

Salinity management in the south-west of Western Australia



Conservation Commission
of Western Australia



The Function of Conservation Commission performance assessments

Conservation Commission performance assessments are undertaken primarily to fulfil the functions described in section 19 (g) of the *Conservation and Land Management Act 1984*. That is; to assess and audit the performance of the Department of Parks and Wildlife (referred to in this document as DPaW and formerly known as the Department of Environment and Conservation) and the Forest Products Commission (FPC) in carrying out and complying with management plans. The assessments also help inform the Conservation Commission's policy development function and enable the Commission to advise the Minister on the conservation and management of biodiversity components throughout the state.

The performance assessment was undertaken in accordance with the *Conservation Commission policy and guidelines for the performance assessment of conservation reserve and forest management plans and biodiversity management in WA*. This document is available on the Conservation Commission's website www.conservation.wa.gov.au.

This report has been prepared by the Conservation Commission of Western Australia.

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Table of Contents

| | |
|---|----|
| Executive summary | 4 |
| Introduction..... | 6 |
| What is salinity? | 7 |
| Context | 9 |
| Is salinity still a threat? | 9 |
| What are the biodiversity impacts of salinity? | 10 |
| The extent of salinity | 11 |
| Inputs and outputs | 17 |
| Measures being taken to manage salinity | 19 |
| Outcomes | 23 |
| Conclusion | 32 |
| Glossary | 33 |
| Bibliography | 35 |
| Appendix 1 – Approximation of elevation for the conservation estate using GIS | 37 |
| Appendix 2 – Department of Parks and Wildlife response to the findings..... | 38 |

Executive summary

In 2004 the Conservation Commission was advised that about 450 plant and 400 animal species are at risk from extinction from salinity. In August 2005 communities in Western Australia's salt-affected regions were advised of \$316 million in funding from the Australian and State governments to tackle salinity. Fast-forward to today and salinity mitigation is seldom mentioned as a priority. This begs the question, 'Is salinity still a threat?' The Conservation Commission through this assessment has sought to clarify what circumstances surround this shift in priorities, to determine whether there has been a change in the threat that salinity poses to the biodiversity values of conservation estate (lands vested in the Conservation Commission), and what the outcomes of management actions have been.

In reviewing the available literature it is apparent that salinity is still recognised as a significant threat to biodiversity in the south-west of Western Australia. Yet there is significantly less interest in salinity work in the recent past. This contrasts starkly with the range of actions and funding which occurred during the seven years (2001-2008) of the National Action Plan for Salinity and Water Quality. The Commission supports and acknowledges the Department of Parks and Wildlife's (DPaW's) long-term commitment to researching and managing salinity under the State Salinity Strategy which was developed by the State Salinity Council after its review of the 1996 Salinity Action Plan. The Commission particularly appreciates DPaW's recognition that the issue will endure when short-term funding from the federal resource management programs (Caring for our Country, the Natural Heritage Trust, and the National Action Plan for Salinity and Water Quality) ceases.

It has not been possible to report in a comprehensive way on the achievement of outcomes relating to salinity management on the conservation estate, as there is limited information that exclusively measures outcomes on the estate. However, information on salinity trends in water-tables, rivers and wetlands is available in various forms and indicates general catchment condition. There is also good information being collated and reported by DPaW on the intermediate outcomes of the Natural Diversity Recovery Catchment Programs, but these are limited to six catchments and there is little potential for expansion into other areas which were previously identified as representing zones of high biodiversity.

The threatened species and threatened ecological communities located in the Natural Diversity Recovery Catchment Program areas are reportedly persisting. Areas of mallee eucalypts (13,000 hectares) have been established but the effectiveness of this endeavour has not been adequately reported. Wider scale adoption of re-vegetation with mallee eucalypts will be required to meaningfully tackle salinity but there are reportedly supply-chain issues with the development of an associated industry. Monitoring information from relevant wetlands indicates long-term trends of declining water levels and increasing salinity at many, but not all, wetlands. Data for the four main rivers which originate in the Wheatbelt, the Avon, Blackwood, Kent and Pallinup Rivers, indicates that salinity levels are continuing to increase. The data sets to inform management on salinity risk are now outdated and require review, along with an overview of the results of the various salinity mitigation initiatives.

The Conservation Commission acknowledges the need to measure success over a period of decades and continues to support DPaW in its ongoing commitment to salinity abatement on the conservation estate.

The findings arising from this report are as follows:

Finding 1

Further information is required to understand the interactions between climate variability and saline groundwater levels, and the changing nature of the threat posed by salinity.

Finding 2

The total area at risk from salinity is now considered less than that estimated by the National Land and Water Resources Audit (2000).

Finding 3

It is 15 years since the salinity estimates which are currently in use were produced and these data sets require updating and review.

Finding 4

Salinity risk mapping of the Edel and Geraldton Hills IBRA sub-regions is not comprehensive.

Finding 5

According to recent data, a relatively small proportion (approximately 5%) of the conservation estate which is at most risk from salinity falls within Natural Diversity Recovery Catchment Program areas.

Finding 6

Only one NDRC plan had been finalised by June 2013.

Finding 7

The Drummond Natural Diversity Recovery Catchment: Recovery Plan 2011-2031, endorsed by the Conservation Commission in 2012, has not yet been published.

Finding 8

There has been no whole-of-state government review into the effectiveness of salinity mitigation under the State Salinity Strategy.

Introduction

In 2004 the Conservation Commission was advised that about 450 plant and 400 animal species are at risk from extinction from salinity. In August 2005 communities in Western Australia's salt-affected regions were advised of \$316 million in funding from the Australian and State governments to tackle salinity. Fast-forward to today and salinity mitigation is seldom mentioned as a priority. This begs the question, 'Is salinity still a threat?' The Conservation Commission through this assessment has sought to clarify what circumstances surround this shift in priorities and determine whether there has been a change in the threat that salinity poses to the biodiversity values of conservation estate (lands vested in the Conservation Commission). The Commission is also concerned about potential impact on biodiversity outside the reserve system in the south-west agricultural region, which contains numerous small reserves and extensive areas of cleared land. With this in mind, this assessment is broadly focused on the threat that salinity poses to biodiversity values of conservation lands vested in the Conservation Commission and the outcomes of salinity-related management actions on those lands.

The Department of Parks and Wildlife (DPaW) has maintained the capacity to undertake on-ground salinity-related research works under the State Salinity Strategy which was developed by the State Salinity Council after its review of the 1996 Salinity Action Plan. The Salinity Strategy showed how government, industry, land managers and the community could work together over the 30 years that followed to make a big difference in combating salinity. DPaW has consistently sought to maintain this capacity to manage salinity-related issues amid a decline in both awareness and funding of salinity-related work.

The Commission supports and acknowledges DPaW's long-term commitment to researching and managing salinity. The Commission particularly appreciates DPaW's recognition that the issue will endure when short-term funding from the federal resource management programs (Caring for our Country, the Natural Heritage Trust, and the National Action Plan for Salinity and Water Quality) ceases. The Conservation Commission also notes the well-structured review of the Natural Diversity Recovery Catchment Program (Wallace, 2011) and the commitment to undertake a wider review which is contained therein: *'This document (Wallace, 2011) forms part of a review of all departmental salinity programs; however the recovery catchment section has been completed first to support strategic decisions in relation to natural resource management programs.'*

What is salinity?

DPaW has described two main types of secondary salinisation: dryland salinity and irrigation salinity. Dryland salinity occurs on non-irrigated land (including wetlands) and usually results from broadscale clearing of native vegetation and its replacement with crops and pastures that use less water. Irrigation salinity occurs when irrigation water is added to a landscape. In both cases, a change to the water balance leads to accelerated land and water salinisation. In Western Australia the predominant form is dryland salinisation, which occurs in the inland agricultural zone of the south-west (DEC, 2012).

A general glossary is provided at the end of this report; however, some key definitions are provided here:

Salinisation: the process of accumulation of salts in soils, waters or sediments.

Salinity: a measure of the concentration of ions in waters, soils or sediments. This measurement is used to describe the differences in waters that are considered 'fresh' (with very low concentration of ions) and those that are considered 'saline' (with high concentrations of ions).

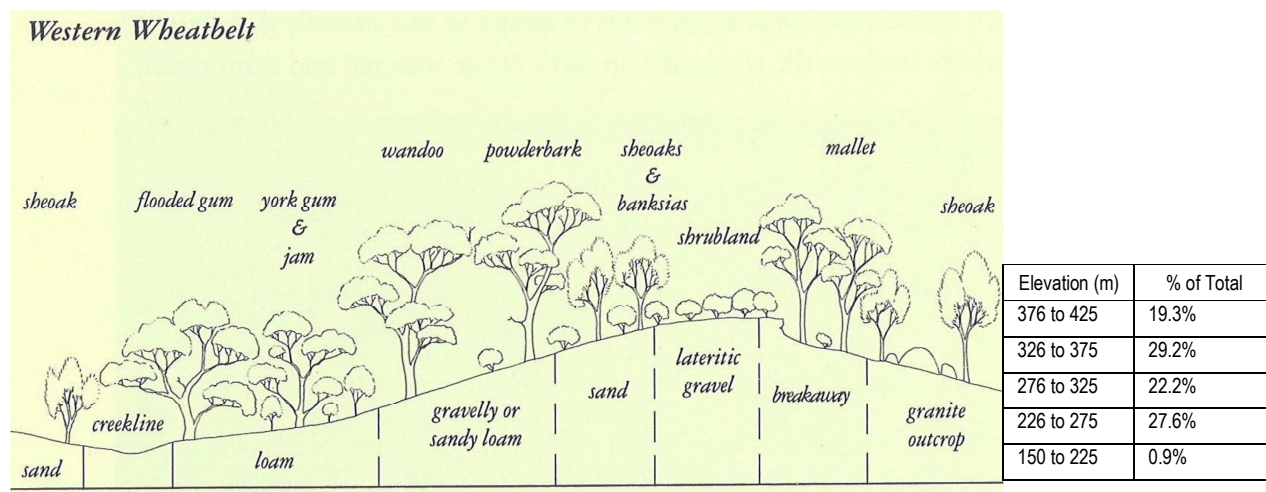
Secondary salinisation: a human-induced process in which the salt load of soils, waters or sediments increases at a faster rate than naturally occurs (DEC, 2012).

