Interpretation of recharge reduction under perennial and annual vegetation reports undertaken in the Coorong and Upper South East Districts in the early 1990's

Commencement date January 2020
Completion date 30th September 2020

Coorong District Council

Tatiara the good country

Coorong Tatiara Local Action Plan

LANDSCAPE SOUTH AUSTRALIA

Contents

Contents 2

Background to the Cooke Plains CSIRO Division of Water Resources & Department of Mines & Energy groundwater studies 3

The Cooke Plains Coomandook CSIRO study area 3

CSIRO Division of Water Resources and Department of Mines and Energy Groundwater flow modelling to assist dryland salinity management of a coastal plain of Southern Australia 4

Publications, reports and papers were released between 1992 and 1997 regarding the Cooke Plains CSIRO Division of Water Resources & Department of Mines and Energy groundwater studies 5

Extensive studies were undertaken across the Coorong District and Upper South in the early to mid 1990's by the CSIRO Centre for Groundwater Studies and Mines & Energy South Australia. 6

Groundwater Flow Modelling Study Outcomes and Key Findings 7

The potential area of dryland salinity in the Coorong Districts 2020 & 2045 8

The list of studies on page 4 & 5 was used as baseline information for the following Local & regional plans & strategies based on previous studies (pages 4 & 5) 9

Preliminary Results of Recharge Investigations in the Upper South East Region of South Australia. November 1992 10

Regional Implementation Strategy, Dryland Areas South Australian Murray Darling Basin 11

The Coorong & Districts Soil Conservation Board District Plan and District Plan Review 12

Lacepede Tatiara District Soil Conservation Board District Plan 13

Natural Resources of the Tatiara, a Plan for Local Action 2013 – 2018 14

Reducing Groundwater Recharge & the Impact of Dryland Salinity in the Coorong & Districts 15

Coorong Districts Local Action Plan 16

Coorong District Local Action Plan - recommendations to address Dryland Salinity 1997 & 2000 17

Coorong District Local Action Plan - No new recommendations to address Dryland Salinity 2012 17

Case Study Review, Coorong District Local Action Plan Dryland Salinity Management Strategy Dooley, Kuys, Ciganovic, Henschke and Walker, Rural Solutions SA. December 2004 18

Coorong Dryland Salinity Review, Improving Salinity Understanding, Coorong District Local Action Plan Committee. June 2019 19

Options for recharge areas 20

Options for discharge areas 21

On-going groundwater monitoring 22

Impact of dryland salinity on the built environment 23

Conclusions 24

Background to the Cooke Plains CSIRO Division of Water Resources & Department of Mines and Energy groundwater studies

Dryland salinity was a growing concern for agriculture in the Coastal Plain of the Murray Basin during the 1980's and early 1990's time period. As with other areas of South Australia and the Victorian Mallee, the studies showed that clearing of native vegetation and replacement with shallow rooted crops and pasture species had led to significant increases in recharge rates *(Walker et al 1992; Kennett Smith et al 1994).*

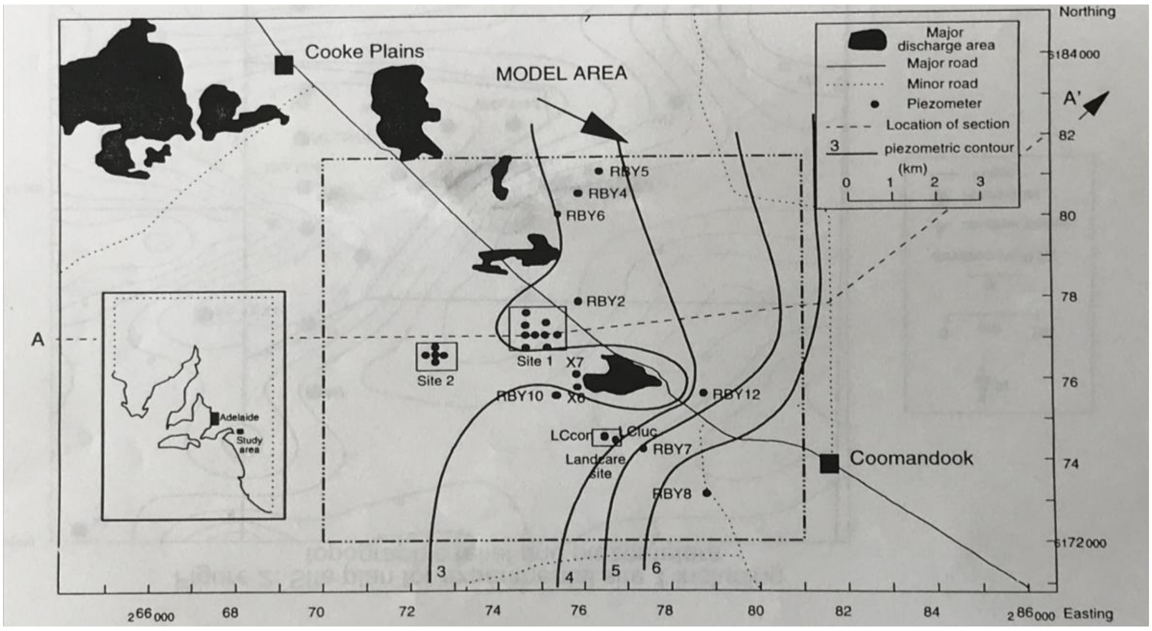
The low topographic relief, coupled with shallow, saline groundwater minimise the lag between the effect of increased recharge rates and watertable response. In 2002 it was identified that water-tables had been rising at a rate of 0.05 to 0.1 metres per year in the decade leading up to 1992, as result of increasing groundwater recharge derived locally, as well as from up gradient areas. Barnett identified that salinisation had been occurring within the lowlands in the decade leading up to 1992.

Within the Upper South East region (which includes the Coastal Plain and the towns of Cooke Plains and Coomandook) it was estimated that up to 200,000 ha of land showed signs of, or was at future risk of salinisation, with an estimated annual cost in production of at least $7million. *(Murray Darling Basin Commission 1992, Case Study 1)*

These reports made it clear that if the spread of dryland salinity was to be contained, remedial measures would be needed. The objective of these measures would be to maintain or lower watertables to a depth where they do not impact agricultural productivity. The report stated that onsite options (ie. within the farm and undertaken by landholders) are feasible in the Coastal Plain and these include recharge reduction (which treats the cause) and discharge enhancement (which treats the effect).

The Cooke Plains - Coomandook CSIRO study area

Title: Groundwater Flow Modelling to Assist Land Management in the Cooke Plains area of S Aust
Authors: Pavelic, Kumar, Narayan and Dillon
Date: 1994 & 1997



The Cooke Plains/Coomandook area is within the Coastal Plain study area covered 10,500 ha.

The landscape is low and undulating and characterised by stranded and reworked beach dunes and alternating swales. The absence of surface drainage features is another prominent feature of the area. The topographic relief is generally less than 10 metres AHD although dunes may extend to greater than 30 meters. Virtually all of the former Mallee vegetation was cleared for agriculture 50 to 80 years ago. The dominant landuse consists of crop/pasture rotations with no fallow and extensive sheep grazing on improved pastures. Lucerne pastures were common in the area up until the aphid infestation in the late 1970s. Therefore pastures have consisted of shallow rooted species. Approximately 4% of the study area is salt affected.

CSIRO Division of Water Resources and Department of Mines and Energy Groundwater flow modelling to assist dryland salinity management of a coastal plain of Southern Australia.

The Plans and Strategies released as part of the Cooke Plains Groundwater Flow Modelling project are listed on the next page. (5)

Information gained from these studies was used as baseline information for sseveral local & regional plans & strategies. These are listed on page 9.

Introduction

The Cooke Plains and Coomandook groundwater recharge studies are among the most extensive conducted in South Australia.

The outcomes of these reports have been applied across the Upper South East / Coastal Plains landscape and form the basis for the Coorong Districts Soil Conservation Board District Plan, three editions of the Coorong District Local Action Plan and the dryland salinity components of the Tatiara Local Action Plan, and numerous other studies and Publications State wide.

Background:

A five year study (1992 to 1997) into the cause of dryland salinity was conducted between Cooke Plains and Coomandook by CSIRO Division of Water Resources and Department of Mines and Energy (MESA)

The aim of study was to develop (by calibrating against field data) a groundwater flow model in order to predict the impact of groundwater levels for land management options which are available to landholders at Cooke Plains / Coomandook for the control of dryland salinity. It considered options which included continuing current land management practices, reducing groundwater recharge and enhanced groundwater discharge.

