SALINITY CHANGE IN THE WEST WIMMERA

September 2002

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ABSTRACT

A key factor in understanding the processes that cause salinity in the West Wimmera region is the development of an inventory of saline sites in the area. Polygons created for salinity maps become one of the fundamentals of salinity investigation. What is sometimes overlooked is the change that these sites have undergone with time, and the identification of primary salinity (naturally saline) or secondary induced salinity (caused by changes in land use associated with post European settlement). Aerial photograph series dating back to the 1940s have been assessed in an attempt to identify changes in salinity in the Edenhope and Telopea Downs areas of the West Wimmera region. The study has shown that there has been significant change at the investigated sites. In the Edenhope area there was a notable increase in the spread and severity of salinity up until the 1980s, but photographs since then appear to reveal reductions in salinity. At Telopea Downs evidence of tree growth before land clearance in presently saline sites suggests that the present salinity is of secondary nature. The severity and occurrence of salinity in the West Wimmera region appears to be highly influenced by climatic conditions, the current apparent reduction of salinity interpreted to be a consequence of the prevailing low rainfall period.

KEYWORDS

Salinity, rate of change, West Wimmera, salinity change

INTRODUCTION

Scope and aim of study

The aim of this report is to identify the change in salinity occurrences in the Edenhope and Telopea Downs areas of the West Wimmera. The objective of the study was to identify salinity in these areas and determine its rate of change over the historic record, classify salinity on the basis of primary/naturally occurring or secondary (human induced) salinity, and to identify the factors that control land salinisation in the West Wimmera. This project has been funded by NRE (Catchment and Water) and written in support of the West Wimmera Salinity Management Plan (SMP).

Location

Two study areas within the West Wimmera region (located in central western Victoria) were chosen to conduct this study (see Figure 1). The Telopea Downs study area is located in the north of the West Wimmera (see Figure 1) below the Big Desert National Park. The Edenhope study area includes the township of Edenhope and extends towards the southern boundary of the West Wimmera region.

