account of sub-surface lateral flow and vertical drainage.			

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Plant water use	#2.8	Inform yourself about the trade-offs between managing the movement of salt versus the movement of water in the landscape before considering large-scale afforestation in any part of your region, and refer to Australian case studies where large-scale afforestation has taken place.			
	#2.9	Identify where woody perennial vegetation will be of greatest benefit in your catchment with due consideration to the location of salt stores.			
	#2.10	Establish the extent to which dryland salinity management is reliant on the development of alternative farming systems in your catchment.			
Saline ecosystems	#2.11	Use the classification system developed by the 'Saline Soils' project to identify the types of saline soils amenable to de-watering in your catchment.			
	#2.12	Apply a precautionary principle in the management of remnant vegetation affected by or at risk of dryland salinity, recognising that plant communities can collapse due to unusual or infrequent events, and consider opportunities for managing vegetation at a micro-scale.			
	#2.13	Identify remnant vegetation on riparian land, along drainage lines and in wetlands vulnerable to hydrological change or in need of restoration, and use the findings of the 'Recruitment Biology' project to support your management decisions.			
	#2.14	Study the relationship between increasing salinity and the health of wetland ecosystems in your region, using results of the 'Wetland salinity' project as a guide.			
Where to from here?	No.	R & D Tips			
NLWRA	#2.1	Review the strategic plan for the National Land & Water Resources Audit Phase II (www.nlwra.gov.au), the 'Catchment Modelling Toolkit' (www.catchment.crc.org.au) and the 'National Evaluation Framework' project for information on proposed data and model development.			
Groundwater flow systems	#2.2	Further development of the <i>Groundwater Flow Systems Framework</i> will take place at several levels – nationally through the NLWRA and 'National Evaluation Framework' project (www.brs.gov.au), for the Murray–Darling Basin through the MDBC (www.mdbc.gov.au), as well as at individual State and regional levels.			
Salt and water transport & movement	#2.3	Keep abreast of activities and advances in airborne geophysics mapping and research (www.affa.gov.au).			
	#2.4	Follow up on the progress of the <i>Heartlands</i> initiative (www.clw.csiro.au/heartlands).			
	#2.5	Consider the on-going development and measures in place to implement and monitor the agreed end-of-valley targets under the Basin Salinity Management Strategy (www.mdbc.gov.au).			
Plant water use	#2.6	Review the CRC for Catchment Hydrology web-site (www.catchment.crc.org.au) to keep abreast of improvements in modelling to account for plant water use and lateral movement of water in the landscape.			
	#2.7	Consider the CRC for Plant-based Management of Dryland Salinity (www.crcsalinity.com) Program 3, Subprogram 5, which includes research on native grasses.			
Saline ecosystems	#2.8	Consider the CRC for Plant-based Management of Dryland Salinity (www.crcsalinity.com) Program 2 on 'Function of natural ecosystems', which includes research on how ecosystems function in recharge zones, and how ecosystems function in soil affected by salinity and waterlogging, and Program 7 on opportunities for enhancing biodiversity in salinising landscapes.			

Question 3 – What are the current and predicted impacts and costs of dryland salinity?