Salinity impacted trees at Cooke Plains

Saline groundwater discharge Meningie East

Publications, reports and papers were released between 1992 and 1997 regarding the Cooke Plains CSIRO Division of Water Resources & Department of Mines and Energy groundwater studies

These included:

Title: Regional Hydrogeology of the Cooke Plains Coomandook Area, Murray Basin, South Australia
Author: S Barnett, Department of Mines and Energy
Date: 1992

Title: Preliminary Results of Recharge and Discharge Studies at Cooke Plains, South Australia
Authors: Walker, Dillon, Pavelic, Kennett-Smith
CSIRO Division of Water Resources and Centre for Groundwater Studies
Date: November 1992

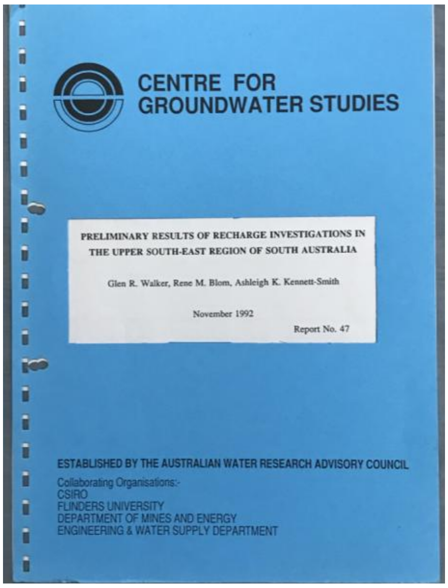
Title: Groundwater Flow Modelling to Assist Land Management in the Cooke Plains area of South Australia
Authors: Pavelic, Kumar, Narayan and Dillon
CSIRO Division of Water Resources and Centre for Groundwater Studies
Date: July 2004

Title: Distribution and Properties of Soil in an Experimental Sub-catchment with Altered Soil Water Regimes near Cooke Plains, South Australia
Author: Hollingworth, Fitzpatrick and Hudnall,
CSIRO Division of Soils
Date: 1996

Title: Integrated Groundwater Flow and Agronomic Modelling for Management of Dryland Salinity on a Coastal Plain in South Australia
Authors: Pavelic, Dillon, Narayan, Herrmann and Barnett,
CSIRO Division of Water Resources & Centre for Groundwater Studies, Primary Industries South Australia & Mines and Energy South Australia
Date: May 1997

Salinity impacted cropping ground, Cooke Plains

Studies undertaken across the Coorong District & Upper South East in 1992/1997 by the CSIRO Centre For Groundwater Studies & Mines & Energy South Australia



CENTRE FOR GROUNDWATER STUDIES

PRELIMINARY RESULTS OF RECHARGE INVESTIGATIONS IN THE UPPER SOUTH-EAST REGION OF SOUTH AUSTRALIA

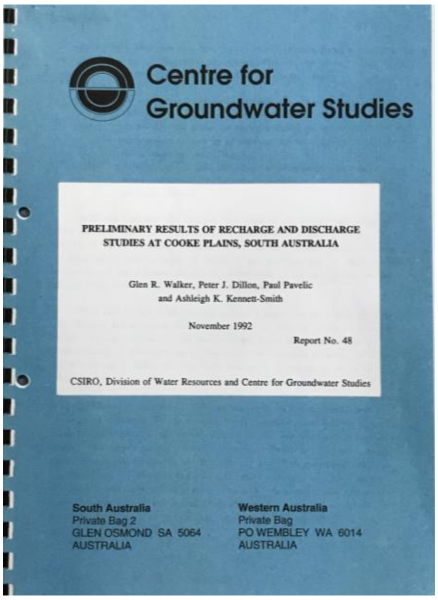
Glen R. Walker, Rene M. Blom, Ashleigh K. Kennett-Smith

November 1992

Report No. 47

ESTABLISHED BY THE AUSTRALIAN WATER RESEARCH ADVISORY COUNCIL

Collaborating Organisations:-
CSIRO
FLINDERS UNIVERSITY
DEPARTMENT OF MINES AND ENERGY
ENGINEERING & WATER SUPPLY DEPARTMENT



Centre for Groundwater Studies

PRELIMINARY RESULTS OF RECHARGE AND DISCHARGE STUDIES AT COOKE PLAINS, SOUTH AUSTRALIA

Glen R. Walker, Peter J. Dillon, Paul Pavelic and Ashleigh K. Kennett-Smith

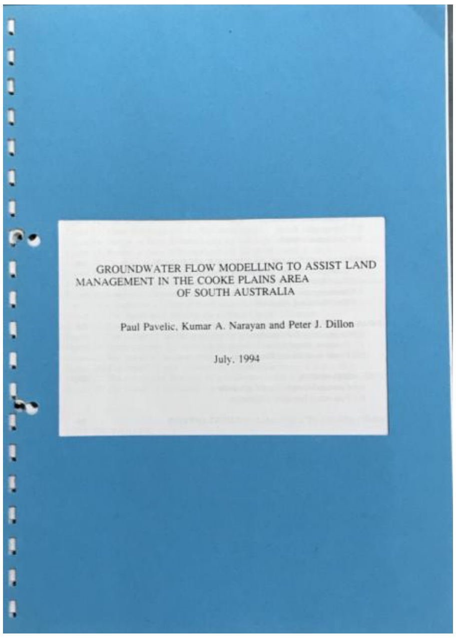
November 1992

Report No. 48

CSIRO, Division of Water Resources and Centre for Groundwater Studies

South Australia
Private Bag 2
GLEN OSMOND SA 5064
AUSTRALIA

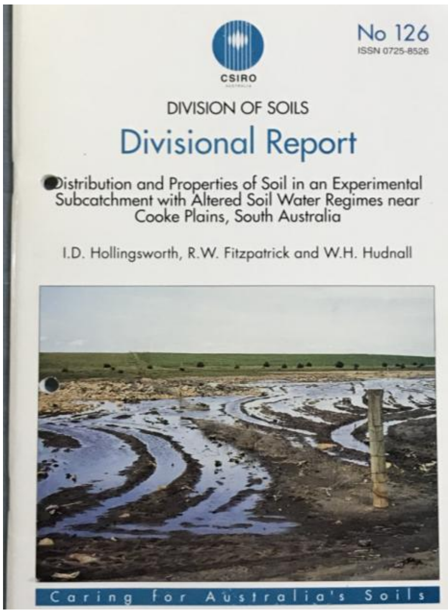
Western Australia
Private Bag
PO WEMBLEY WA 6014
AUSTRALIA



GROUNDWATER FLOW MODELLING TO ASSIST LAND MANAGEMENT IN THE COOKE PLAINS AREA OF SOUTH AUSTRALIA

Paul Pavelic, Kumar A. Narayan and Peter J. Dillon

July, 1994



No 126
ISSN 0725-8526

CSIRO

DIVISION OF SOILS

Divisional Report

Distribution and Properties of Soil in an Experimental Subcatchment with Altered Soil Water Regimes near Cooke Plains, South Australia

I.D. Hollingsworth, R.W. Fitzpatrick and W.H. Hudnall

Caring for Australia's Soils

SOIL RESEARCH

Groundwater flow modelling to assist dryland salinity management of a coastal plain of southern Australia

Paul Pavelic, Kumar A. Narayan and Peter J. Dillon

Australian Journal of Soil Research 35(4) 669 - 686
Published: 1997

Abstract

Groundwater flow modelling has been undertaken for an area of 10 500 ha within the regional unconfined aquifer system of a coastal plain of southern Australia, in the vicinity of the town of Cooke Plains, to predict the impact of various land management options (including recharge reduction and discharge enhancement) on the extent of land salinisation caused by shallow saline watertables. The model was calibrated against field data collected over 6 years. Sensitivity analysis was performed to assess the influence of mesh size, boundary conditions, and aquifer parameters, and particularly rates of recharge and evaporative discharge, on groundwater levels. These were varied until the model was shown to be capable of simulating seasonal trends and regional and local flow patterns. The model was then used to predict the impact of the management options on groundwater levels.

The results showed that continuing current annual crop–pasture rotations will result in watertable rises of approximately 0·2 m in 20 years (significant in this setting), with a further 50 ha of land salinised. A reduction in the rates of groundwater recharge through the establishment of high water-use perennial pastures (e.g. lucerne) showed the most promise for controlling groundwater levels. For example, a reduction in recharge by 90% would result in watertable declines of 0·6–1·0 m within 5–10 years, with the return to productivity of 180 ha of saline land. Small-scale (say <100 ha) efforts to reduce recharge were found to have no significant impact on groundwater levels. Enhanced groundwater discharge such as pumping from a windmill was found to be non-viable due to the relatively high aquifer transmissivity and specific yield.