Saline environments are a natural feature in the south-west of Western Australia, but changes in land and water management have caused a widespread increase in salinisation of the land and rivers of the region. The areas of remnant vegetation remaining in the Wheatbelt which are found low in the landscape are most vulnerable to being adversely affected by rising water-tables. In the Wheatbelt of Western Australia the annual rainfall declines from 500mm to 280mm from west to east, and changes in the woodlands occur along this gradient.

'Trees and shrubs typical of the woodlands in the west give way to other species as one journeys east.' (Bamford, 1995.).

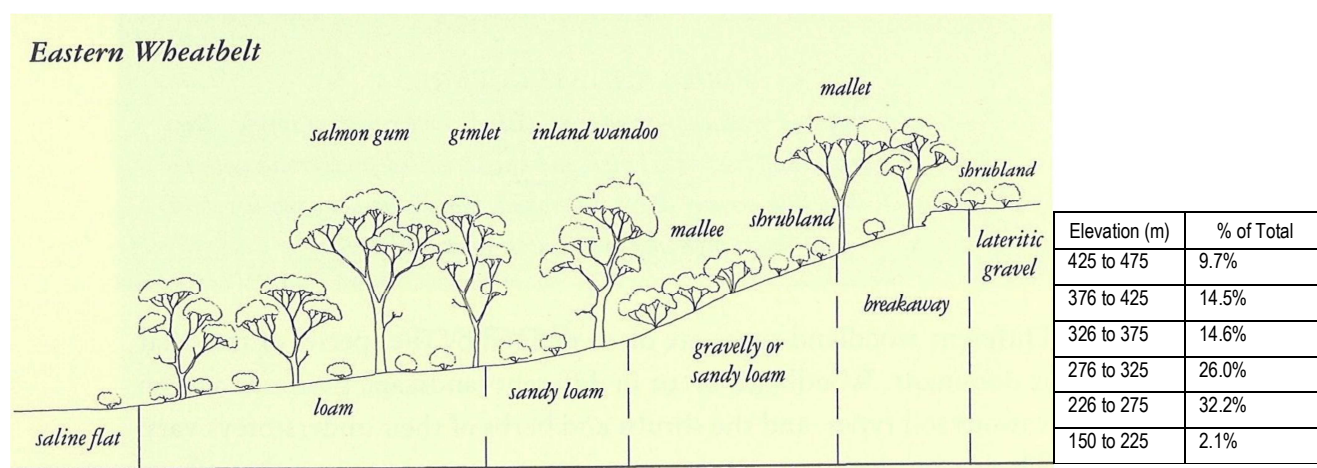
Landscape profiling has been added to Bamford's stylised soil and vegetation image below using statistics by Interim Biogeographic Regionalisation for two Australia (IBRA) sub-regions: Avon Wheatbelt P1 representing the 'Eastern Wheatbelt' and Avon Wheatbelt P2, the 'Western Wheatbelt'. Approximately 2% of the area of these two IBRA sub-regions is land vested in the Conservation Commission. The reserve system in the Wheatbelt is characterised by small, scattered reserves.

Figure 1 Stylised adaption (from page 45 of *Exploring Wheatbelt Woodlands*, Bamford, M., Department of Conservation and Land Management, 1995) of soil and vegetation image with elevation statistics for areas vested in the Conservation Commission in the Avon Wheatbelt P2 IBRA sub-region in the western Wheatbelt



The Avon Wheatbelt P2 IBRA sub-region in the western Wheatbelt has 2.1% (602 square kilometres) of the sub-region's area (29,922 square kilometres in total) vested in the Conservation Commission. 28.4% of the conservation estate in this area is low in the profile (less than 275 metres above sea level); 51.4% is mid-profile (276 metres to 375 metres); and 19.3% is high in the profile.

Figure 2 Stylised adaption (from page 45 of *Exploring Wheatbelt Woodlands*, Bamford, M., Department of Conservation and Land Management, 1995) of soil and vegetation image with elevation statistics for areas vested in the Conservation Commission in the Avon Wheatbelt P1 IBRA sub-region in the eastern Wheatbelt



The Avon Wheatbelt P1 IBRA sub-region in the eastern Wheatbelt has 2.4% (1,578 square kilometres) of the sub-region's total area (65,231 square kilometres) vested in the Conservation Commission. 34.3% of the conservation estate is low in the profile; 40.6% is mid-profile; and 24.2% is high in the landscape profile.

Context

Is salinity still a threat?

There is significantly less interest in salinity work in the recent past. This contrasts starkly with the funding available and the range of actions which occurred during the seven years (2001-2008) of the National Action Plan for Salinity and Water Quality (NAP). The NAP was a well-resourced salinity program (which included a budget of \$1.4 billion – half Commonwealth and half state funding) which ceased on 30 June 2008. However, the continued decline in annual rainfall in the south-west of Western Australia, may influence the rate of salinisation. In the 2005 Indian Ocean Climate Initiative report titled 'How Salinity has Changed' (McFarlane, D., Rupprecht, J, 2005) it was noted that, *'The reduced incidence of wet winters since the mid-1970s has almost certainly resulted in a slowing in the rate of salinisation in many parts of the agricultural area ... Salinity remains a very serious degradation process for the State but we may now have more time to develop solutions than we previously thought.'* Furthermore, it was noted in the same document that changes in climate may also present new opportunities, such as, *'If dry conditions persist it may be possible to consider reclamation of previously affected areas.'* (McFarlane, D., Rupprecht, J, 2005)

The 2011 State of the Environment report (State of the Environment 2011 Committee, 2011) noted that *'...in regions with previously identified salinity risks, it is widely reported that shallow, saline groundwater levels (one of the fundamental drivers of secondary salinisation) are falling. There seem to be fewer reports of spreading land salinisation ... Recent changes in salinity are most likely reflecting a changing balance between saline groundwater levels and dilution flows due to the widespread drought across southern Australia. Less rainfall can mean drops in local saline groundwater levels, thus reducing the delivery of salt to soil and streams. On the other hand, reduced river flows can mean local increases in salinisation.'* (State of the Environment 2011 Committee, 2011).

Surface water monitoring data presented later in this report for the four main rivers which originate in the Wheatbelt, the Avon, Blackwood, Kent and Pallinup Rivers, indicates that salinity levels are continuing to increase while rainfall in the catchment areas of the south-west of Western Australia has generally declined.

In reviewing the available literature it is apparent in an overall sense that salinity is still recognised in contemporary literature as a significant ongoing threat to biodiversity in the south-west of Western Australia.

Further in the report 'How Salinity has Changed' (McFarlane.D; Ruprecht.J, 2005) it is noted that *'Streamflow is more saline in dry years... However, the wet years lead to greater recharge to the groundwater leading to more saline groundwater discharge and increasing stream salinities in later years.'* The authors conclude that *'Further work is needed to understand the interactions between decadal climate variability, climate change, and land use change and assess their relative impacts on land and stream salinity'*.

Finding 1

Further information is required to understand the interactions between climate variability and saline groundwater levels, and the changing nature of the threat posed by salinity.

What are the biodiversity impacts of salinity?

As described in the Department of Environment and Conservation (DEC) publication, *The potential effects of groundwater disposal on the biota of wetlands in the Wheatbelt, Western Australia*, (Susan Jones, 2009) the majority of wetlands in the Wheatbelt are naturally saline and temporary because of the Mediterranean to semi-arid climate.

Groundwater disposal, in particular deep drainage, is a widely used engineering option by the agricultural sector for reclaiming salt-affected growing areas. Yet despite this wide application, *'there is limited understanding of the full range of impacts that agricultural drainage has on the biological communities living in wetlands of the Wheatbelt.'* (Jones S. M., 2009). To alter salinity levels in drainage lines by pumping requires long-term commitment and the salt from the drained area then has to be dealt with. Because of salinity and waterlogging in properties adjoining land vested in the Conservation Commission, suggestions have been made to discharge water into vested land. Another suggestion is to sacrifice several rivers, (the Avon-Swan and Blackwood Rivers) by converting them into salt drains.

Some of the issues relating to drainage and Conservation Commission vested land include the following:

- Conservation reserves are often located in discharge areas, and wetlands in such reserves, including streams and associated vegetation, are particularly vulnerable. A 1993 survey recorded the dominant class of vegetation in wetlands as 'dead trees' (Halse et al, 1993)
- Off-site effects which may lead to problems in reserves include altered surface hydrology (changes in the quantity and timing of water draining into the reserved land), altered groundwater flow (changes in mean water-table levels and altered seasonal patterns), and altered water quality (increased nutrients, salt, silt and metal ions)
- The water, nutrients and silt which are lost from farmland are the very products essential for the maintenance of farm productivity
- Drains or pumps are sometimes used to reduce both waterlogging and salinity in agricultural land – this requires sites into which the resulting water can be discharged or diverted.