Section	No.	Action	Cost	Time	Confidence
NLWRA (1997–2002)	#3.1	Identify the resources in your catchment that may be adversely affected by the current extent of dryland salinity and its risk of spread and list these 'assets' in order of priority for action.			
	#3.2	Use the Audit data to make a preliminary calculation of what dryland salinity is costing your regional economy, and the relative importance of off-farm versus on-farm costs, except where your catchment was part of the 'Costs' project (see Action #3.3).			
Current & future costs	#3.3	Use the 'Costs Guideline' to estimate current, marginal or future predicted costs for any region in Australia, but start by reading the 'Costs' final report to see what work has already been done and what sort of results you can expect.			
	#3.4	Refer to the 'Tools Regional Information Packages' for summary information on the findings of the 'Costs' project in your region, and consult the 'Salinity Information Package' for more general information on salinity costs.			
	#3.5	Refer to the 'Local government' project information kit on CD-ROM and the series of booklets on urban salinity to guide salinity identification and management for urban areas in your region.			
	#3.6	Consider the estimates for current and predicted impact costs on farm profits for agro-ecological zones for individual grain growers and the grains industry in your management response to dryland salinity.			
	#3.7	Ascertain whether an assessment of the current and predicted impact costs on farm profits for beef, sheep meat, wool or other industries is needed to inform your management response to dryland salinity.			
Ecosystem responses	#3.8	Estimate the loss of aquatic biota from a rise in salinity in your catchment using the preliminary methods developed by the 'In-stream health project' project to rapidly test the relative salinity tolerance of a large number of macro-invertebrate species.			
	#3.9	Test the decision-tree approach developed by the 'Restoring Remnant Vegetation' project in your catchment to predict likely ecosystem responses to changes in hydrologic balance.			
	#3.10	Use waterlogging and elevation as an initial indicator of the capacity of primary saline ecosystems to persist in a secondary saline environment.			
Cost sharing	#3.11	Investigate opportunities for cost-sharing arrangements to inform the development and support the implementation of your regional dryland salinity plan.			
	#3.12	Develop opportunities to market ecosystem services in your region to make sustainable land management more economically viable, and maintain a watching brief on the progress and relevance of programs and activities taking place elsewhere.			
Where to from here?	No.	R & D Tips			
NLWRA	#3.1	Review the strategic plan for the National Land & Water Resources Audit :Phase II (www.nlwra.gov.au) and/or speak with Audit staff to ascertain the extent to which the planned program of activities will meet your particular needs.			
Current & future impacts and costs	#3.2	Consider the on-going activities of the Salinity Investment Framework, Rural Towns Program and the implementation of the Basin Salinity Management Strategy (www.mdbc.gov.au).			
	#3.3	Consider the outcomes of research from the Sustainable Grazing on Saline Lands (SGSL) Program on the changing value of saline land as an agricultural resource.			
Ecosystem responses	#3.4	Consider the research portfolio of the CRC for Freshwater Ecology (www.environmentdirectory.com.au/research/crcfw.html) and the WA Engineering Evaluation Initiative for further information.			
Cost sharing	#3.5	Follow the progress of investigations by CSIRO Land and Water (www.clw.csiro.au) on efficient trading systems and on ecosystem services under the NAP (www.napswq.gov.au).			

Question 4 – What can we do and how to measure progress?

Section	No.	Action	Cost	Time	Confidence
Getting started	#4.1	Undertake a comprehensive review of all relevant regional plans in the light of current dryland salinity research outcomes, and assess the need to align the plans, with particular consideration to the suitability and feasibility of management options and measuring progress.			
	#4.2	Access the 'Tools Salinity Information Package', 'Salinity Management handbook', 'Rapid Catchment Appraisal' or similar resource to understand the broad salinity options available.			
	#4.3	Refer to the table on 'Suitability of options for managing dryland salinity' in the 'Tools Regional Information Package' for your region (or as a model to develop your own) to identify broad management options and ratings for each groundwater flow system type.			
NLWRA (1997–2002)	#4.4	Use the 'National Evaluation Framework' guidelines to plan how to systematically build on existing knowledge for each groundwater flow system type through coordinated management, monitoring and research. Refer to <i>Participatory evaluation for landcare and catchment groups – A guide for facilitators</i> for background information on monitoring and evaluation.			
	#4.5	Consider the broad scope of options available to manage dryland salinity – plant-based, engineering, saline industries, living with salinity – and select those that optimise the benefits to your region considering the short-term and long-term costs and benefits.			
	#4.6	Use the surveys and modelling tool developed by the Audit to examine potential social impacts of your proposed management approach to dryland salinity, and develop a better understanding of the social trajectory of your community.			
Modelling land use and management change scenarios	#4.7	Read the paper <i>An overview of modelling techniques and decision support systems and their application for managing salinity in Australia</i> and the booklet <i>Groundwater models – A community guide to better understanding</i> to get an overview of salinity modelling, and then consult the PRISM CD-ROM to help inform the choice of an appropriate approach for your region.			
	#4.8	Visit the CRC for Catchment Hydrology web-site (www.catchment.crc.org.au) to view the 'Catchment Modelling Toolkit' and consider the benefits of attending a 'Catchment Modelling School' to improve modelling capacity in your region.			
	#4.9	Ensure that your regional salinity management plan complies with the requirements of higher order plans like the Basin Salinity Management Strategy.			
	#4.10	Use the model developed by the 'In-stream Health' project to evaluate the effect of predicted salinity rises on aquatic biodiversity, and develop locally specific guidelines to prevent unacceptable impacts.			
	#4.11	Consider the brochure <i>Science for Decision Makers</i> , together with the paper <i>Critical factors affecting the adoption of airborne geophysics for management of dryland salinity</i> , and use the five-step approach described if a cost-benefit analysis indicates that airborne geophysics technology is appropriate to your circumstances.			
Vegetation options	#4.12	Try to achieve multiple outcomes from the vegetation options used to address dryland salinity management in your region, recognising that viable land use solutions that satisfy the criteria of relevance, effectiveness, robustness and profitability may not yet be available in all cases.			
	#4.13	Consider lucerne as a viable land use option for controlling recharge in the <600 mm winter-dominant rainfall zone – with particular potential to lower water tables in local groundwater flow systems – but limited to an optimal area for enterprise profitability and with some establishment and persistence limitations.			