The modelling approach has enabled a relatively small area within a regional aquifer system to be modelled for a finite time (20 years) and has shown that extension of the boundaries of the model would not have altered the predicted outcomes. Furthermore, the analysis of sensitivity to cell size in an undulating landscape where net recharge areas can become net discharge areas with only small increases in groundwater level is novel, and has helped to build confidence in the model.

Modelling has demonstrated that dryland salinisation can be controlled by reducing groundwater recharge over substantial tracts of land, and is not dependent on recharge reduction over an extensive area upgradient, at least over the next 20 years.

ScienceDirect

Get Access Share Export

Agricultural Water Management
Volume 35, Issues 1–2, December 1997, Pages 75-93

Integrated groundwater flow and agronomic modelling for management of dryland salinity of a coastal plain in southern Australia

Paul Pavelic [a], Peter J. Dillon [a], Kumar A. Narayan [a], Tim N. Herrmann [b], Stephen R. Barnett [c]

[a] Centre for Groundwater Studies and CSIRO Land and Water, Adelaide, Australia
[b] Primary Industries South Australia, Adelaide, Australia
[c] Mines and Energy South Australia, Adelaide, Australia

Accepted 23 May 1997, Available online 4 March 1998.

Show less

https://doi.org/10.1016/S0378-3774(97)00027-9

Get rights and content

Abstract

An 'integrated modelling approach' was used to explore a range of options for land management to control dryland salinity. Three models were developed for this study: a numerical groundwater flow model which predicts groundwater levels for various land uses; agronomic models quantifying crop and pasture yield response to shallow saline watertables and seasonal rainfall; and a financial model of farm revenues, costs and discount rates. When combined, these provided information on groundwater levels, agricultural production, and farm incomes for a 105-km^2 site on a coastal plain in southern Australia. The simulations included current as well as various alternative land management options for a 20-year period. The results indicated that the establishment of deep-rooted perennial pastures can reduce both rates of groundwater recharge and the area of salinised land, thereby enhancing productivity. However, the cost of reclaiming salinised land is high. Compared with current land management practices, the economic benefit of perennial pastures is marginal, and depend strongly on future farm commodity prices and discount rates. The methodology described herein represents a holistic means of dealing with a variety of environmental problems of agricultural management. Its advantages and disadvantages are also discussed.

Groundwater Flow Modelling Study Outcomes and Key Findings

Title: Groundwater Flow Modelling to Assist Land Management in the Cooke Plains area of South Australia

Authors: Pavelic, Kumar, Narayan and Dillon, CSIRO Division of Water Resources and Centre for Groundwater Studies

Date: July 2004

Overview

Groundwater flow modelling has been undertaken for an area of 10,500 ha within the regional unconfined aquifer system of the coastal plain of southern Australia, in the vicinity of the town of Cooke Plains, to predict the impact of various land management options (including recharge reduction and discharge enhancement) on the extent of land salinisation caused by shallow saline watertables.

The model was calibrated against field data collected over 6 years. Sensitivity analysis was performed to assess the influence of study size, boundary conditions, and aquifer parameters, and particularly rates of recharge and evaporative discharge, on groundwater levels. These were varied until the model was shown to be capable of simulating seasonal trends and regional and local flow patterns. The model was then used to predict the impact of the management options on groundwater levels. Different land uses in the studies included:

- Lucerne
- Crop/pasture
- Perennial pasture
- Mallee
- Do nothing - control

Key Findings

The results showed that continuing current annual crop–pasture rotations will result in watertable rises of approximately 0·2 meters in 20 years (significant in this setting), with a further 50 ha of land salinised. A reduction in the rates of groundwater recharge through the establishment of high water-use perennial pastures (e.g. lucerne) showed the most promise for controlling groundwater levels. For example, a reduction in recharge by 90% would result in watertable declines of 0·6–1·0 meters within 5–10 years, with the return to productivity of 180 ha of saline land. Small-scale (say <100 ha) efforts to reduce recharge were found to have no significant impact on groundwater levels. Enhanced groundwater discharge such as pumping from a windmill was found to be non-viable due to the relatively high aquifer transmissivity and specific yield.

The modelling approach has enabled a relatively small area within a regional aquifer system to be modelled for a finite time (20 years) and has shown that extension of the boundaries of the model would not have altered the predicted outcomes. Furthermore, the analysis of sensitivity to cell size in an undulating landscape where net recharge areas can become net discharge areas with only small increases in groundwater level is novel, and has helped to build confidence in the model.

Modelling has demonstrated that dryland salinisation can be controlled by reducing groundwater recharge over substantial tracts of land, and is not dependent on recharge reduction over an extensive area up-gradient, at least over the next 20 years.

Recommendations from these CSIRO and PIRSA reports

These reports found that putting management practices in place within 10 years would reduce recharge rates across the district by 50% of the 1994 levels reducing the spread of dryland salinity.

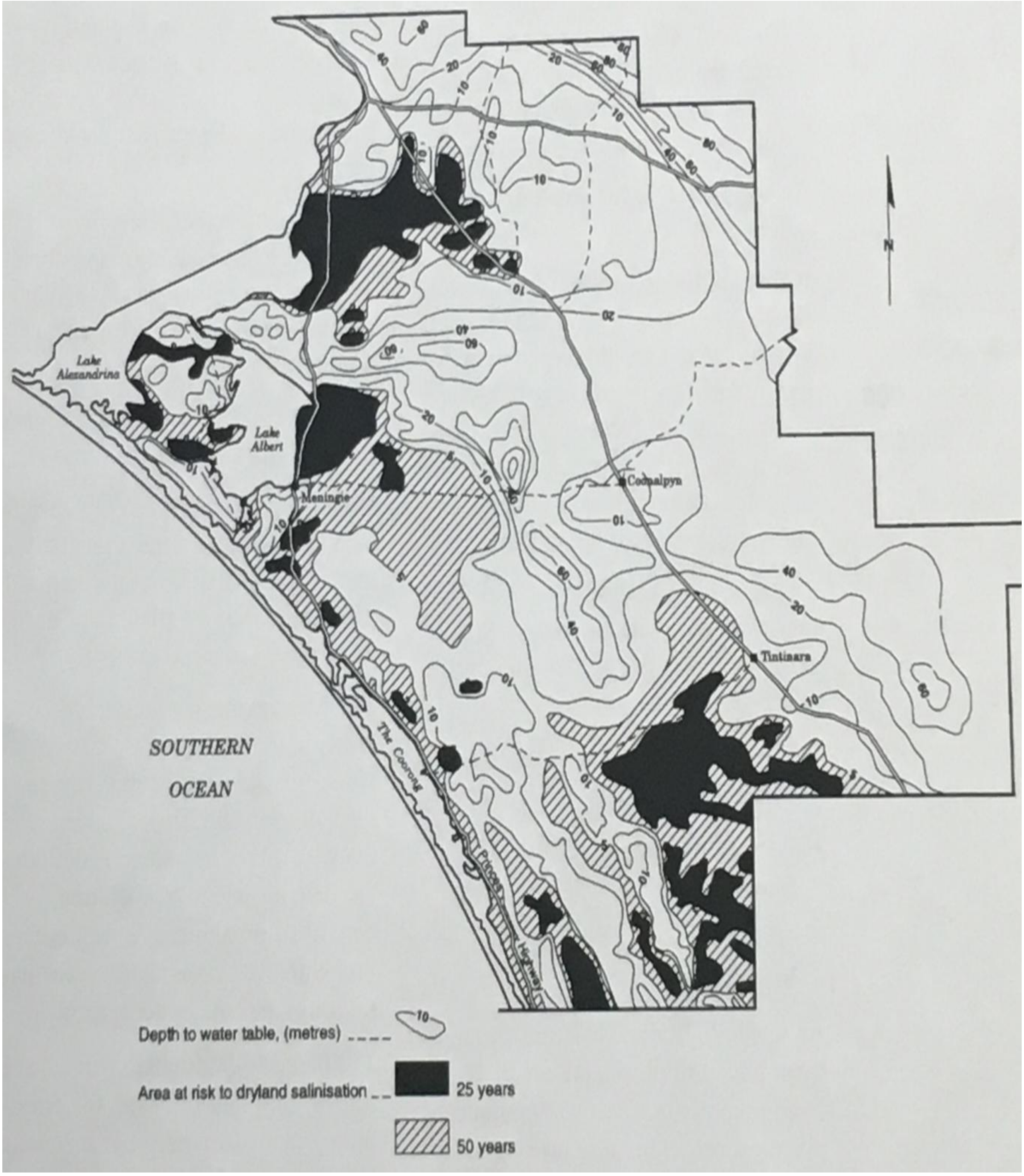
The results were encouraging in that they confirmed that local groundwater recharge is the major issue. Lateral flows are of relatively minor importance in the spread of dryland salinity at this location. Local action which increases water use can have a significant beneficial impact on regional dryland salinity.