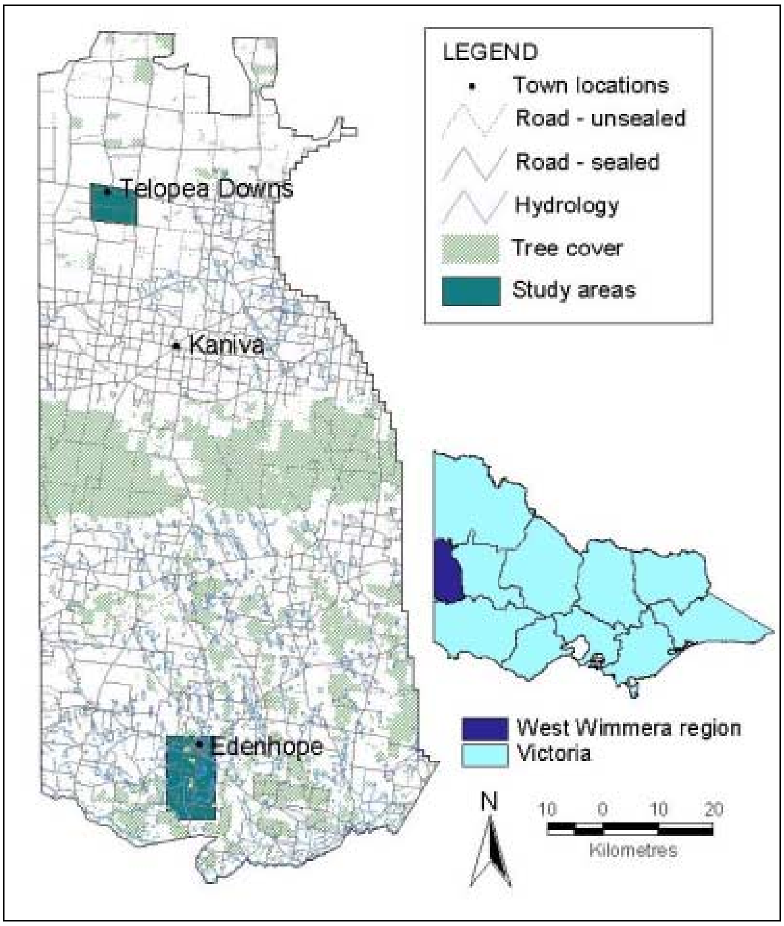

Figure 1 Location map of the areas of study within the West Wimmera Region

Land use history

The European settlement of the West Wimmera began in the 1830s (LCC 1996), and by the 1860s it had spread throughout the majority of the region. Initially, no formal boundaries existed between neighbouring land as sheep and cattle grazed on the native grasslands in low densities over large areas (LCC 1979). Between the 1850s and 1890s large areas of woodland were cleared due to the increased demand for timber by the gold mining industry.

The 1860s saw the beginning of true surveying and settling of the area (LCC 1996). Significant land clearance commenced (predominantly by ringbarking and burning of forested areas), primarily for agricultural development. The Department of Crown Lands and Survey encouraged clearing by setting it as a condition in the purchase of lease land (LCC 1996). Timber demands brought about by township development and construction of the Victorian railways also had an impact on native forest areas.

The initiation of the Forests Commission of Victoria led to improved resource management of forested areas by reforestation, the introduction of timber plantations, and the reclamation of land that had been abandoned due to poor productivity (LCC 1996).

Edenhope

The decline of native grasses and degradation of land was readily recognised by early settlers in the southern portion of the West Wimmera region. J. C. Hamilton, a local land holder in the Ozenkadnook area, observed the rapid replacement of the kangaroo grass post 1846, to less productive grasses such as herbs and yams, severely debilitating the grazing supply (Barr & Cary 1992).

Telopea Downs

Agricultural and pastoral development of the Telopea Downs region began in 1954 (Blake 1981) as part of a major experiment carried out by the AMP (Australian Mutual Provident) Society. Their goal was to transform desert country in both South Australia (the Ninety Mile Desert) and Victoria (the Big Desert) into productive farmland (Blake 1981).

Prior to clearance these desert areas were fairly untouched, consisting of undulating sand dunes and plains, scattered with native vegetation (Fergusson 1984). The stunted growth of existing vegetation reflected the lack of nutrients available for healthy plant growth in these areas. Test plots revealed that the addition of copper and zinc to the sandy soils vastly improved productivity.

AMP was allotted 240 000 acres of the Big Desert in the vicinity of Telopea Downs. The area was ploughed, levelled and initially leased for grazing until the soils were productive enough to sustain crop growth (Fergusson 1984), with the intent to subdivide into smaller plots and sell to settlers.

A major drought in 1959 crippled the small community of Telopea Downs, with new settlers struggling to survive. This led to larger subdivisions of predominantly grazing land in the area. By 1967, nearly 200 000 acres had been purchased by settlers (Fergusson 1984).

Climate

Climatic conditions for the southern region of the West Wimmera are characterised by Mediterranean style dry hot summers and wet cool winters. To the north the climate is described as semi-arid, characterised by high potential evaporation rates throughout the year which are generally only exceeded by rainfall during high intensity summer storms.

Rainfall

Mean annual rainfall varies considerably across the region. The southern part of the region receives approximately 610 mm/yr (at Edenhope) (monitoring station no. 079011). To the north (around Telopea Downs), annual average rainfall approximates 390 mm/yr (monitoring station no. 077093).

Evaporation

Mean annual evaporation rates are in the order of 1600 mm/yr (recorded at the Kaniva monitoring station (no. 078078)). This rate is typical for semi-arid conditions and allows fairly rapid accumulation of salt in the soil profile, as the lack of well developed surface drainage inhibits salt flushing.

Previous studies

There are few investigations relating to the historical development of salinity in Victoria. A recent study in the Dundas region of the Glenelg catchment by Nathan (1998) suggests land salinisation was apparent at the time of European settlement, based upon historical records. In the Wimmera, Strudwick (1992) broadly quantified salinity change along the Lower Wimmera River region and concluded that 19% of land salinisation was attributed to secondary salinity (post European settlement).