As further described in the DEC publication (Jones S. M., 2009), *'...disposal of groundwater that is more saline than the receiving basin is likely to devastate the biota. These effects are especially detrimental in originally freshwater or sub-saline wetlands, where species richness will start to decline once the salinity rises above 2-3 g/L.*

Further loss of invertebrate, emergent plants and waterbird species is likely to occur above 10 g/L and then again for invertebrates and waterbirds at 30 g/L. Once the salinity of the wetland

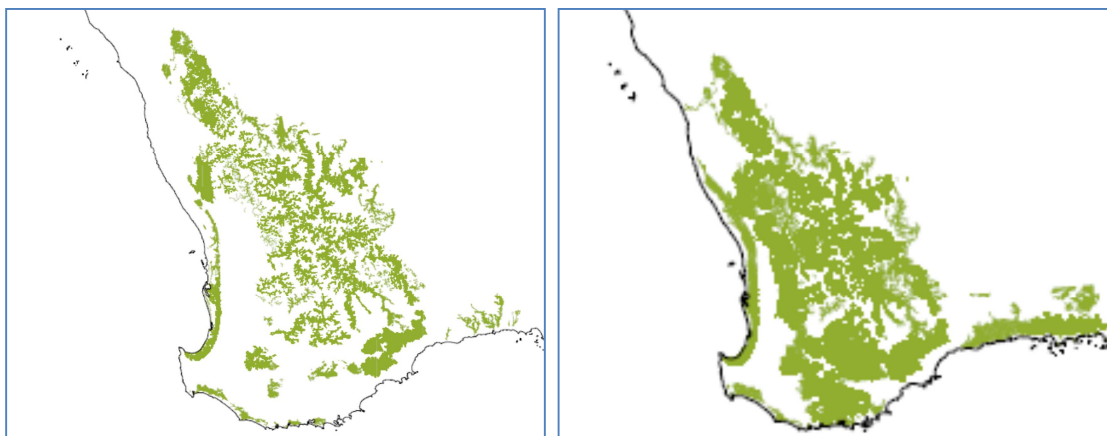
consistently rises above 45 g/L, submerged macrophyte communities will stop reproducing and further declines in invertebrates will occur.'

It has also been suggested (White, 2000) that it may require changes on the scale of geomorphologic or climatic change to reverse the damage already done to the system. White also suggests it may be necessary to reforest large parts of the landscape, and to use engineering methods to keep things going long enough for the planted vegetation to take effect, which could take many years.

The extent of salinity

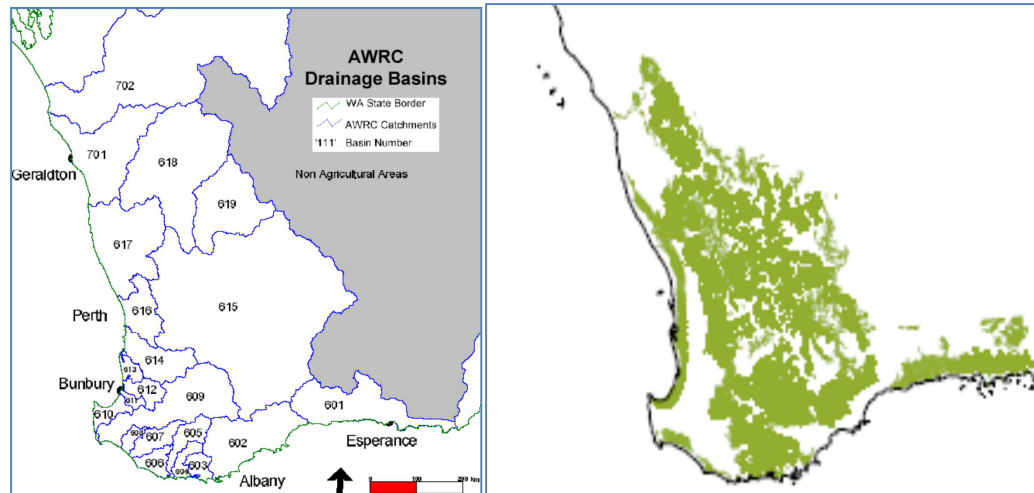
In researching this topic, the common reference data for describing the extent of salinity in Australia is the Australian Dryland Salinity Assessment 2000 from the National Land and Water Resources Audit (NLWRA). It includes information on salinity monitoring, risk and hazard, and likely increases at national and state levels. The Year 2000 map of dryland salinity risks represents both depth and trend of groundwater at year 2000 within broad regional systems. Trend data were then used to predict future water-table depths and to allocate a risk rating in 2050 (see Figure 3 below). The future risk of a shallow water-table is based on depth to groundwater. Predicted groundwater depths for the year 2050 were determined by projecting trends at the then current rates of rise. An assumption is that land use and rainfall do not change. The underlying assumption behind these projections (that rainfall will not change in the period 2000 to 2050) needs careful consideration, as there has been a reduced incidence of wet winters since the mid-1970s.

Figure 3 From the National Land and Water Resources Audit - areas containing land of high hazard or risk of dryland salinity in 2000 (left) and forecasted areas containing land of high hazard or risk of dryland salinity in 2050 (right)



To further illustrate these predictions, risk was assigned to the Australian Water Resources Council drainage basins depicted below. (McConnell, 2001)

Figure 4 McConnell 2001 reported on salinity risk to the Australian Water Resources Council drainage basins (left), with 2050 salinity hazard or risk projections (right)



Risk by percentage (based on area) in each basin was calculated and the percentages at high risk of shallow water-tables shown. The largest drainage basin, Avon (#615 in figure 4), covers most of the Wheatbelt and at that time it was estimated to have 16% of its area at high risk. This was projected to increase to 18% by 2020 and 21% by 2050. This contrasts with the Blackwood Basin (#609 in figure 4) where the area of high risk was projected at the time to increase from 16% in 2000 to an estimated 45% by 2050.

It is now generally agreed that the total area at risk from salinity in Australia is probably less than that estimated by the NLWRA (Munday.B, 2006) a report which goes on to state that *'It is likely that the NLWRA, which used data from a 'wet' period, therefore presented a worse case scenario.'*

Finding 2

The total area at risk from salinity is now considered less than that estimated by the National Land and Water Resources Audit (2000).

The NLWRA and related Land Monitor (the main salinity mapping at a landscape scale in WA) are still the most ubiquitous references for describing the extent of salinity, but these were produced 12 years and 15 years ago respectively. Caccetta makes the same observation: *'... there is now a requirement that another round of current salinity estimates be undertaken as it is 12 years since the last analysis.'* (Caccetta, 2010)

Finding 3

It is 15 years since the salinity estimates which are currently in use were produced and these data sets require updating and review.

Land Monitor

Caccetta describes the different methods of mapping, monitoring and predicting salt-affected land that have been used in WA. These include Australian Bureau of Statistics (ABS) surveys, extrapolating from detailed catchment mapping, groundwater levels coupled with soil-landform maps (NLWRA methodology) and satellite remote sensing and digital terrain models ('Land Monitor') (Caccetta, 2010).

Caccetta goes on to explain that '*...the ABS method may underestimate the extent of salinity, whereas catchment mapping and the NLWRA method overestimates its extent and hazard.*' The Land Monitor method has advantages in that it shows where salinity is within catchments. Furthermore, hazard areas on a regional scale are identified more efficiently than with any other method. In addition, the method is repeatable and allows confidence limits to be placed on the estimates. (McFarlane, George, & Caccetta, 2004)

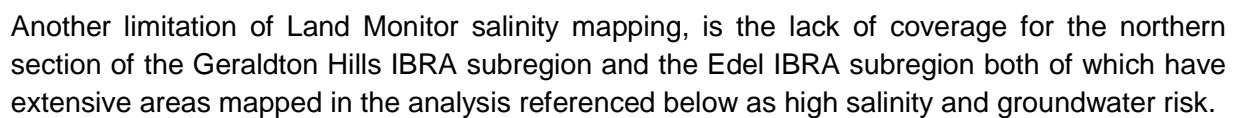
The Land Monitor method estimates that about 821,000 hectares were affected by secondary salinity (more than in 1996) and that this area had increased by about 14,000 ha per annum since 1989. The area affected by salinity hazard (i.e. land which may develop salinity in the future depending upon controlling factors) is estimated to be up to 5.4 million hectares of total land (between 2.8 and 4.4 million hectares of agricultural land).

In its 2008 analysis of salinity trend, the Avon Catchment Council noted that '*Inherent errors exist within Land Monitor salinity coverages*' but further noted that, '*Land Monitor provides an opportunity to assess salinity trends at a regional scale using archived data that can be repeated as knowledge of salinity development within the region improves.*' (Avon Catchment Council, 2008). This echoes comments by Munday - '*While Land Monitor is the most accurate overall measure, it underestimates salinity in wetter areas, and overestimates in some drier northern areas.*' (Munday, B., 2006)

Opinions therefore vary on the amount of and best method for estimating salinity risk. However, Land Monitor provides DPaW managers with a readily available guidance tool. The metadata of the Land Monitor data set itself describes limitations for its use as follows: '*The salinity maps were produced by combining Landsat TM data (25m) with information derived from digital elevation models (10m). The scale of the Land Monitor salinity mapping is suitable at the synoptic overview level only, and should not be applied to paddock scale analysis. Risk areas show areas at risk of developing higher water tables.*'

An example of the output from Land Monitor is provided below:

* Map of salinity hazard for the Lake Toolibin recovery catchment area. Areas mapped as salt-affected in 1988 are shown in orange. Areas that became salt-affected by 1998 are shown in red. The salinity hazard areas are shown in blue. The greyscale background is a January 1994 Landsat TM mosaic image.