The potential area of dryland salinity in the Coorong Districts 2020 & 2045

Map Title: The potential area of dryland salinity in the Coorong Districts 2020 & 2045.

Author: Steve Barnett, Mines and Energy South Australia.

Year: 1995.



The potential area of dryland salinity in the Coorong Districts, 2020 & 2045 if no action was taken.

The list of studies on page 5 & 6 was used as baseline information for the following local & regional plans & strategies. Studies marked * have been commented on below

The findings of the Coorong and Upper South East Districts Groundwater Studies in the early to mid 1990's have been extensively used throughout South Australia including examples listed below.

* Case Study Review, Coorong District LAP Dryland Salinity Management Strategy: *Dooley, Kuys, Ciganovic, Henschke and Walker, Rural Solutions SA*, 2004

* Coorong District Local Action Plan, Protecting Agriculture and Natural Resources; *Coorong District Local Action Plan Committee*, 1997

* Coorong District Local Action Plan, Protecting Agriculture and Natural Resources: *Coorong District Local Action Plan Committee*, 2000

* Coorong District Local Action Plan Sustainability, Agriculture, Environment; *Coorong District Local Action Plan Committee*, 2012

* Coorong Dryland Salinity Review; Improving Salinity Understanding, June 2019 *Coorong Districts Local Action Plan Committee*.

* Coorong & Districts Soil Conservation Board District Plan; *Coorong District Soil Conservation Board*, 1995.

* Coorong & District Soil Conservation Board District Plan Review; *Coorong District Soil Conservation Board*, 2000.

* Lacepede Tatiara District Plan for Soil Conservation and Land Management; *Lacepede Tatiara Soil Conservation Board,* 2000.

* Natural Resources of the Tatiara, a Plan for Local Action: *Tatiara Local Action Plan Committee*, 2013.

* Preliminary Results of Recharge Investigations in the Upper South East Region of South Australia. *CSIRO Division of Water Resources and Centre for Groundwater Studies Walker, Blom and Kennett Smith* 1992

Reducing Groundwater Recharge and the Impact of Dryland Salinity in the Coorong & Districts: *Peter Butler,* 1997.

* Regional Implementation Strategy, Dryland Areas Murray Darling Basin - South Australia*; Soil Boards CARE Program*, 1996.

Other Plans and Strategies relevant to the area.

These Plans also reference the findings of the Reports undertaken in Coorong and Upper South East Districts in the early to mid 1990's.

Groundwater Investigations in the Meningie-Narrung area; *Barnett, Department of Mines & Energy*, 1997.

High Priority Target Areas for Revegetation, Coorong District LAP: *Dooley & Henschke, Rural Solutions SA*, 2005.

Management of Regional Groundwater Discharge in an area of Dryland Agriculture; *Glen Walker* CSIRO Land & Water, 1997.

Meningie Narrung Land and Water Management Plan, Scoping Report: *Dooley Kuys and Liddicoat, Rural Solutions SA,* October 2005.

Potential for Salinisation of the Groundwater beneath Mallee Areas of the Murray Basin; Cooke, *Telfer, and Walker,* Centre for Groundwater Studies, 1993

Recharge Reduction Reaping the Rewards, Summary of Background Papers; *Coorong District Local Action Plan Committee,* 1997.

Saltland Pastures for South Australia; Liddicoat and McFarlane, Department of Water, Land and Biodiversity Conservation, 2007.

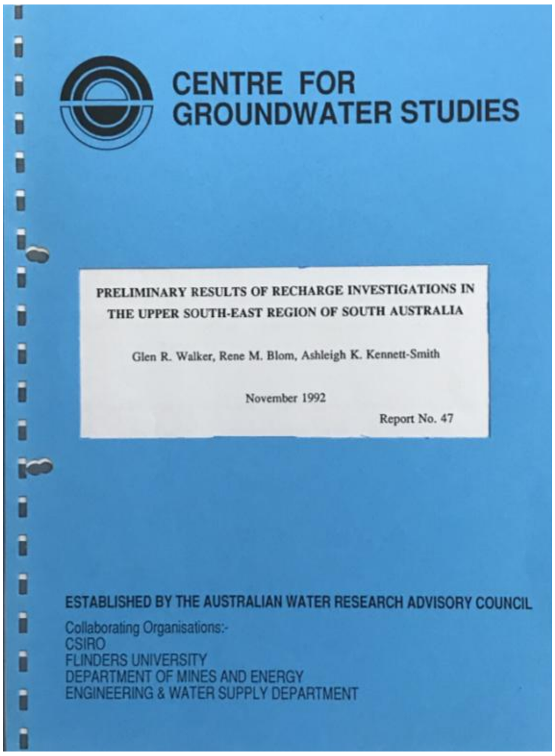
Upper South East Dryland Salinity and Flood Management Plan, Upper South East Dryland Salinity and Flood Management Plan Steering Committee, 1993.

Preliminary Results of Recharge Investigations in the Upper South East Region of South Australia

Title: Preliminary Results of Recharge Investigations in the Upper South East Region of South Australia

Author: CSIRO Division of Water Resources & Centre for Groundwater Studies *Walker, Blom and Kennett Smith.*

Year: November 1992.



Study area

The field site was located 30kms south west of Keith near the Keith Cantara Road and Bunbury Road intersection. The study area was a typical dune swale system common to the area. The annual rainfall is 530mm. The area was sewn to annual pasture, and one site had a 10 year old stand of lucerne. There were several large stands of Mallee vegetation in the study site.

Overview

Up to 200,000 ha of land in the Upper South East Region of South Australia could be affected by dryland salinity *(anon 1991).* This led to a recommendation for deep surface drains in the area to not only enable surface water to move from land locked areas to either the ocean, the Coorong or evaporation basins but also shallow groundwater to be intercepted. An Environmental Impact Study evaluated various options for drainage in the area.

As part of this study:

- A slice groundwater model had been developed to aid the prediction of various scenarios.
- Various land management options were considered in conjunction with the drainage scheme.

For both these options it was helpful to obtain estimates of recharge in the area under different land uses and compared to those obtained elsewhere.

Key Findings

- The annual pasture on the dune crest was found to have a much higher recharge rate than that under the Mallee and Lucerne.
- The recharge rate of 50-70 mm per year is likely to be high compared to the regional average because of the extremely sandy texture on the sight.
- The dryland lucerne was found to significantly dry the profile to 4.5m in 10 years. The recharge rate for the lucerne site found in this case study was unlikely to be more than a few mm per year.
- The recharge rates in the Study and that of CSIRO Cooke Plains Study fit into the general trend of recharge rates with soil texture and rainfall, although they fall slightly on the low side.
- The low recharge rate under lucerne found in this study is consistent with results from other studies.
- In the 1970's about 70% of the pastures in the area was lucerne. In the late 70's and early 80's lucerne aphid wiped out the lucerne greatly increasing the groundwater recharge.

Regional Implementation Strategy, Dryland Areas SA Murray Darling Basin

Title: Regional Implementation Strategy, Dryland Areas, SA Murray Darling Basin

Author: South Australia; Soil Boards CARE Program, 1996.

Year: 1996

Overview

The Soil Boards CARE program had facilitated a range of activities in support of natural resource management and three Soil Conservation Boards in the dryland areas of the South Australian Murray Darling Basin. These activities promoted education, awareness and involvement in action in sustainable natural resource management.

In 1995 with the introduction of Local Action Planning by the Murray Darling Basin Commission, the Soil Boards CARE Program saw the opportunity to further its aims and then developed the Local Action Planning initiative in the dryland areas of the South Australian Murray Darling Basin.

During discussions with the Murray Darling Basin Commission in 1995 it became apparent that groundwater recharge was an underlying and priority issue on which the initiative could be based.