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Vegetation options	#4.14	Encourage and develop profitable enterprises based on the use of saltland pastures as a means of adapting to salinity over extensive areas.			
	#4.15	Consider the establishment of agroforestry plantings in your catchment that achieve multiple benefits, satisfying both commercial and environmental objectives, and use the Design principles and Manuals series, together with resources from the Heartlands initiative to assist your work.			
	#4.16	Recognise that investing public or private monies in vegetation management options for the purpose of dryland salinity management in a regional groundwater flow system will require high adoption levels and that realisation of gains will be very long-term.			
Saline environments	#4.17	Assess the potential for reversing chemical, physical and biological changes in salinised soil using the eight simplified Soil Salinisation Categories and best management practices developed by the 'Saline Soils' project, and monitor improvements in landscape health when remedial treatments have been implemented.			
	#4.18	Consider the potential for applying (or adapting) the prioritisation framework developed by the 'Restoring Remnant Vegetation' project based on an assessment of the degree of threat, value of the asset, and likelihood of successful intervention in your catchment.			
	#4.19	Refer to the report <i>Managing groundwater and surface water for native terrestrial vegetation health in saline areas</i> for information on approaches and techniques for the assessment, monitoring and management of the health of native vegetation communities, and review the model for restoring saline land use based on understanding the recruitment biology of vegetation communities on saline soil.			
	#4.20	Consider ways of using salinity as a resource, and use the 'Options for the Productive Use of Saline (OPUS) Land' database on the NDSP web-site as a guide to the options available.			
Engineering options	#4.21	Use the 'Engineering Options' on-line decision support tool (www.ndsp.gov.au) to determine what engineering management options might have high potential for success and be cost-effective in your region.			
	#4.22	Examine the applicability of deep drains in your catchment, including both beneficial and adverse impacts, and establish management arrangements to ensure their appropriate use.			
	#4.23	Identify whether desalination is a relevant and cost-effective option in your catchment, using the decision-tree developed by the 'Desalination Technologies' project to guide your choice of technique.			
Social and institutional capacity	#4.24	Review the structural adjustment indicators used to identify potential catchment management plan implementation problems shown in <i>Adjusting for catchment management</i> and the socio-economic research findings in the reports <i>Understanding landholders' capacity to change to sustainable practices</i> and <i>Landmark</i> , and consider the potential implications and your possible responses.			
	#4.25	Consider the approach and outcomes of the 'Target' project in developing appropriate strategies to achieve salinity targets in small, medium and regional scale catchments.			
	#4.26	Use the SRD Kit and associated report to inform partnerships in sustainable regional development.			