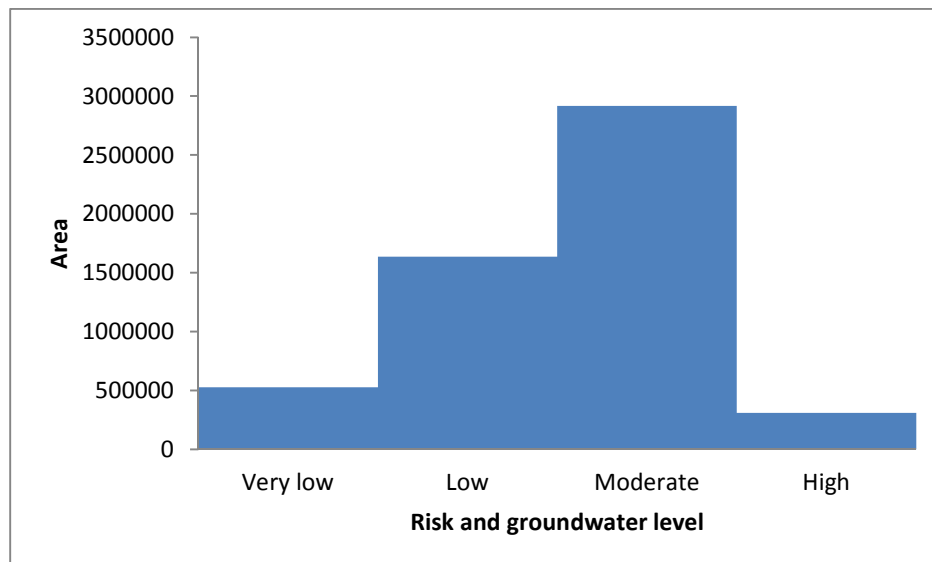


Salinity risk mapping of the Edel and Geraldton Hills IBRA sub-regions is not comprehensive.

Salinity management in the south-west of Western Australia

The area of conservation estate within hydrozones by their respective risk rating is provided in the graph below:-

Figure 7 Area of conservation estate within hydrozones (clipped to south-west agriculture zones*)



*the hydrozones have been provided by DAFWA and clipped to a boundary which encapsulates the south-west agricultural zones.

The area of the conservation estate that falls within the hydrozones assessed in the DAFWA Report as 'high risk' above was then intersected with areas containing land of high hazard or risk of dryland salinity in 2050 (see Figure 3). This preliminary analysis indicates that approximately 200,000 hectares of the conservation estate is within the high risk hydrozones and also within the high hazard or risk of dryland salinity by 2050 dataset. Of this approximately 200,000 hectares, approximately 10,000 hectares (or 5%) falls within Natural Diversity Recovery Catchment Program areas (Further detail on the recovery catchments is provided below in the section 'Measures being taken to manage salinity').

Finding 5

According to recent data, a relatively small proportion (approximately 5%) of the conservation estate which is at most risk from salinity falls within Natural Diversity Recovery Catchment Program areas

Figure 8 The Moore River adjacent to the Moochamulla Nature Reserve - assessed in the 2013 DAFWA Report as within a high risk hydrozone and of high risk of dryland salinity in the National Land and Water Resources Audit (2000)



Inputs and outputs

Federal and state agencies, regional natural resource management boards, local government, research organisations, community groups, non-government organisations, volunteers, land holders and many others, all contribute significantly to the management of our natural resources. (Department of Water Land and Biodiversity Conservation, 2009) As mentioned earlier in this report, the NAP was a well-resourced salinity program (including a budget of \$1.4 billion, half Commonwealth and half state funding) which ceased on 30 June 2008.

By June 30 2007, the following fund allocations had been reported:

Table 1. Allocation of Australian Government funds under the National Action Plan for Salinity and Water quality (\$ million) Cumulative Australian Government National Heritage Trust 2/NAP funding for each State/Territory as of 30 June 2007

| | State | | | | | | | | Total |
|------------------------------|-------|-------|-----|------|------|-----|-------|-----|-------|
| | WA | NSW | NT | Qld | SA | Tas | Vic | ACT | |
| On-groundworks | 72.5 | 60.0 | 0.0 | 9.8 | 50.5 | 0.0 | 27.3 | 1.1 | 221.3 |
| Extension, capacity building | 41.3 | 99.6 | 0.4 | 34.9 | 13.8 | 1.9 | 68.9 | 1.0 | 261.8 |
| Information, R&D | 4.0 | 8.3 | 0.5 | 7.4 | 9.0 | 0.6 | 14.7 | 0.1 | 44.5 |
| Monitoring and evaluation | 12.4 | 6.5 | 0.7 | 6.7 | 5.8 | 1.6 | 11.6 | 0.2 | 45.5 |
| Planning | 6.8 | 9.0 | 0.4 | 8.4 | 4.8 | 0.9 | 10.0 | 0.1 | 40.5 |
| Administration, CMO capacity | 3.5 | 2.5 | 0.1 | 8.0 | 6.4 | 0.3 | 8.5 | 0.0 | 29.2 |
| Total | 140.5 | 185.7 | 2.1 | 75.4 | 90.4 | 5.3 | 141.1 | 2.4 | 642.8 |

ACT, Australian Capital Territory; NSW, New South Wales; NT, Northern Territory; Qld, Queensland; SA South Australia; Tas Tasmania; Vic, Victoria; WA, Western Australia. Source: database of projects provided by the Australian Government.

Since the 1990s, there have been four major Commonwealth initiatives: 1) The National Landcare Program (NLP) (1990-1996); 2) The National Heritage Trust Phase-I (1996-2002); 3) The National Heritage Trust Phase-II and the National Action Plan for Salinity and Water Quality (2003-2008); and 4) Caring for our Country (2008-2013).

The National Action Plan for Salinity and Water Quality and Natural Heritage Trust Program 2003–2009: Final Report outlines that one of the legacies of the NAP and National Heritage Trust (NHT) programs was the development of six approved Regional NRM Strategies covering the whole state. These identified the priorities of the regional communities. The Commonwealth replaced NAP and the NHT with Caring for our Country (CfoC) which was to provide \$2.5 billion nationally for five years to June 2013. CfoC is different to NAP and NHT in some key areas – notably it has a much reduced emphasis on regional strategies and no longer requires matching funds from the state. The reduction in funding coincides with relatively less interest in salinity work in the recent past. The CfoC reporting for the period 2008-2013 does not specifically identify salinity as a priority program.

For its part, DPaW has maintained the capacity to manage salinity-related issues amid a decline in awareness and funding of salinity-related work through the WA Salinity Action Plan / Salinity Strategy. DPaW has begun a review of all departmental salinity programs with its review of recovery catchment expenditure. DPaW has summarised expenditure for the period 1996-2006 as presented below:

Table 2. Summary of recovery catchment expenditure and outputs against core activities 1996–2006 (Wallace, 2011)

| Activity | Outputs | Expenditure (\$ millions) | Expenditure (%of total) |
|---|--|---------------------------|-------------------------|
| Expansion of conservation estate through land purchase, including survey work | 1,394 ha purchased | 1.14 | 7% |
| Re-vegetation to buffer remnant vegetation, provide new habitat and provide hydrological control | 2,672 ha re-vegetated, 3.1 million seedlings | 2.88 | 18% |
| Re-vegetation with commercially prospective plants to buffer native vegetation, provide habitat and provide hydrological control | 2,249 ha re-vegetated, 1.7 million seedlings | 0.84 | 5% |
| Rehabilitation of degraded areas on Crown lands | 310 ha rehabilitated | 0.33 | 2% |
| Improved protection of remnant vegetation on private property | 5,161 ha 350 km fencing | 0.82 | 5% |
| Weed and feral animal control | Not applicable | 0.09 | 1% |
| Engineering works on Crown lands to protect public assets | 39 sites | 2.94 | 18% |
| Engineering works on private property to protect public assets | Not applicable | 0.66 | 4% |
| Monitoring, research and investigations, including impact assessments (other than funds allocated against specific management projects) | Not applicable | 4.44 | 28% |
| Management of committees, recovery planning, communication and volunteer management | Not applicable | 1.72 | 10% |
| Other (e.g. development of recreation/interpretation sites) | Not applicable | 0.31 | 2% |
| Total | | 16.17 | 100% |

Work on the established recovery catchments continues. However, funding is not sufficient to initiate any further recovery catchments and further work on selecting new areas has ceased. Further details regarding the recovery catchments are provided within the 'Measures taken to manage salinity' section below. Expenditure on monitoring since 1997 covers the South West Wetlands Monitoring Program, which has been conducted by DPaW and funded under the WA Salinity Action Plan (1996) and Salinity Strategy (2000), as outlined in the South West Wetlands Monitoring Program Report 1977-2011. Further details on the results of this monitoring are provided under the 'Outcomes' section of this report.

Measures being taken to manage salinity

Measures being taken to manage salinity include:

- Clearing controls
- Re-vegetation
- Introducing tree crops and perennial pastures to farming systems
- Engineering options such as drainage.

DPaW has maintained the capacity to manage salinity-related issues amid a decline in awareness and funding of salinity-related work. As previously mentioned, DPaW's main program, which aims to address the adverse effects of salinity on biodiversity, is the Natural Diversity Recovery Catchment Program.

Natural Diversity Recovery Catchment (NDRC) Program

The Salinity Action Plan (1996) identified a recovery program targeting at least six key catchments over 10 years. The Salinity Strategy (2000) committed the program to targeting at least six more catchments by 2005. The overall intention was to recover and protect representative areas of high biodiversity. Implementation of the recovery programs is still active but reportedly subject to limited financial resources.

Six recovery catchments have been adopted to date, the last being centred on Drummond Nature Reserve and established in 2001. Of the six existing NDRC programs (Toolibin Lake est.1996, Muir-Unicup est.1996, Lake Warden est.1996, Lake Bryde System est. 1999, Drummond est. 2001 and Buntine Marchagee est. 2001) only Buntine Marchagee has an existing NDRC recovery plan. Lake Toolibin has an existing plan – the Toolibin Lake Recovery Plan which was written in 1994, prior to the establishment of the Natural Diversity Recovery Catchment Program.

Toolibin Lake is in the Avon Wheatbelt P2 IBRA sub-region and, as part of this performance assessment, a site visit was made to view the management recovery efforts. The Recovery Plan involves an integrated strategy of short-term and ongoing measures at a local and catchment scale. Endorsed by the Corporate Executive of the Department of Conservation and Land Management (now DPaW) and the National Parks and Nature Conservation Authority (now the Conservation Commission) in September 1994, it is considered a pre-existing plan to the NDRC

Program. The Recovery Plan outlined biological and physical recovery criteria by which the success or failure of the total recovery process was to be measured. The Plan states that they are not criteria for the implementation of the individual management actions, but rather long-term criteria which should be met. However, Lake Toolibin has been dry or near-dry for 12 years, which has meant much of the recovery criteria information cannot be measured (for example, the following specified criteria, 'The maximum salinity of lake water when the lake is full should be 1,000 mg/l Total Dissolved Salts (TDS)', cannot be measured unless the lake is full).