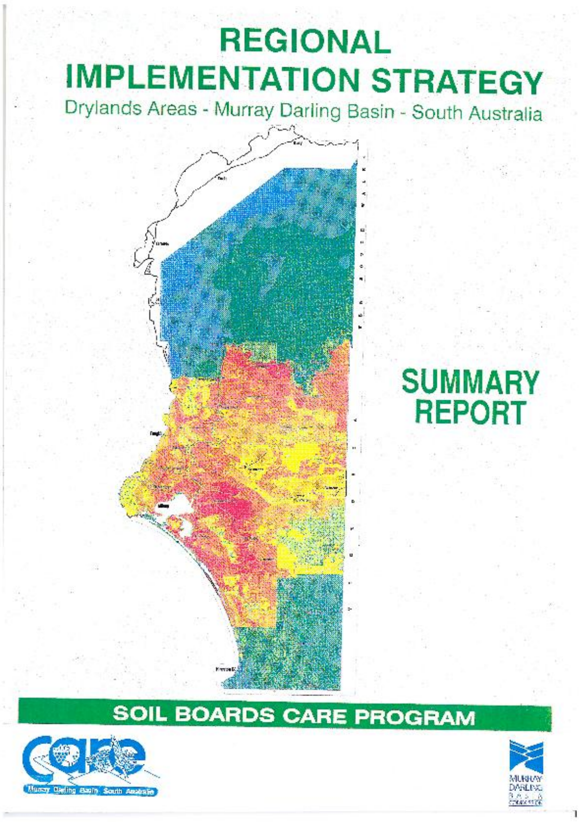
To better understand groundwater issues and how they interrelate with dryland areas of the South Australian Murray Darling Basin, a Regional Implementation Strategy was prepared.

Following the completion of the South Australian Murray Darling Basin Soil Boards District Plans, dryland salinity was seen as the highest priority issue in the region.

This prompted the formation of the Coorong & District Local Action Plan and made funding available to produce the first edition of the Local Action Plan, and to commence implementation.

Community Action for the Rural Environment

Murray Darling Basin South Australia



The Coorong & Districts Soil Conservation Board District Plan and Plan Review

Title: The Coorong & Districts Soil Conservation Board District Plan
Author: Coorong District Soil Conservation Board
Year: 1995

Title: The Coorong District Soil Conservation Board District Plan Review
Author: Coorong District Soil Conservation Board
Year: 2000

Overview

The Coorong & Districts Soil Conservation Board was established under the Soil Conservation Act 1989 with the duty of preparing a District Plan by 1995.

The District Plan was released in 1995 and dryland salinity was seen as the highest priority issue in the Coorong & Districts.

Key Findings

Significant recharge reductions would be necessary to re-establish cropping in presently saline areas. Significant watertable declines could be expected within 5 to 10 years of recharge reduction being implemented.

If current land management practices continued, the net rise in groundwater levels across their study area was predicted to be about 20cm over the next 20 years (1995 to 2015) which could result in an increased area of farmland becoming salinised. This rise in water table could be higher in other areas and can be shown by extrapolating trends in observation wells. *(Pavelic, Kumar, Narayan and Dillon, 1994)*

Recharge reductions at a paddock scale (eg 100ha) had no significant influence of groundwater levels due to the overriding effect of higher rates of recharge in surrounding areas. *(Pavelic, Kumar, Narayan & Dillon, 1994)* This prompted the formation of the Coorong & District Local Action Plan providing a structure to make funding available to produce the first edition of the Local Action Plan and to commence implementation in 1997.

Recommendations

Coorong & Districts Soil Conservation Board recommendations to address Dryland Salinity;

For recharge areas:

Establish Perennial Pastures

Increase crop and pasture water use

Establish fodder shrubs eg tagasate or saltbush

Reduce bare areas caused by wind erosion

Establish trees

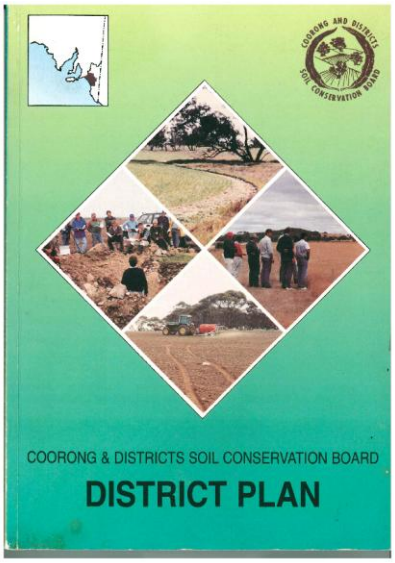
For discharge areas

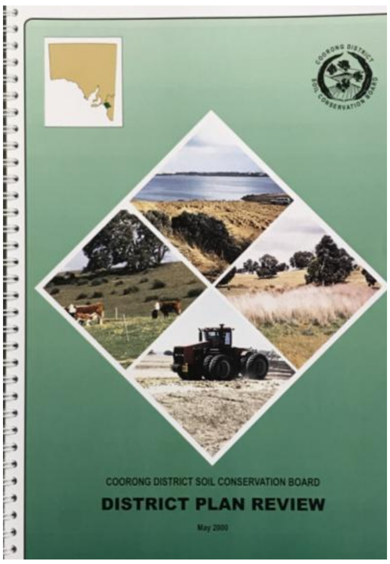
Establish salt tolerant pastures

Maintain surface cover

Establish salt tolerant trees and shrubs

Fence salt affected areas





Lacepede Tatiara Soil Conservation Board District Plan

Title: Lacepede Tatiara District Plan for Soil Conservation and Land Management

Author: Lacepede Tatiara Soil Conservation Board

Year: 2000

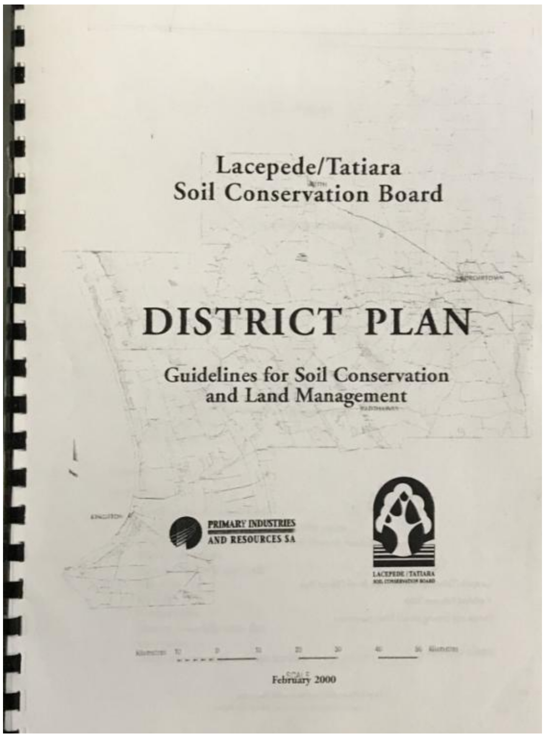
Background

Large areas of productive agricultural land in the Upper South East have been degraded by salinisation as a result of the combined effects of rising saline groundwater levels and flooding.

In particular, the areas west of Keith, from the end of Naracoorte Creek and Kingston in the south, to Tintinara in the north, is affected with evidence of the degradation spreading every year.

The current rate of increase in salinity is between 4 and 12 percent with the loss of annual productivity equating to the loss of two average sized farms (1,500ha) each year from the area.

Smaller areas of localised salinity in the dune swale area north of Bordertown and Keith, due to seepage from dunes. In this area claying sand hills and increasing water use with productive pastures and crops to reduce recharge, is the key.



The rise in groundwater levels is the result of increased recharge to groundwater caused by the removal of the majority of native vegetation in the region. Wide scale lucerne establishment kept the watertable in check until the arrival of the Spotted Alfalfa Aphid in conjunction Wingless Grasshoppers in 1978/79, which decimated the original Hunter River dryland lucerne.