The majority of salinity in the West Wimmera region was mapped by Hocking (1998). The mapping identified 3187 ha of salinity in the region and acknowledged there was more unmapped salinity in the Telopea Downs region. The mapping documented various types and severities of salinity. The majority of the severe salinity was evident within the Mosquito Creek Catchment, with minor salinity occurrences in the Telopea Downs area.

Telopea Downs

Following on from the salinity mapping, Luke and Hocking (2000a) examined the salinity causing processes of the Telopea Downs region. The report suggested salinity was associated with groundwater perching above a hardpan layer within the upper soil profile, inhibiting deep drainage to the regional aquifer. High permeabilities in the overlying sand unit allow sub-surface water to accumulate in low-lying areas where evaporative processes concentrate salt leading to land salinisation.

The Telopea Downs Landcare group has also acknowledged salinity in the area and established salinity trials in the early 1990s. The trials showed that the majority of the salinity in the area can be treated and prevented by establishing lucerne.

Edenhope

Within the Mosquito Creek catchment salinity identification and treatment began in the early 1980s with groundwater drilling and revegetation activities by the then Department of Conservation Forest and Lands. Salinity research since the mid 1990s has seen stream salinity surveys (Hocking 1995), identification of salinity causing processes (Hocking 1998), groundwater monitoring (Hocking 1996), groundwater drilling (Hocking 1997), watertable mapping (Hocking 1999), a salinity control report (Luke & Hocking 2000b) and a recharge investigation (Mintern and Hocking 2001). Since the 1980s it has become apparent that salinity in the area is starting to impact on Lake Wallace's water quality. Groundwater levels near the lake appear to be rising at a rate of 26 cm/year for the past 12 years (Muller & Hocking 2002).