Figure 9 Drainage diversion gates - Lake Toolibin



Figure 10 Re-vegetation with commercially prospective plants in the Lake Toolibin catchment area



The recovery catchment review (Wallace, 2011) recommended all current recovery catchments have recovery plans at final draft stage by June 2013. However, only one plan (Buntine Marchagee) has been finalised to date.

Finding 6

Only one NDRC plan had been finalised by June 2013.

The endorsement of the Drummond Natural Diversity Recovery Catchment: Recovery Plan 2011-2031 was tabled at the Conservation Commission meeting on 2nd April 2012 and endorsed. However, the Drummond Recovery Plan has not been published at the time of drafting this report.

Finding 7

The Drummond Natural Diversity Recovery Catchment: Recovery Plan 2011-2031, endorsed by the Conservation Commission in 2012, has not yet been published.

The Commission is aware of the other complementary programs (often within the designated recovery catchments) past and present being undertaken and supported by DPaW to manage the impacts of salinity. These include:

Crown Reserves Program

The Government, as a landholder, is responsible for managing its land and protecting biodiversity values under threat from salinity. In the DPaW Wheatbelt region, a systematic process has been applied to assessing the nature conservation and other values of Crown Lands (lands not vested in the Conservation Commission), with a view to potential expansion of the conservation estate.

Drainage

Drainage proposals that affect the vested estate are normally referred to the Conservation Commission. The Commission decides whether the effects of such proposals have been adequately considered. As a result of salinity and waterlogging in private properties adjoining land vested in the Conservation Commission, suggestions have been made to discharge water into Conservation Commission vested land. DPaW has also brought proposals to the Conservation Commission to alter drainage into lands vested in the Conservation Commission in situations where it is deemed necessary for the management of that reserve, under either the terms of a management plan, or as necessary operations. In its deliberations, the Conservation Commission recognises that drainage or pumping can be an appropriate activity within reserves (or farmland), especially in the short term, while longer-term solutions are being devised and implemented. For example, on waterlogged sites, it may be necessary to undertake some drainage in order to establish trees, and trees may be useful to de-water agricultural or reserved lands. However, the Conservation Commission has expressed concerns in relation to the impact of drainage, as quite often, the excess water is released into low-lying remnant vegetation and wetlands.

Relevant proposals on adjoining land are taken to the Conservation Commission by a referral either by the Department of Agriculture under the *Soil and Land Conservation Regulations 1992* (*Notice of Intention to Drain or Pump*), or by the Environmental Protection Authority.

The Conservation Commission evaluates proposals for drainage affecting vested land as follows:

1. where deemed to be beneficial or neutral to the values of the reserve, the proposals may be supported;
2. where deemed detrimental to these values, the proposals would be opposed;
3. where a short-term detrimental effect is offset by a long-term gain, the proposals may be supported.

The Conservation Commission's position in each case is communicated to the proponents and, where appropriate, to DAFWA, the Department of Water, the Water Corporation, the Environmental Protection Authority, and DPaW or the Minister for Environment.

Since the formation of the Conservation Commission, a number of items dealing with drainage issues have been tabled before the Conservation Commission. These include proposals to dispose of drainage into the conservation estate and drainage out of conservation reserves

A whole-of-government policy framework for inland drainage was released in December 2012. The Conservation Commission will continue to evaluate its role in protecting conservation values and encourages co-operation with other agencies in finding catchment-wide solutions to drainage problems. This will include a review of the Conservation Commission's drainage policy against the whole-of government policy framework.

Commercial tree crops

The Conservation Commission has previously expressed that the development of new commercially viable industries will be an essential part of addressing salinity. Pannell notes the great difficulty of mitigating dryland salinity, commenting that, *'In many cases it is a highly intractable problem'* and observing after further analysis of the data from the NLWRA that, *'Modelling indicated that, in most locations, a very large proportion of the landscape area would need to be planted to perennials to get salinity under control.'* (Pannell, 2013). The Commission acknowledges the work of DPaW, in partnership with the Commonwealth Government, research and development organisations and industry, on various options including the oil mallee, blue gum and maritime pine programs. Under the Salinity Action Plan, development of new vegetation systems – including commercial woody perennials – was highlighted as a priority area for salinity management. The need to significantly reduce recharge to ground water through re-vegetation measures remains a key target for DPaW. It was also noted in the review of the NDRC Program in 2010 (Wallace, 2011) that *'the mallee program is contributing to a wide range of other outcomes including the management of climate change. For example, plantings contribute to carbon sequestration'*.

The Future Farm Industries Cooperative Research Centre (FFI CRC) and DPaW (as the Department of Environment and Conservation (DEC)) released a joint statement in 2012 to explain their joint venture supply chain approach to research and development (R&D) for mallee industry development and the priorities for R&D activities along the supply chain. In the joint statement, eucalypt mallees are described as the most prospective genus for biomass production in the <600mm annual rainfall zone. A feature of mallee growth is the development of a large lignotuber. Coppicing from the lignotuber allows regular harvesting cycles of three to five years, depending on biomass production.

In the review of the NDRC Program in 2010 (Wallace, 2011) it was recommended that: *'Work within the department to develop an industry based on mallees is maintained until June 2014, at which point progress should be reviewed. This date is consistent with DEC's formal commitments to the Future Farm Industries Cooperative Research Centre.'*

DPaW has advised that there are two main areas that are preventing the large-scale adoption of the mallee industry: a weakness in the supply chain (the lack of a commercially available mallee harvester) and biofuels technology. In compiling this report the Conservation Commission has heard anecdotally that on a small scale, some landholders have started removing oil mallee

plantations on their properties. However, this claim has not been substantiated and has not been pursued further in this report. Discussions with DPaW indicate that a viable outcome is still a few years away but that it is likely that a commercial harvester will become available in the next three years.

Other institutional arrangements and structures

The institutional arrangements and structures that relate to salinity management have altered significantly over the past decade. Community catchment groups continue to develop, particularly at a regional level, however, in general, public interest and investment in initiatives to deal with the issue of salinity have diminished over the last four to five years.

Outcomes

An overall aim of this assessment is to report on the outcomes of salinity management on the conservation estate. Salinity often arises from management impacts outside the conservation estate and management is generally at the catchment scale. As the conservation estate is generally a small fraction of that catchment (e.g. approximately 2% of the Avon Wheatbelt IBRA sub-regions statistically analysed earlier in the document), there is limited information that specifically applies to the conservation estate. The Bureau of Rural Sciences report from 2008 also outlines the use of different indicators as follows:- *It is apparent that no single indicator will be useful in all environments and across scales. Groundwater salinity is useful for providing contextual information although the results of the trials suggest it should not be used on its own as a primary indicator. Monitoring streamflow and stream salinity, rather than just baseflow salinity was thought to provide more meaningful data to determine salinity trends and response to management actions.* (Sciences, Bureau of Rural, 2008) For Western Australia information on salinity trends in water-tables, rivers and wetlands is available in various forms to provide an indication of general catchment condition.

Trends from water-table monitoring

As outlined, water-table levels have been used in some studies to indicate salinity risk. Changes in salinity risk as evidenced by declining water-table levels are noted as follows (Munday.B, 2006):

'Hydrologists monitor a network of over 1000 strategically-placed bores throughout the WA agricultural areas. Salinity risk, as indicated in part by water table levels, is declining in the eastern parts of the Northern Agricultural Region, but is either stable, or continues to climb, throughout most of the remainder of the agricultural areas, according to bore monitoring evidence.

Trends from water condition monitoring (South West Wetlands Monitoring Program) and River salinity levels

There is comprehensive water condition monitoring information for some of the receiving environments which are lower in the catchment, such as wetlands (for an example, see Figure 9 for Lake Toolibin below). This can be used to guide management. The South West Wetlands

Monitoring Program (SWWMP) has been conducted since 1997 by DPaW and funded under the WA Salinity Action Plan (1996) and Salinity Strategy (2000). The report presents results of long-term monitoring of more than 100 wetlands in National Parks and Nature Reserves in the Midwest, Wheatbelt, South Coast, Warren, South West and Swan Regions. Monitoring results show that, of the *'...28 wetlands that experienced their highest-recorded September and/or November salinities in 2010, all but nine decreased in salinities in 2011. Three wetlands that did not experience their highest-recorded salinities in 2010, did so in 2011. Eleven SWWMP wetlands experienced their lowest-recorded salinities in 2011.'* Long-term trends are evident, particularly declining water levels and increasing salinity at many, but not all, wetlands. These and other changes are affecting fringing and emergent vegetation and the suitability of certain areas for waterbirds and other fauna (Lane, 2013).

Recently, the Western Australian Department of Water won an award for its work on returning saline water to drinkable quality in the Denmark River on the state's south coast. Salinity in the Denmark River peaked, on average, at 700mg/litre, but has now reduced to 470mg/litre – the international standard for freshwater is 500mg/litre. In a press release, the Minister for Water indicated that the salinity reduction could mainly be attributed to the re-vegetation of cleared farmland with blue gum plantations (Hon Bill Marmion, 2012).