In the areas west of Keith, increased areas of salinised land were observed following the 1981 floods and successive years of winter flooding. It is estimated the area of land affected by salinity is 250,000 ha with a further 175,000 ha at risk of degradation due to salinisation. *(Upper South East Dryland Salinity and Flood Management Plan, 1993)*

Recommendations:

The Soil Board endorsed the Upper South East Dryland Salinity & Flood Management Plan which refers to a series of activities which would alleviate dryland salinity. The Soil Board recommended the following management practices to assist in the rehabilitation of saline land after the drainage work was in place to reduce the risk of flooding;

- Establish farm drainage
- Establish saltland agronomy on suitable areas
- Improve water use and reduce recharge to groundwater by clay spreading on sand hills where appropriate
- Re-establishment of deep rooted perennial pasture on both hills and flats
- Promote healthy vigorous plant growth using appropriate fertiliser regimes
- Establish deep rooted trees and shrubs
- Use appropriate grazing regimes on saline areas to maintain a vegetative surface cover to prevent evaporation over summer
- Establish salt tolerant grasses, shrubs and/or trees on and around the edge of the affected sites

Natural Resources of the Tatiara, a Plan for Local Action 2013 – 2018

Title: Natural Resources of the Tatiara, a Plan for Local Action

Principal Author: Adrian Barber, Chair, Tatiara Local Action Plan Committee
Prepared by the Tatiara Local Action Plan Committee, on behalf of the Tatiara District Council

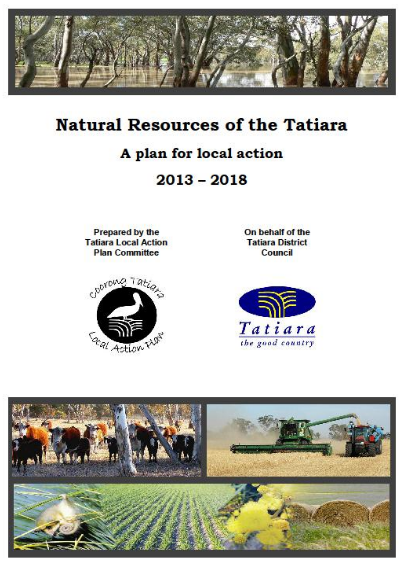
Year: 2013

Overview

A huge amount of salt is stored in the subsurface soils underlying parts of the Tatiara. Historically this salt was accumulated when the area was originally covered with seawater. In the Mallee highland zone the salt is held at depth while on the Coastal plains it is much closer to the surface. A dryland salinity problem emerges when the salts are mobilised and carried upwards by a rising water table and surface evaporation.

In the western part of Tatiara area, originally the deep rooted native vegetation cover kept the watertables at depth by providing a balance between rainfall recharge and evapotranspiration.

With clearance of scrublands and their replacement with shallow rooted annual crops and pastures, this balance is disrupted and more rainfall reaches the watertable causing a general rise bringing the dissolved salts closer to the surface.



Key Findings

The widespread sowing of lucerne in the ranges when the land was first cleared assisted in keeping watertables in check, however the pasture aphid invasions of the late 1970's and the dramatic loss of susceptible lucerne stands at that time led to a general watertable rise and a rapid spread of dryland salinity in adjacent low lying areas.

In the western part of the Tatiara depth to the water table are typically less than a few metres under interdunal areas while beneath the remnant dune ridges depth is often more than 15 metres. In eastern and northern areas depth to the water table increases to more than 40 metres in many parts reflecting the elevated topography.

The Upper South East Dryland Salinity and Flood Management Program are designed to remove excess surface water and saline groundwater from the salty flats on the Coastal plains and direct it into the Coorong or out to sea via the Blackford Drain. However the lateral effects of the drains in reducing adjacent dryland salinity on pasture land are still being assessed due to a run of dry years.

Within the Tatiara, no built up areas appear to be at risk from urban salinity, however some road surfaces in the western region of the Council area have been affected by rising water tables leading to extra maintenance.

Recommendations

- Adoption and re-establishment of salt tolerant pasture species on drained low-lying land.
- Continuing research on alternative pasture legumes suitable for saline soils eg Messina.
- Re-establishment of deep rooted perennial pasture species on high ground, preferably lucerne to minimise annual recharge. This may include clay spreading on the dune rises.
- Use of perennial fodder shrubs.
- Retention, rehabilitation or re-establishment of native vegetation.
- Grazing management practices that maximise summer – autumn groundcover.
- Investigation of other land uses such as inland aquaculture and biomass production.

Reducing Groundwater Recharge & the Impact of Dryland Salinity in the Coorong & Districts

Title: Reducing Groundwater Recharge & the Impact of Dryland Salinity in the Coorong & Districts

Author: Peter Butler. Primary Industries South Australia

Date: 1997

Summary

The Coorong and Districts has a dryland salinity problem which is of serious concern to the local population. Over 10,000 ha of land is already salinised and a further 35,000 ha is at risk within 50 years.

The bio-physical processes operating within the region have been investigated and this information underpins a catchment planning process which is underway.

A three year study into the causes of dryland salinity was conducted between Coomandook and Cooke Plains by the CSIRO Division of Water Resources and the Department of Mines and Energy SA (MESA). Computer modelling of groundwater flows arising from the studies have shown that recharge reduction of at least 50% is required (over the whole model area) in order to reduce watertables by at least 40 cm (Pavelic, Narayan, & Dillon). Recharge reduction of 50% or more would also be necessary to re-establish cropping in presently saline areas. Significant water table declines could be expected within 5 to 10 years of these recharge reduction targets being achieved.

Key Results

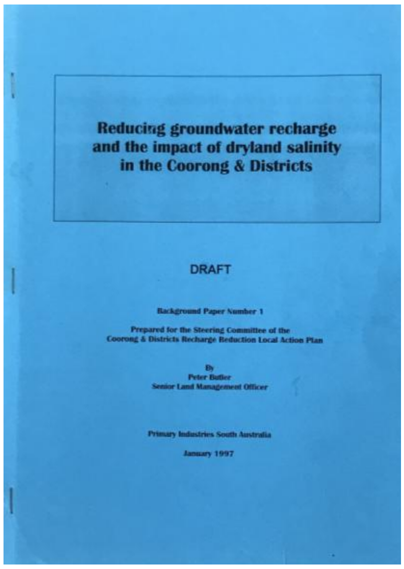
Results are encouraging in that they confirm that local groundwater recharge is the issue. Lateral flows are of relatively minor importance in the spread of dryland salinity at this location. As a consequence, local action which can have a significance beneficial impact on the problem.
It was proposed that the goal of the Local Action Plan be to achieve at least a 50% reduction in recharge.

Indicative recharge reduction targets for the LAP area

Recharge reduction option	**Area to be treated**	**Estimated recharge reduction**
Alley grazing systems	36,840 ha	7%
Dryland lucerne pasture	56,120 ha	14%
Phase cropping with lucerne	55,050 ha	15%
Alley cropping system	24,500 ha	2%
Stabilising bare eroded soil	3000 ha	2%
Increased water use on annual crops	31,600 ha	2%
TOTAL	207,110	42%
Note: Based on the initial LAP project area of 686,830 ha, later expanded to 883,500 ha		

As an associated strategy, it was recommended that maintaining existing levels of native vegetation as a priority preventing future increases in recharge.

A range of possible solution had been considered. The relative merit of each option is discussed and priority actions identified.


Reducing groundwater recharge
and the impact of dryland salinity
in the Coorong & Districts

DRAFT

Background Paper Number 1

Prepared for the Steering Committee of the
Coorong & Districts Recharge Reduction Local Action Plan

By
Peter Butler
Senior Land Management Officer

Primary Industries South Australia

January 1997

Recommendations

Stage one would involve;

- Implementing works to achieve a 40% recharge reduction
- Implementing works to maintain existing perennial vegetation
- Implementing works to mitigate the impact of dryland salinity
- Identify works that would yield an additional 10%
- Monitoring the impact of the works implemented
- Implementation of recharge reduction first targeting the highest priority Hundreds), and offering a wide range of management options, while maintaining a core focus on the establishment of broad acre perennials.

Coorong District Local Action Plan, Protection Agriculture & Natural Resources

Title: Coorong District Local Action Plan, Protection Agriculture & Natural Resources
Authors: Coorong District Local Action Plan Committee
Dates: First edition 1997, update in 2000 and rewrite in 2013

Background

The Coorong District Local Action Plan (LAP) Committee was formed in 1995, following the completion of the Coorong District Soil Conservation Board's District Plan. The initial focus of the Committee was to prepare a plan that addressed the areas priority NRM issues as indicated in the Soil Board's District Plan.

The LAP was produced in 1997 and reviewed in 2000 following extensive community consultation.
The implementation of the LAP commenced in 1997, with the aid of Natural Heritage Trust and later National Action Plan funding, and aimed to address land management and environmental issues by:

- Controlling groundwater recharge through the broad scale planting of deep rooted perennial plants.
- Conserving and enhancing biodiversity through the protection of remnant native vegetation and wetlands and extensive revegetation using local native species.
- Supporting and promoting sustainable agricultural productivity which maintains and enhances the long-term productive capacity and environmental health of the land.
- Improving groundwater management.
- Empowering the community through education and awareness about natural resource management issues.
- Provision of professional support to community NRM groups and individuals.

In 2009 the LAP area of activity changed to include all of the Tatiara District Council area following the funding of a joint on-ground works project by Caring for Our Counter.