TELOPEA DOWNS STUDY AREA DESCRIPTION

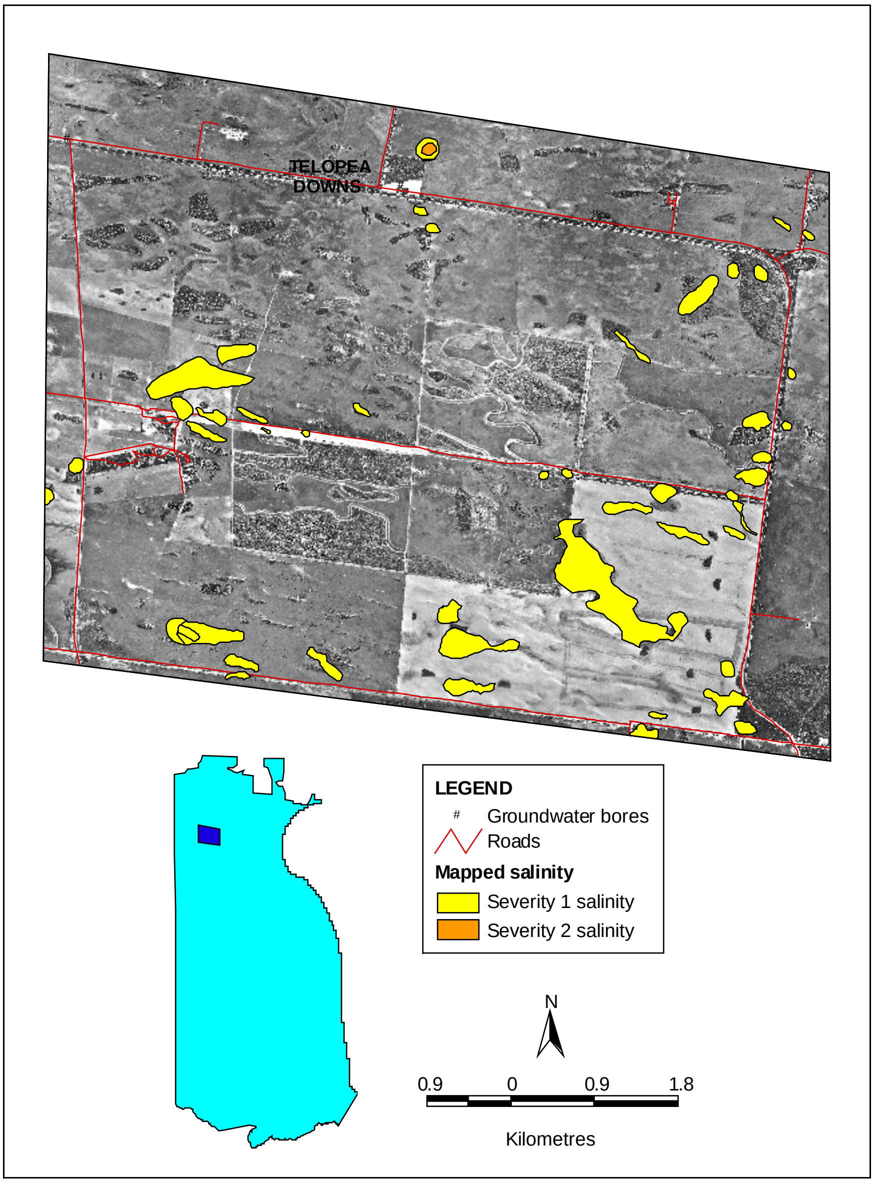

Figure 2 Location map of the Telopea Downs study area featuring the 1981 airphoto

In the Telopea Downs study area (see Figure 2) fine grained unconsolidated Lowan Sand almost entirely covers the Parilla Sand creating undulous topography. Dune formations of this unit typically trend east-west. Poor surface drainage has resulted in little or no deposition of the Shepparton or more recent Coonambidgal formations. Within the Parilla Sand, iron hardpan layers have developed between the two formations as a result of iron remobilisation in the upper part of the profile.

The hardpan layers have a significant effect on groundwater movement in the area as they act as an aquitard, limiting infiltration to the regional aquifer below. A dominant lateral flow of near-surface groundwater and surface runoff to low-lying areas and topographic depressions is inferred. Where the hardpan layer is nonexistent a more vertical flow, and therefore, higher recharge to the Parilla Sand Aquifer is possible.

Salinity in the Telopea Downs area appears to occur due to local groundwater processes (break-of-slope and groundwater perching), and is mostly classed as low severity (Bozon & Matters 1995). Saline sites occur at the break-of-slope and are not very well established (see Plates 1 & 2). Only one site within the Telopea Downs study area is considered to be of moderate severity (see Plate 3)

Plate 1 Break-of-slope salinity in the Telopea Downs study area featuring low severity salinity plant indicator species

Plate 2 Waterlogging at the break-of-slope within the Telopea Downs study area

Plate 3 Saline site due north-east of the Telopea Downs Hall, displaying moderate severity salinity (Class 3)