The tributaries of four rivers originate in the Wheatbelt (the main study area of this report): the Avon River, the Blackwood River, and the Kent and Pallinup Rivers. While not directly related to the salinity risk conditions on the conservation estate, as outlined for the Denmark River above, information on the salinity trends of these rivers is available in various forms and indicates the relevant general catchment condition. In the section below, the report includes details of information on SWWMP-monitored wetlands associated with the Kent River and the upper reaches of the Blackwood River catchment (Lake Toolibin). These details do not include information from the Avon River, the Pallinup River or the lower reaches of the Blackwood River, as these are essentially riverine or estuarine and do not contain SWWMP-monitored wetlands. As mentioned, a measurement of 500mg/litre (mg/L) is the international standard for freshwater (mg/litre equates to parts per million). In some graphs below, salinity is measured as parts per thousand (ppt), which measures grams of salt per kilogram of solution.

Figure 11 Catchment boundaries of the four main rivers originating from the Wheatbelt area



Avon River

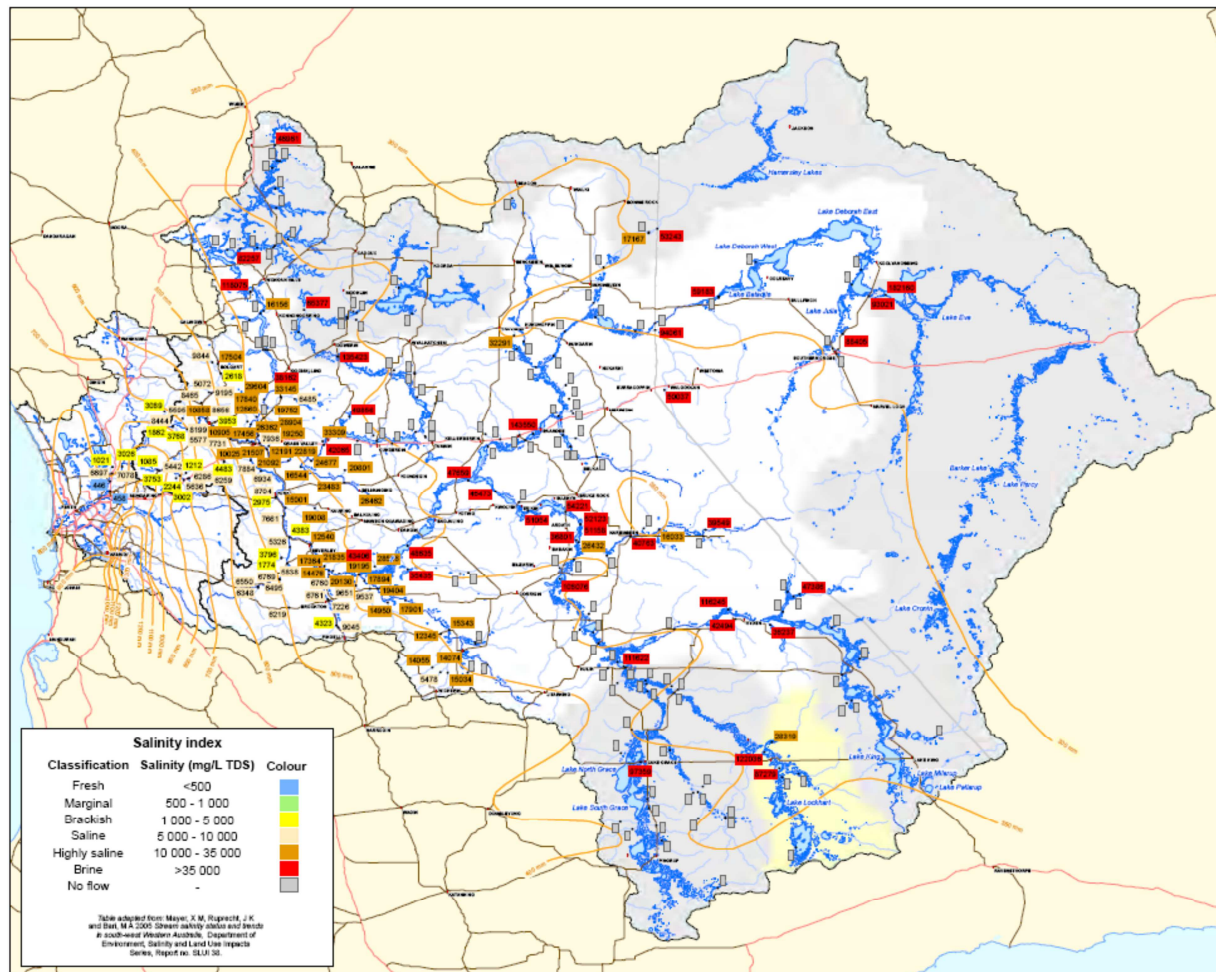
The Avon River drains approximately 120 000km², the largest catchment area in Western Australia. The majority of river flows are naturally brackish to saline (Pen, 1999).

In the Avon catchment, the larger regional groundwater aquifers are generally saline (often exceeding 30 000 mg/litre), while the smaller local groundwater aquifers range from fresh to saline. The Land Monitor project estimates that currently 5.4% of land used for agriculture in the Avon catchment is affected by salinity and this could eventually increase to 27% (see previous Land Monitor discussion under the section titled 'The extent of salinity' above).

A graphical depiction from the Avon River Catchment Water Quality and Nutrient Monitoring Program (2008) has been reproduced below as a visual guide to the changing salinity levels

across the catchment. Red is brine (>35,000mg/L); orange is highly saline (10,000-35,000mg/L); and yellow is brackish (1,000-5,000mg/L).

Figure 12 Salinity for the Avon River Basin (2008 snapshot)



Source: (Avon River Catchment Water Quality and Nutrient Monitoring Program, 2009)

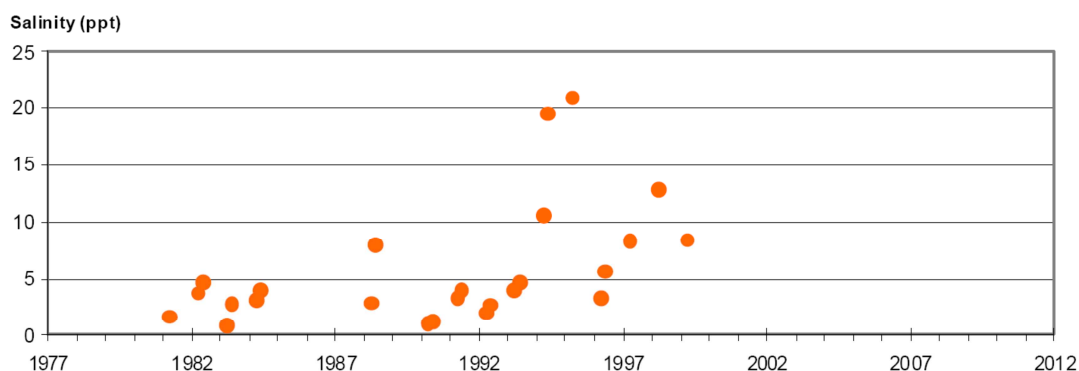
Blackwood River

The Blackwood River is the longest river in Western Australia's south-west and is a continuation of the Arthur River. The Blackwood's catchment area (22,000 km²) is the largest catchment in the south-west of the state. Almost all of the basin's waterways are affected by salinity, particularly those in the middle and upper reaches of the catchment. (Blackwood Basin Group, 2004).

Salinity in the Blackwood River, with 85% of the upper catchment cleared, has gone from about 500 mg/litre in the mid 1950s to approximately 4,500 – 6000 mg/litre in the mainstream reach at present. (South West Regional NRM , 2004)

Lake Toolibin in the eastern section of the catchment near Narrogin is listed as the only freshwater lake left in the Wheatbelt. It is recognised as a waterscape of international significance under the Ramsar convention and as a very important refuge for flora and fauna (it is a breeding refuge for many waterbirds including the rare Freckled Duck, *Stictonetta naevosa*). However, Lake Toolibin has now been dry/near-dry (at the time of measurement) in September and November each year for 12 years (2000-2011) (Lane, 2013). This is an unusually long period for Toolibin (at least in the past three decades) and is due to a combination of drier years and diversion of higher-salinity surface flows away from the lake (Jones S. M., 2009). As a consequence of the dry lake bed, salinity cannot be measured. A partial fill event in 2006–07 is referenced in (Wallace, 2011) but no salinity measurements have been recorded. However, the graph below depicts a general upward trend for the preceding years of monitoring.

Figure 13 Graph of salinity measurements at Lake Toolibin. Source: DEC - South West Wetlands Monitoring Program Report 1977-2011



Pallinup River

The Pallinup River starts on the almost flat Yilgarn Plateau, up to 300 metres above sea level. Here, much of the drainage is internal to salt lakes, some of which overflow and contribute to the river in very wet years. The headwaters begin south of Katanning and travel through the shire of Gnowangerup, Wellstead and Boxwood Hills to eventually reach the Beaufort estuary some 250 kilometres downstream. River water is saline, and the salinity has increased following clearing, most of which has taken place since the 1950s.

Kent River

The Kent River is over 100 kilometres long, draining the southern edge of the Yilgarn Plateau, where the flat drainage is dotted with salt lakes, swamps and areas of internal drainage. Clearing for agriculture in the northern part of the catchment, where rainfall is less than 600 millimetres per annum, has increased the flow of saline water into the river. At its mouth, where

it flows through Owingup Swamp on the coastal plain, and into Irwin Inlet, the Kent River is brackish, a combination of the saline water from the inland agricultural area and the fresh water from the catchment. The river has been degraded by loss of vegetation, erosion and sedimentation in areas cleared for agriculture, but the forested sections are in good condition and have some value for recreation.