This Plan can be viewed by clicking the link below.
https://www.coorong.sa.gov.au/council-services/coorong-tatiara-local-action-plan/about-us-and-latest-news/about-us

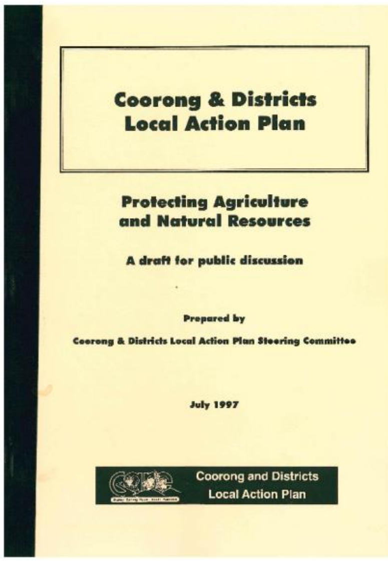
Key Findings

- ***The aim of the Coorong District Local Action Plan was to implement planned works within ten years to achieve at least a 50% reduction in recharge.***
- Actions aimed at slowing dryland salinity processes are often profitable to the landholder, while having a range of other benefits.
- The management of dryland salinity is generally done using a two pronged approach of attacking the cause and mitigating the impacts.
- To prevent dryland salinity it is best to make the maximum use of rain where it falls, in order to prevent this water from entering the groundwater system (as recharge).
- Preventative works need to be carried out over a large scale to be effective. A reduction in recharge of at least 50% and preferably 90% is needed over thousands of hectares.
- To achieve this level of adaptation, the recharge reduction solutions need to be cost effective and ideally profitable.

1997 & 2000 Coorong District LAP recommendations to address Dryland Salinity

Title: Coorong District Local Action Plan, Protecting Agriculture and Natural Resources
Authors: Coorong District Local Action Plan Committee
Year: 1997

Title: Coorong District Local Action Plan, Protecting Agriculture and Natural Resources
Authors: Coorong District Local Action Plan Committee
Year: 2000



Recommendations for recharge areas

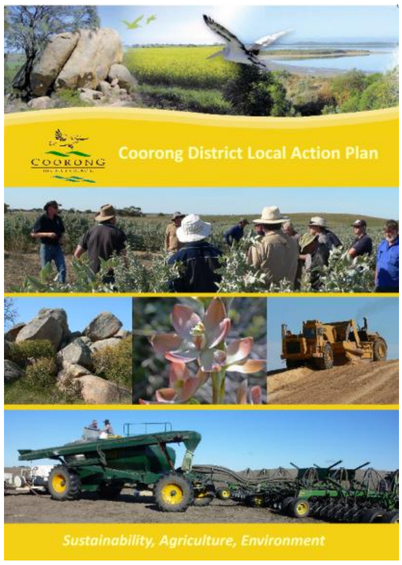
- Perennial Pastures systems
- Increase crop and pasture water use
- Establish fodder shrubs eg tagasaste or saltbush
- Establish trees
- Alley Farming - later added to Soil Board recommendations
- Phase cropping - later added to Soil Board recommendations
- Reduce bare areas caused by wind erosion

Recommendations for discharge areas

- Establish salt tolerant pastures
- Maintain surface cover
- Establish salt tolerant trees and shrubs
- Fence salt affected areas

2012 CD LAP - No new recommendations to address Dryland Salinity

Title: Coorong District Local Action Plan, Sustainability, Agriculture, Environment
Authors: Coorong District Local Action Plan Committee
Year: 2012



Recommendations for recharge areas

- Establish deep rooted Perennial Pastures.
- Increase crop and pasture water use.
- Establish fodder shrubs eg tagasaste or saltbush.
- Establish trees.
- Alley Farming.
- Phase cropping.
- Reduce bare areas caused by wind erosion.

Recommendations for discharge areas

- Establish salt tolerant pastures.
- Maintain surface cover.
- Establish salt tolerant trees and shrubs.
- Fence salt affected areas.

Case Study Review, Coorong District LAP Dryland Salinity Management Strategy

Authors: Dooley, Kuys, Ciganovic, Henschke and Walker, Rural Solutions SA

Date: December 2004

Overview

As result of a series of research studies done in the LAP area by CSIRO and MESA, especially those of Pavelic et al (1994 and 1997), showed that broadscale recharge reduction had the potential to effectively manage salinity. For the study area of 10,000 ha at Cooke Plains, groundwater modelling determined that a 50% reduction in recharge would reduce watertables within a short (10 year) time frame, and offer control of the predicted increases in salinity.

Review Findings

The results confirmed that local recharge was a prime cause of the spread of salinity in such areas of shallower watertables, and local action (recharge reduction) could have a significant impact on the problem (CD LAP, 2000). As a consequence, the LAP Committee (CD LAP, 1997) formulated an overarching goal;

To implement planned works within ten years to achieve at least a 50% reduction in recharge.

Based on the modelling studies and associated research, *Butler (1997)* calculated the level of land management and land use change required to progress towards this goal of 50% recharge reduction across the (then) 687,000 ha of the Coorong District LAP area. He concluded that a reduction of around 42% was possible (given high adoption rates) without greatly altering the current agricultural systems, and that the establishment of dryland lucerne would play a major part.

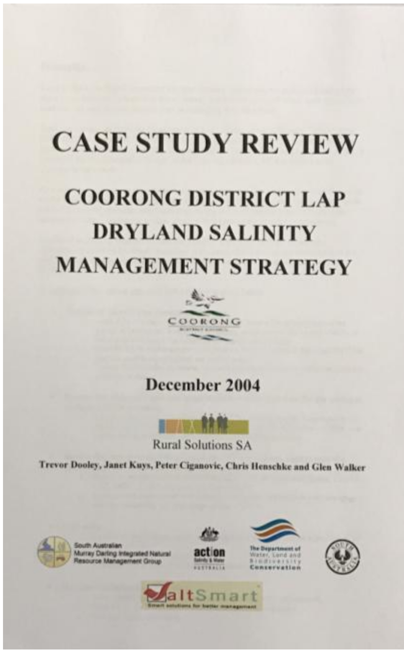
Indicative recharge reduction targets for the LAP area

Recharge reduction option	Area to be treated	Estimated recharge reduction
Alley grazing systems	36,840 ha	7%
Dryland lucerne pasture	56,120 ha	14%
Phase cropping with lucerne	55,050 ha	15%
Alley cropping system	24,500 ha	2%
Stabilising bare eroded soil	3000 ha	2%
Increased water use on annual crops	31,600 ha	2%
TOTAL	207,110	42%
Note: based on the initial LAP area of 686,830 ha.		*Butler (1997)*

As an associated strategy, *Butler (1997)* recommended the maintenance of existing native vegetation for preventing future increases in recharge.

In his background technical paper, *Butler (1997)* recommended that the LAP Committee should aim to achieve a 40% reduction in recharge within ten years, and aim for the additional 10% required over the longer term, subject to additional investigations.

He suggested that implementation of recharge reduction should first target the highest priority Hundreds), and offer a wide range of management options, while maintaining a core focus on the establishment of broad acre perennials.



Key Findings

The recharge reduction strategy adopted by the Coorong District LAP is predicated upon a conceptual model of the prevailing groundwater flow system, in this case based on the work of Pavelic et al (1997). This work is still considered state-of-the art with respect to the modelling of land salinisation. *(Dooley et al (2004)*

Coorong Dryland Salinity Review, *Improving Salinity Understanding*

Title: Coorong Dryland Salinity Review, Improving Salinity Understanding, June 2019

Authors: Coorong Districts Local Action Plan Committee

Chris Henschke Senior Consultant Hydrogeology, PIRSA Rural Solutions, Steve Barnett– Principal Hydrogeologist, Department for Environment and Water and others

Year: June 2019

Background

In recent years there has again been an increase in area affected with a recent land owner surveys,(2018 & 2020) from the area revealing that 1835 hectares of good arable land has been lost to dryland salinity in the past 5 years.

The Coomandook, Cooke Plains, Meningie East and Tintinara West and Colebatch areas have been identified as having high potential for dryland salinity formation due to the low lying nature of some parts of this landscape and it's proximity to the regional groundwater system.

In 2016, the CTLAP organised public meetings at the Coomandook Hall and Meningie to discuss the issue and seek local land owner ideas about the cause of salinity resurgence and potential remedies. Over 100 people attended including 80 land owners demonstrating the high level of interest in the issue.