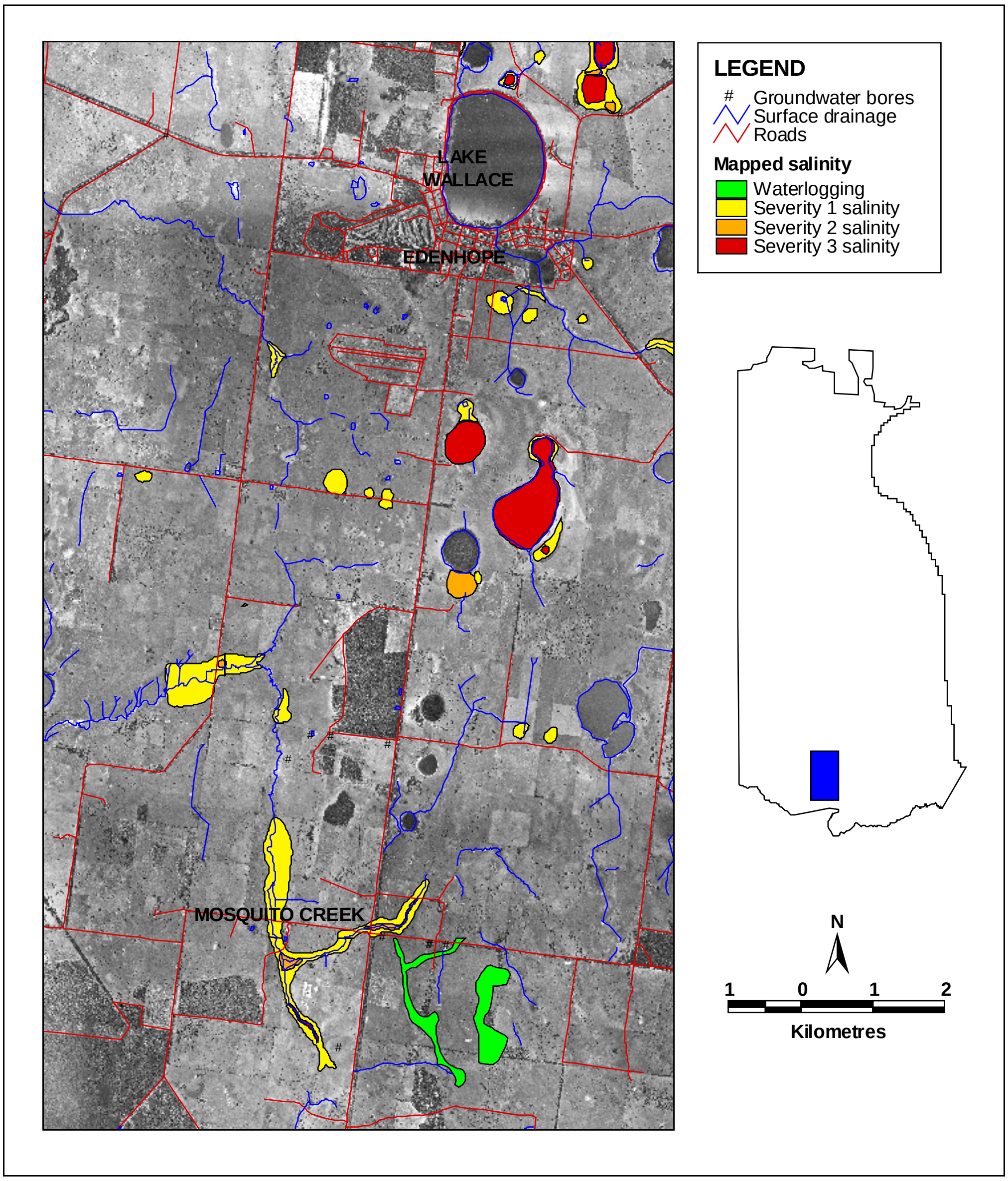

Figure 3 Location map of the Edenhope study area featuring 1981 airphoto

The Edenhope study area (see Figure 3) has a greater variation in geology and geomorphology than the Telopea Downs study area. Lake systems and drainage lines are influenced by the NNW-SSE trending drainage lines between Parilla Sand ridges. Within these lower - lying areas a vast number of lakes and swamps exist, some of which have lunette formations on their eastern flanks as a result of intermittent waterlevels. The Lowan Sand appears to occur on topographic highs, most likely overlying the Parilla Sand. Underlying the Parilla Sand, the geology is very flat and extensive. The Murray Group Limestone aquifer (a fresh water aquifer) is hydraulically confined by the overlying Bookpurnong Beds which act as an aquitard, inhibiting groundwater flow from the overlying Parilla Sand and other near surface aquifers.

Salinity in the Edenhope area is attributed to both local and regional groundwater processes. The area is underlain by a shallow watertable and the condition of saline discharge sites in the area ranges from low to high severity affecting both land and drainage lines.

METHOD

In order to assess and compare current salinity sites with possible historic salinity occurrences, aerial photographs dating from 1949 to 2000 for both the Telopea Downs and Edenhope regions were analysed. The photomosaics produced from aerial photographs were orthorectified, allowing current mapped salinity by Hocking (1998) to be overlayed. Evidence of salinity on these earlier airphotos was assessed to determine the rate of change in salt-affected areas over the past 50 years. Table 1 summarises the actual dates of the aerial photographs that were investigated for evidence of salinity.