Figure 14 Salinity data as presented in the Kent River Water Resource Technical Series (J De Silva, 2007)

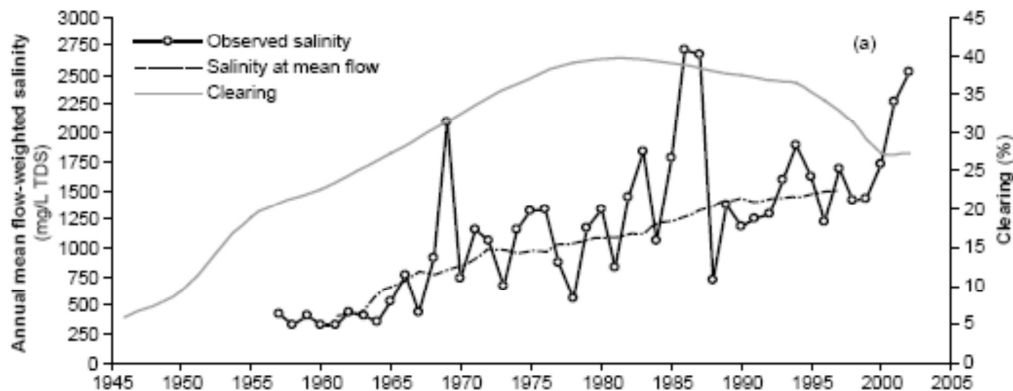


Figure 15 Graph of salinity measurements at Boat Harbour 1 - a component of the 'Owingup Swamp System', which is listed in the 'Directory of Important Wetlands in. Source: DEC - South West Wetlands Monitoring Program Report 1977-2011

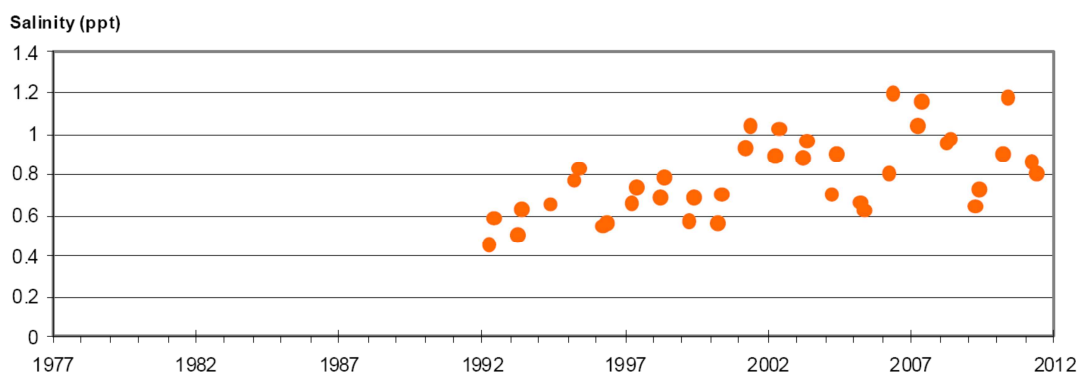
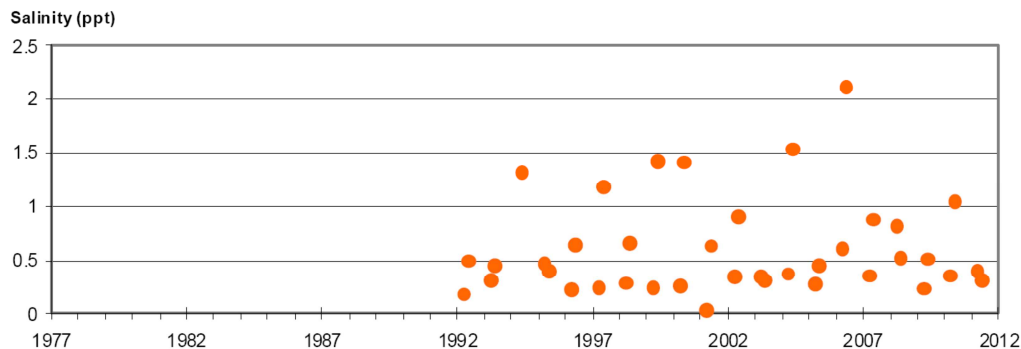


Figure 16 Graph of salinity measurements at Owingup - a component of the 'Owingup Swamp System', which is listed in the 'Directory of Important Wetlands in. Source: DEC - South West Wetlands Monitoring Program Report 1977-2011



'The majority of sites in Western Australia (Indian Ocean and South-west Coast drainage divisions) rated very poorly for salinity. Elevated salinity in this area is likely to be caused by a number of inherent characteristics, such as naturally occurring saline soils, combined with anthropogenic influences, especially the legacy effects of land clearing.' (State of the Environment 2011 Committee, 2011).

The State of the Environment Report 2011 also notes that:

'...in regions with previously identified salinity risks, it is widely reported that shallow, saline groundwater levels (one of the fundamental drivers of secondary salinisation) are falling. There seem to be fewer reports of spreading land salinisation.' It goes on to say *'These changes, if real, are unlikely to be due to the success of the National Action Plan for Salinity and Water Quality or other investments in salinity management, (according to an analysis by Pannell and Roberts (Pannell DJ, 2010)). This program did, however, identify where we can expect to have ongoing salinity issues. Recent changes in salinity are most likely reflecting a changing balance between saline groundwater levels and dilution flows due to the widespread drought across southern Australia. Less rainfall can mean drops in local saline groundwater levels, thus reducing the delivery of salt to soil and streams. On the other hand, reduced river flows can mean local increases in salinisation.'* (State of the Environment 2011 Committee, 2011)

Also, on a national level, there were very strong criticisms by the Australian National Audit Office (ANAO) 2008 in its review of the Regional Delivery Model for the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality: *'Overall, the ANAO considers the information reported in the Department of Agriculture Fisheries and Forestry and NHT annual reports has been insufficient to make an informed judgement as to the progress of the programs towards either outcomes or intermediate outcomes,'* and further added that *'There is little evidence as yet that the programs are adequately achieving the anticipated national outcomes ... Where the impact [of NAP investment] on resource condition is identified by regional bodies, the expected results were often low (frequently less than one per cent of the longer-term resource condition target).'*' (Auditor General, 2008), pp. 19-20)

Outcomes for the natural diversity recovery catchments have been reproduced below from the summary provided in (Wallace, 2011):-

Natural diversity recovery catchments

Outcomes

Management success in recovery catchments needs to be reviewed over decades because the outcomes of most interventions at landscape scales to counteract secondary salinity can rarely be fully assessed in shorter time periods. This reflects the difficulty of resolving problems that have developed over more than 100 years. Exacerbating this situation is that the path to recovery may be different from and more difficult than the process that developed the problem. For example, restoring soil structure after salinisation needs more than just recession of the shallow saline groundwater. At the minimum, it also requires time for the salt to leach from the soil profile. The positive results from management are even more difficult to assess where, as in the case of salinity in the south-west, landscape degradation is continuing. Thus, management that either slows the rate of decline or decreases the final, full expression of salinity is, in many cases, a highly beneficial outcome.

Biodiversity

The key outcomes realised to date for each recovery catchment are briefly summarised below.

Buntine-Marchagee: Recent conceptual models of salinity development in the wheatbelt have given greater emphasis to the management of surface water before it affects biodiversity assets on valley floors. In this context, the broadscale surface water management currently being implemented at Buntine-Marchagee, which integrates surface engineering, revegetation and other improved practices, is an important success. Initial work focused on landholders in an 860-hectare demonstration subcatchment, with work largely completed in 2006. In the future, this type of work will be expanded and more tightly focused on key biodiversity assets. The quality of the work in this catchment is underlined by it being listed as a “Highly Commended Australasian project” by the Global Restoration Network. The threatened ecological community remains intact.

Drummond: The initial phase of revegetation and investigations was completed in 2009. Much of this initial activity was conducted throughout the 39,500 hectares of the Soloman-Yulgan Brook and Mt Anvil Gully catchments. This work was aimed at ‘no regrets’ actions to improve water retention in the upper catchment and protection of vegetation, landscape connectivity and hydrological function. Increasing understanding and support for the program was also a priority. Recovery activity over the latter years has focused on the priority assets which were identified through the investigations to date. The assets, two freshwater claypans and their biological communities, are located within Drummond Nature Reserve. It is currently predicted that some additional revegetation work and a small amount of surface water engineering will ensure that these key asset targets are secure in the short to medium term. In summary, it is anticipated that projected recovery works will maintain the current, good condition of biological communities of the freshwater claypans. However, further investigations will be required to assess the management required for the wandoo woodland.

Lake Bryde: Investigations and early modelling indicate that conserving significant parts of this major wetland complex depends on extensive surface water management works (including the main constructed waterway) to control waterlogging and groundwater recharge on the valley floor. Most of the works on reserved land were completed during 2009, and this will greatly improve the protection of native vegetation on the valley floor, together with some of the smaller wetlands. Additional works on private property are then proposed. Further investigations are also needed to monitor the effectiveness of surface water management and to determine the urgency of direct groundwater management around key wetlands. The threatened ecological community, which includes one species of declared rare flora,

persists at three locations. While vegetation condition has continued to decline in some areas, the construction of the waterway should halt decline due to waterlogging of important areas of valley floor vegetation. In addition, the waterway will ultimately provide the basis for surface water management in relation to Lake Bryde itself.

Lake Warden: While the salinity of surface inflows must be controlled, and previous and ongoing revegetation and other works will contribute to this, detailed investigations and modelling have shown that the immediate problem is overfilling of the lake system. In 2009 the initial engineering works to relieve the problem were completed, and the planning and impact assessment of more substantial works is now well underway. The priority 1 and priority 3 ecological communities in this system are currently conserved, and provided the next phase of engineering works is implemented, the recovery goal should be achieved.

Muir-Unicup: This is an exceedingly complex hydrological and biological system. Although widespread tree farming in the catchment has helped protect conservation values, there are significant management issues related to increasing salinity and acidity. Operational works by DEC have largely eradicated one surface saline scald on the inflow to Yarnup swamp and there is some anecdotal evidence of Baumea recovery. Private re-diversion of flows has helped recovery of Baumea swamps in the Geordenup/Neeranup Swamp system. Current knowledge will allow further small scale recovery works to be undertaken, but more intensive works require further investigations. These investigations are underway and appointment of a catchment hydrologist under contract has helped this process. The 10 threatened species at risk from altered hydrology in this catchment are currently conserved.