Key Findings

The Coorong Dryland Salinity Review;

- Brings together resources to provide an overview of the current level of dryland salinity in the Coorong District,
- Provides discussion of the potential causes of the dryland salinity,
- Identifies actions, and where further resourcing is required to better understand the causes and potential solutions

The Coorong Dryland Salinity Review can be found at:
https://www.coorong.sa.gov.au/council-services/coorong-tatiara-local-action-plan/soil-health-and-dryland-salinity/coorong-dryland-salinity-review-2019

Previous Research

The local effect is stronger than any regional input, so the adoption of high water use crops and pastures at a large scale can have an impact, especially in dune-swale topography where local water flow cells overlie the regional flow system. Groundwater flow modelling suggested that a 50% recharge reduction in the Coorong District would be required to limit the spread of land salinisation.

Recharge reduction needs to be carried out on a very large scale (i.e. thousands rather than hundreds of hectares. Individually, farmers undertaking recharge reduction management on a single paddock will not make a difference, but collectively, many farmers doing the same thing can make a difference.

Recommendations

Attacking the cause of dryland salinity;

- Establish Perennial Pastures
- Consider higher water use or longer season cropping alternatives
- Increase crop and pasture water use
- Improve soil health by identifying & ameliorating soil constraints
- Establish trees, native shrubs and fodder shrubs

Treating the effects of dryland salinity;

- Understand your soil
- Management of cropping land with low to moderate salinity
- Management strategies for saline land (land which is too saline for broad acre crops)
- Salt tolerant pastures, fodder shrubs and revegetation
- Address bare patches
- On farm desalination for farm water supplies

Options for recharge areas

Deep rooted perennial pastures

Revegetation with native species

Increase crop and pasture water use

Fodder shrubs

Farm Forestry

Prevent recharge on bare areas

Other options for recharge areas include:

- Clay spreading and other forms of soil amendment that enhance soil water holding capacity holds moisture near the surface and increased water use
- Protecting remnant native vegetation

Options for discharge areas

Puccinellia

Tall wheat grass

Saltbush

Messina

NyPa Forage – Distichlis

Fencing saline area for improved management

Other options for discharge areas include:

- Drainage
- Aquaculture
- On farm desalination for farm water supplies
- Groundwater pumping
- Salt production

Ongoing groundwater monitoring

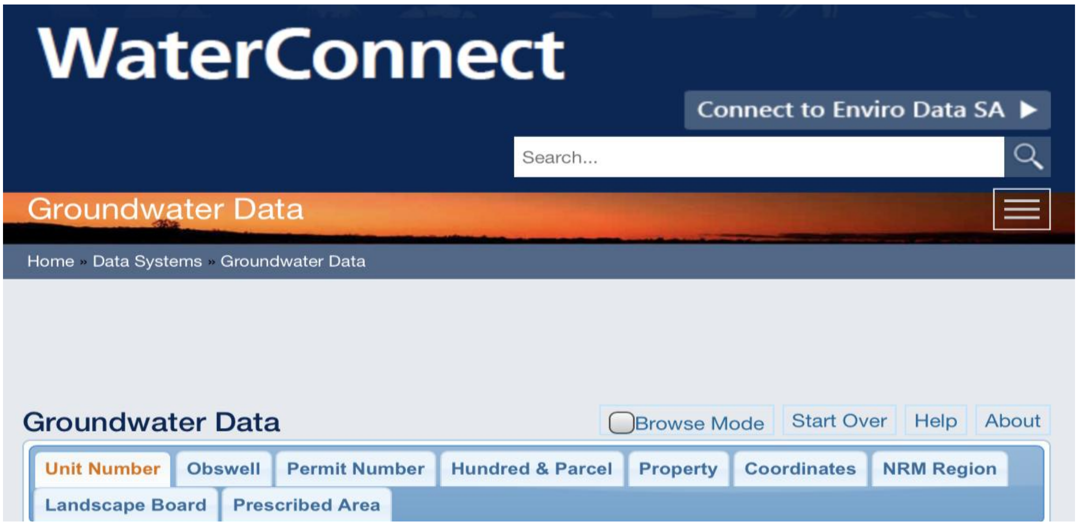
Many of the piezometers installed for the CSIRO studied in 1992-1997 are still being monitored twice yearly.

Some of these are included in the Coomandook/Cooke Plains Landcare Monitoring Network. The 25 piezometers in the network were established in April 1994. These are currently monitored twice yearly by staff from the Coorong Tatiara LAP.

The Department for Environment and Water also monitor several piezometers in the area.

Groundwater monitoring Information is available on Water Connect web site. This information includes water levels, salinity levels (some) bore/piezometer and construction details.

https://www.waterconnect.sa.gov.au/Pages/Home.aspx



Impact of dryland salinity on the built environment

Some township areas in the Coorong District are located in low lying areas.

Urban salinity occurs as a result of a combination of excess water and excess salt in the environment. Our use and management of land and water resources has a large impact on urban salinity.

As with dryland salinity, urban salinity occurs when deep-rooted native vegetation is cleared and the replacement system transpires much less water. This creates an imbalance in the water cycle, with increased amounts of water escaping past the root zone and into the underlying groundwater (referred to as 'groundwater recharge'). The installation of roads, buildings and other infrastructure also alters natural drainage patterns, while other sources of excess water may result from leaking sewerage, stormwater & water pipes.

Over time, the groundwater system can fill and bring dissolved salts from weathered rocks deep below the surface and from other sources. Salt is naturally present in soil, groundwater, waterways and rain. Additional (very minor) sources of salt in urban environments include effluent (household and industrial), swimming pools, fertilisers, soap and detergents, and building materials.

Where saline groundwater comes within about 1.5 metres of the soil surface, it is drawn up by capillary action to form 'saline groundwater discharge' sites. These sites most often occur in low areas of the landscape.

Impacts can include;

- Structural damage to houses, sheds, and other buildings,
- Reduced life of water pipes and electrical equipment,
- Decline of quality in unconfined groundwater bores for use on sporting grounds, gardens and domestic uses,
- Damage to pumping and water reticulation equipment,
- Roads, footpaths, pipelines, culverts, septic systems, underground communication cables, and the footings of powerlines and electrical transmission
- Farm infrastructure such as fencing, roadways. Farm buildings, farm vehicles and water infrastructure.

Salt damp

Salt damage to public infrastructure

Salt damage to public infrastructure

Salt damp

Conclusions

Key Recommendations from the reviewed plans, strategies and studies in this report.
Actions aimed at slowing dryland salinity processes are often profitable to the landholder, while having a range of other benefits.

Other reasons to undertake actions formally considered dryland salinity focused include; restoration of native vegetation, reducing wind erosion, protecting groundwater quality, increasing groundcover and maintaining soil carbon.

Preventative works need to be carried out over a large scale to be effective. A reduction in recharge of at least 50% and preferably 90% is needed over thousands of hectares. To achieve this level of adaptation, the recharge reduction solutions need to be cost effective and ideally profitable.

The Key outcomes summarised across these plans and strategies and studies

To implement planned works within ten years to achieve at least a 50% reduction in recharge.

The recommended strategies to achieve this are:

- Establish deep rooted perennial pastures or fodder shrubs.
- Increase crop and pasture water use by increasing their health and productivity.
- Establish trees and shrubs as forestry blocks and windbreaks to use up water that drains below the surrounding crop and pastures root zone. The density of plantings will depend on the species, age and health of the trees, climate, soil and landscape position.

The second approach to managing dryland salinity is to manage affected soils that result from rising water tables.

Following are some strategies for rehabilitating and potentially preventing the spread of these salt affected areas.

On cropping land with low to moderate salinity;

- Use salt tolerant crops such as barley or canola.
- Sow salt tolerant pasture cultivars, e.g. Balansa Clover or Puccinellia.
- Grow high yielding crops and pastures to maximise plant water use.
- Aim to overcome other limiting factors ie. low fertility, disease control, weed control and seed bed preparation.
- Maintain crop and pasture residues to ensure the soil surface is covered at all times, reducing evaporation.

On land that is highly saline:

- Pastures need to be fenced off to enable the control of grazing pressure. Where possible keep this separate from annual crop and pasture land.
- Establish salt tolerant perennial pastures.
- Encourage and maintain surface cover at all times to reduce evaporation and prevent salt from concentrating at the soil surface.
- Graze perennial pastures in Spring and Autumn and allow them to set seed on a regular basis to maintain stand density.
- In areas suited for revegetation, establish salt tolerant native trees and shrubs around the edge of salt affected sites to increase water use and halt or slow down the rate of spread.
- Rip bare patches to roughen up the soil to promote the leaching of salt.
- Where possible, cover any bare patches with sheep crutchings, hay, straw, or similar material to reduce evaporation, encourage natural regeneration and reduce erosion.
- Drainage and groundwater pumping may be an option in some areas.