Table 1 A summary of the actual years that aerial photographs were taken that have been analysed for this study

	Aerial photography years	
Decade	Edenhope	Telopea Downs
1940s	1949	1949
1970s	1973	
1980s	1981	1981
1990s	1993	1997
2000s	2000	2000

Saline discharge sites were field investigated for evidence that may suggest the sites were not always saline. Analysis of recent historic groundwater trends from Victorian and South Australian databases was undertaken to assist in understanding the causes of salinity. The relationship between climate and salinity was assessed to determine the influence climate has upon the annual and longer-term variation of salinity.

RESULTS

Telopea Downs study area

Most saline discharge sites within the Telopea Downs study area are of low severity. Minimal land degradation has occurred and the dominance of salt tolerant species is confined to the break-of-slope. Interestingly, evidence of salinity and/or waterlogging can be clearly defined on all of the airphoto series, dating back to the 1940s. Two sites have been selected as examples of salinity occurrence and trends in the Telopea Downs region. Figure 4 depicts the salinity occurrence north-east of the Telopea Downs Hall, featuring both low and moderate severities. Although the mapped salinity layer (Hocking 1998) is skewed (offset to the west of the site on the images), it represents the boundaries of severity accurately when positioned correctly.

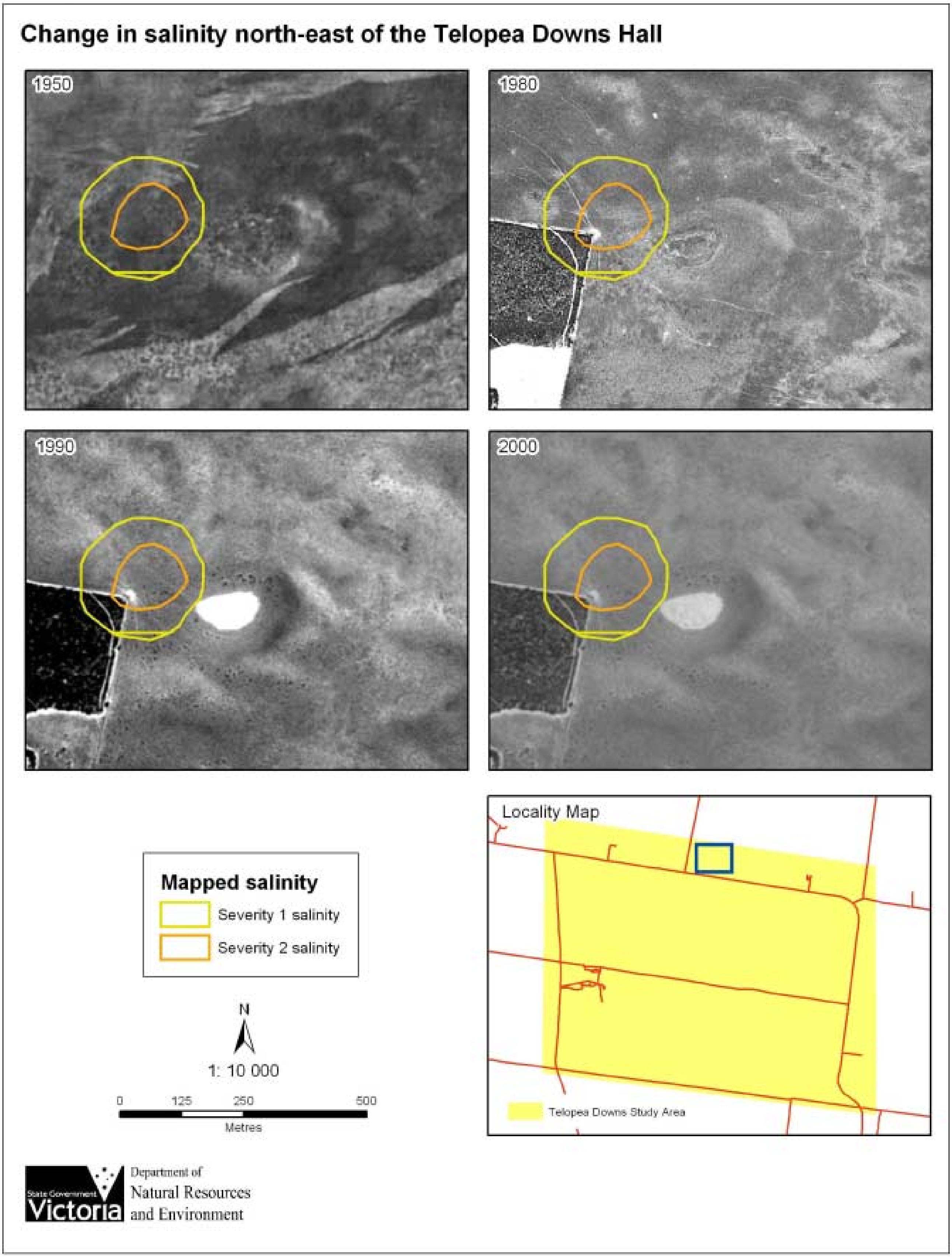

Figure 4 Airphoto series for saline site located north-east of the Telopea Downs Hall (Note: mapped salinity layer is skewed, or offset, to the west of actual salinity site)

The moderate salinity and surrounding halo of low salinity can be clearly defined on all images with the exception of the 1940s airphoto, as the poorer resolution makes the image appear unfocused at this magnification. The extent of the waterlogged halo has appeared to remain constant throughout the 50-year period, although the severity may have increased significantly between 1949 and 1981.