Toolibin Lake: Management has largely achieved two key physical indicators of lake recovery (depth to groundwater and quality of surface inflows) and there are areas of vegetation recovery including significant areas of seedling regeneration. Mechanical and electrical problems with groundwater pumps have, however, resulted in some groundwater rises and recovery criteria are under review. Despite improvements in physical recovery indicators, and areas where vegetation condition has remained stable or improved, vegetation decline continued over substantial areas until about 2005. There is evidence that vegetation condition has now stabilised; however, whether this is correct will not be confirmed until the next round of monitoring is complete. Due to dry conditions and the by-passing of saline flows, there has been little opportunity to assess other biological indicators which are based around lake filling events. Twenty-four waterbirds, 11 displaying breeding behaviour, were recorded on Toolibin and Dulbinning (upstream of Toolibin) following a partial fill event in 2006–07. A further six species of waterbirds were recorded during the same period immediately downstream at Walbyring Lake, and it is likely that these birds were also present in the project area. In summary, progress to date against recovery indicators is a major achievement given the intensity of hydrological threats to the lake and its biological communities. In 2002 the project partners at Toolibin were awarded the Institution of Engineers Australia National Salinity Prize. The threatened ecological community at Toolibin remains intact, but almost certainly would have disappeared without recovery actions.

As reported in the same document (Wallace, 2011), the then DEC also flagged its intent to conduct a ‘...review of all departmental salinity programs.’ The Conservation Commission sees this as vital future information for its management planning responsibilities, but points out that DPaW review efforts, while increasingly important, should be complemented by outcome-reporting information from other government-funded salinity initiatives, past and present. In drafting the State NRM Program Investment Priorities 2010/11 – 2013/14, the draft document indicated the following intent at that point in time :- ‘*With respect to salinity, the major priority is a review of salinity threats and of key management options. After a period of significant salinity investment it is time to assess the generally accepted predictions about the threat posed by salinity to agricultural land, biodiversity, water and infrastructure assets right.[sic] It is time to assess whether the costs and benefits of the key management options are well known. It is time to*

make sure we understand the drivers and impediments to adoption of options that have a net benefit. (State NRM Program, 2010)’

However, this intent does not appear on the final list of State NRM Program Investment Priorities 2010/11 – 2013/14 and to date there has been no overall review into the effectiveness of salinity mitigation under the State Salinity Strategy.

Finding 8

There has been no overall review into the effectiveness of salinity mitigation under the State Salinity Strategy.

Conclusion

It has not been possible to report in a comprehensive way on the achievement of outcomes relating to salinity management on the conservation estate, as there is limited information about the estate itself. However, information on salinity trends in water-tables, rivers and wetlands is available in various forms and indicates general catchment condition. There is also good information being collated and reported by DPaW on the intermediate outcomes of the Natural Diversity Recovery Catchment Programs, but these are limited to six catchments. There is little potential for expansion into other areas which were previously identified as representing zones of high biodiversity.

The threatened species and threatened ecological communities located in the Natural Diversity Recovery Catchment Program areas are reportedly persisting. Areas of mallee eucalypts (13,000 hectares) have been established but the effectiveness of this endeavour has not been adequately reported. Wider scale adoption of re-vegetation with mallee eucalypts will be required to tackle salinity but there are reportedly supply-chain issues with the development of an associated industry. Monitoring information from relevant wetlands indicates long-term trends of declining water levels and increasing salinity at many, but not all, wetlands. Data for the four main rivers which originate in the Wheatbelt – the Avon, Blackwood, Kent and Pallinup Rivers – indicates that salinity levels are continuing to increase. The data sets to inform management on salinity risk are now out-dated and require review, along with an overview of the results of the various salinity mitigation initiatives. The Conservation Commission acknowledges the need to measure success over a period of decades and continues to support the DPaW in its ongoing commitment to salinity abatement on the conservation estate. DPaW review efforts, while increasingly important, would be complemented by outcome-reporting information from other government-funded salinity initiatives but there has been no overall review into the effectiveness of salinity mitigation under the State Salinity Strategy

Glossary

As derived from definitions provided in the 'A guide to managing and restoring wetlands in Western Australia' (DEC, 2012).

Biodiversity: encompasses the whole variety of life forms—the different plants, animals, fungi and microorganisms—the genes they contain, and the ecosystems they form. A contraction of 'biological diversity'

Ecosystem: a community of interdependent organisms together with their non-living environment

Endemic: naturally occurring only in a restricted geographic area

Erosion: wearing away and movement of land surface materials (especially rocks, sediments and soils) by the action of water, wind or a glacier

Geology: the composition, structure and features of the Earth, at the surface and below the ground

Groundwater: water occurring beneath the ground surface in spaces between soil grains and pebbles and in fractures or crevices in rocks

Groundwater table: the upper surface of the groundwater in an unconfined aquifer (top of the saturated zone)

Hydrology: the properties of the Earth's water, particularly the distribution and movement of water between the land surface, groundwater and atmosphere

Invertebrate: an animal without a backbone

Landform: a natural feature of a landscape such as a valley, mountain, basin or plain

Perennial: a plant that normally lives for two or more growing seasons (from germination to flowering, seed production and death of vegetative parts)

Salinisation: the process of accumulation of salts in soils, waters or sediments

Salinity: a measure of the concentration of ions in waters, soils or sediments

Secondary salinisation: a human-induced process in which the salt load of soils, waters or sediments increases at a faster rate than would have occurred naturally

Sediment: in general terms, the accumulated layer of mineral and dead organic matter forming the earth surface of a wetland. Used interchangeably in this guide with the terms 'wetland soil' and 'hydric soil', although all three of these terms have more specific meaning in wetland pedology

Species richness: the total number of species (in a defined area)

Thresholds: points at which a marked effect or change occurs

Transpire (transpiration): the loss of water from plants to the atmosphere through evaporation

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Appendix 1 – Approximation of elevation for the conservation estate using GIS

The depictions in Figures 1 and 2 of this report are stylised adaptations of a soil and vegetation image (Bamford, 1995). The elevation statistics for areas vested in the Conservation Commission were approximated in a Geographic Information System as follows:

CONTOUR contains the elevation of the nearest 50m contour line to the centre point. The contour dataset is the Geodata contours sourced from Geoscience Australia. The “Near” tool, in Arc Info was used, as was the “Extract Values to Points” from the Spatial Analyst extension in ArcMap. The contour data generalised for 50m intervals.



Government of Western Australia
Department of Parks and Wildlife

Thank you for your letter dated 18 February 2014 regarding the Conservation Commission's draft report – Salinity management in the south-west of Western Australia, and seeking a response on the report's findings.

Comments below relate to the findings reported in the draft report.

Findings 1-3

With regard to Findings 1-3, I note there is no reference to the Department of Agriculture and Food's 2013 *Report Card on Sustainable Natural Resource Use in Agriculture*. This is the most up-to-date assessment on salinity in the south-west of Western Australia, and confirms that salinity continues to be a significant threat to a wide range of public and private assets, with some 2.8 to 4.5 million hectares of valley floor soils at risk from salinity. Within this area, some 850 south-west taxa of native plants and animals remain at risk of global or regional extinction as a result of salinity. Together with other, water-related issues, such as seasonal waterlogging, salinity remains a primary threat to wildlife conservation in Western Australia.

Since 1996, the Department of Parks and Wildlife and its predecessors have undertaken a number of programs aimed at amelioration of salinity in the Agricultural Zone. This includes the Natural Diversity Recovery Catchments Program (NDRCP), which focuses on six catchments. Since its inception, the NDRCP has been successful in slowing the overall decline of biodiversity in those catchments, and some biological assets have responded positively with management intervention. The program is a good example of where the department is working with other landholders and industry at a landscape scale to address salinity and waterlogging issues.

The Department of Agriculture and Food is the lead agency in Western Australia for mapping and predicting salinity risk.

Findings 4 and 5

Estimating the area of the south-west at risk from salinity is difficult given the lack of data at a fine scale. This, in turn, makes it difficult to estimate the area of conservation lands at risk. However, the area calculated in the report (200,000 hectares) seems low. It is not clear if wetlands that are primary saline areas – such as those at Newdegate and Lake Grace – are included in the calculations. Natural salt lakes can be significantly degraded by secondary salinisation. It would be helpful if more information on the calculation of areas at risk was provided in the report.

It is correct that, although the natural diversity recovery catchments cover different subregions within the Interim Biogeographic Regionalisation for Australia, they include only a small part of the conservation estate at risk. However, the recovery catchments were selected on the basis that they contain the highest priority assets with representative samples of the State's biodiversity. Three of the six catchments contain Wetlands of International Importance Listed under the Ramsar Convention. Thus, they represent a particularly important set of biological assets.

Findings 6-7

Buntine-Marchagee and Toolibin Lake both have recovery plans, although the latter is currently being revised. Drummond has a recovery plan which is finalised and awaiting approval for release. As such, there are effectively three current plans. Future progress with planning will depend on available resources.

Finding 8

The Department of Parks and Wildlife is the only agency that has published thorough reviews of progress in salinity management. This includes a recent review of recovery catchment work. Since the department's recovery catchment review was published, the numbers of waders and health of riparian vegetation have responded positively to management actions at Lake Warden, and modeling work, which will be reported later in 2014, provides additional support for the management approaches at Lake Bryde and Toolibin Lake. This is encouraging progress given the difficulty of managing salinity and associated risks.

Western Australia has experienced major hydrological change over recent decades, and this poses complex challenges for land management. Understanding the impacts of hydrological change will enable appropriate management response for protection of the wildlife, recreation, production and infrastructure assets of the south-west of the State.

Thank you for the opportunity to comment on the draft report.

Yours sincerely



Jim Sharp
DIRECTOR GENERAL

26 March 2014