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	#4.27	Consider the institutional capacity-building strategies developed by the 'Institutional arrangements' project relevant to your region, including possible incentives and funding sources.			
	#4.28	Use the 'Community engagement toolkit' to familiarise yourself with the diversity of tools and techniques available to support community consultation processes in natural resource management.			
	#4.29	Identify opportunities and the economic rationale for progressive Local Government planning and development policies to control dryland salinity in your region, and support their implementation through incentive options, capacity-building and research.			
	#4.30	Identify the training and educational needs to support salinity management in your region, and consider regional options and partnerships for meeting priority needs.			
Where to from here?	No.	R & D Tips			
NLWRA	#4.1	Consider the <i>National Evaluation Framework</i> project as a foundation from which to build benchmarking, monitoring and evaluation mechanisms at all scales of salinity management, using consistent and transferable approaches, and drawing on adequate and reliable data.			
	#4.2	Review the strategic plan for the National Land & Water Resources Audit Phase II and/or speak with Audit staff to ascertain the extent to which the planned program of activities will meet your particular needs.			
Models, frameworks and decision support tools	#4.3	Visit the CRC for Catchment Hydrology web-site (www.catchment.crc.org.au), developing the 'Catchment Modelling Toolkit' and providing information about the 'Catchment Modelling School' for the training of model users.			
Vegetation options	#4.4	Consider the three research programs of the CRC for Plant-based Management of Dryland Salinity on targeted revegetation and profitable and sustainable grazing systems from perennial pastures in recharge areas (www.crcsalinity.com.au).			
	#4.5	Consider the objectives and program of research and communication activities for Grain & Graze targeting mixed grain and meat enterprises (www.grainandgraze.com.au).			
	#4.6	Watch the progress of the National Market-based Instruments (MBI) Pilots Program (see www.napswq.gov.au) and the NSW Environmental Services Scheme pilot project (www.dipnr.nsw.gov.au).			
	#4.7	Read the five-year plan for the Joint Venture Agroforestry Program for information on farm forestry research, development and extension (www.jvap.gov.au).			
Saline environments	#4.8	Consider the research and associated producer networks established under the Sustainable Grazing on Saline Lands (SGSL) Sub-Program (www.lwa.gov.au) and PUR\$L (www.ndsp.gov.au).			
Engineering options	#4.9	Consider the Engineering Evaluation Initiative in Western Australia, with \$2 million allocated to identify the most effective engineering options for salinity management.			
Social and institutional capacity	#4.10	Consider aspects of socio-economic research in the 'Social and Institutional Research Program' (www.lwa.gov.au), the 'Human Dimension Program' (www.mdbc.gov.au), the 'Human Capital, Communication & Information Systems Program' (www.rirdc.gov.au) and the CRC for Plant-based Management of Dryland Salinity Program 5 on 'People, land & water' (www.crcsalinity.com).			

Question 5 – How do we integrate with other natural resource management issues?

Section	No.	Action	Cost	Time	Confidence
Integrated natural resource management	#5.1	Review the strategic plan for the National Land & Water Resources Audit Phase II (www.nlwra.gov.au) and/or speak with Audit staff to ascertain the extent to which the planned activities will meet your particular regional needs.			
Salinity Investment framework	#5.2	Consider the application of the Salinity Investment Framework in your regional context as an approach to deciding between multiple objectives and prioritising investment.			
Salinity and biodiversity	#5.3	Review the SA report on salinity and biodiversity and the decision support tools identified and consider whether your regional plans give adequate recognition of the threat of salinity to biodiversity.			
Catchment condition	#5.4	Consider the map products and methods developed by the 'Catchment condition' project within the context of your regional planning.			
Landmark	#5.5	Consider the integrated, catchment-scale method developed by the <i>Landmark</i> project to assess the sustainability of current land use and scenarios for land use change for application in your region.			
Heartlands	#5.6	Consider the method trialed by the <i>Heartlands</i> initiative to develop an integrated land use map for sub-catchment-scale planning and implementation in your region			
Sediment & nutrient exports	#5.7	Consider the benefits from additional data and information to inform investment decisions, as demonstrated by the <i>Sediment & nutrient exports</i> project, and the potential to optimise investment benefits by using the prioritisation framework coupled with salinity modelling to prioritise work in your region.			
Watermark	#5.8	Use the findings, guidelines and tools developed by the <i>Watermark</i> projects to link dryland salinity management decision-making more closely with irrigation management in your catchment.			
BushTender	#5.9	Consider the auction approach trialed in the <i>BushTender</i> program in achieving multiple benefits from remnant vegetation protection in your region.			
Ecosystem services	#5.10	Consider ways of valuing and investing in ecosystem services to support integrated catchment management in your region, using the resources developed by the <i>Ecosystem services</i> project.			
National Market-based Instruments Pilots	#5.11	Consider the wide array of mechanisms being tested under the <i>National Market-based Instruments Pilot Program</i> to value and invest in ecosystem services to support integrated catchment management in your region.			
TARGET	#5.12	Consider the final reports from the TARGET project within the context of your regional planning, particularly the integration of salinity and biodiversity using 'bio-indicators'.			