The 1940s airphoto shows evidence of a circular feature most likely representing the present depression. Within this boundary the image appears blotchy which may suggest the presence of tree/vegetation cover. It is inferred that tree cover also exists around this depression, except where the photo appears very pale which is more likely to represent unvegetated sand dunes.

The 1980s photo depicts the cleared form of the study area, however, evidence of salinity is unclear. The 1990 and 2000 airphotos suggest the depression is inundated. The existing moderate and low severity salinity is likely to be also reflected in the 1990-2000 aerial photographs.

Site investigations (during mid to late 2001) revealed that the depression holds water and is surrounded by a perimeter of bare land. Within the depression there is a large number of tree stumps (refer to Plate 4). They appear in situ which complements the evidence in the 1940s airphoto that trees were present within the depression, suggesting the site has not always been saline.

Plate 4 Numerous tree stumps are scattered within the boundary of the current salinity (at the study site north-east of the Telopea Downs Hall), which may suggest that salinity has not always been present

Figure 5 depicts a large elongate saline site and a number of smaller irregular saline sites in the south-east corner of the Telopea Downs study area. The mapped salinity (Hocking 1998) represents the extent of salinity accurately. The 1940s airphoto depicts the area before land clearance although there is a distinct difference in the vegetation cover within the boundary of the presently saline site compared to the surroundings. Aerial extent of this site has remained unchanged throughout the record.

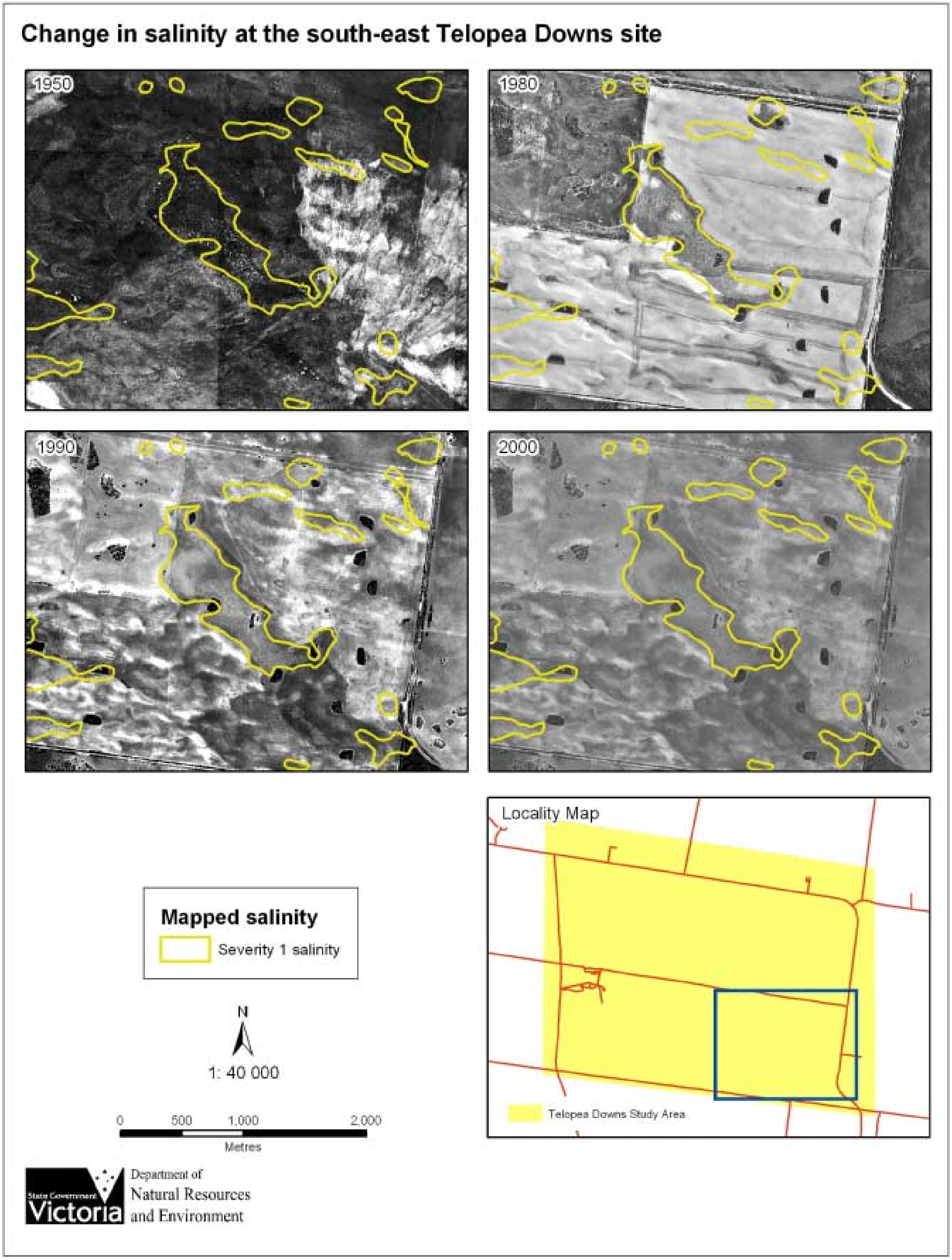

Figure 5 Airphoto series for saline site located in the south-east corner of the Telopea Downs study area

Edenhope study area

Three well-recognised saline sites with ranges of salinity severity were investigated in the Edenhope area (see Figure 6). Polygons created by identifying differing extents of salinity by aerial photograph interpretation suggest salinity was increasing until the 1980s where it appears to peak. Following the 1980s, salinity degradation has appeared to become less severe, and in some places has reduced. The three sites selected for the investigation in the Edenhope area appear to have reasonably consistent results. The resolution of the 1940s aerial photograph did not make it possible to delineate or identify any potential salinity at most sites. In the 1970s the effect of salinity can be seen quite clearly at all three sites. This salinity can be seen to increase in extent and/or severity in the 1980s. By the 1990s the impact of dryland salinity can be seen to reduce significantly in comparison to the preceding decade. A further reduction can be also observed in the year 2000.

The following tables (Tables 2, 3 and 4) show the change in salinity over time at the three sites in the Edenhope area.

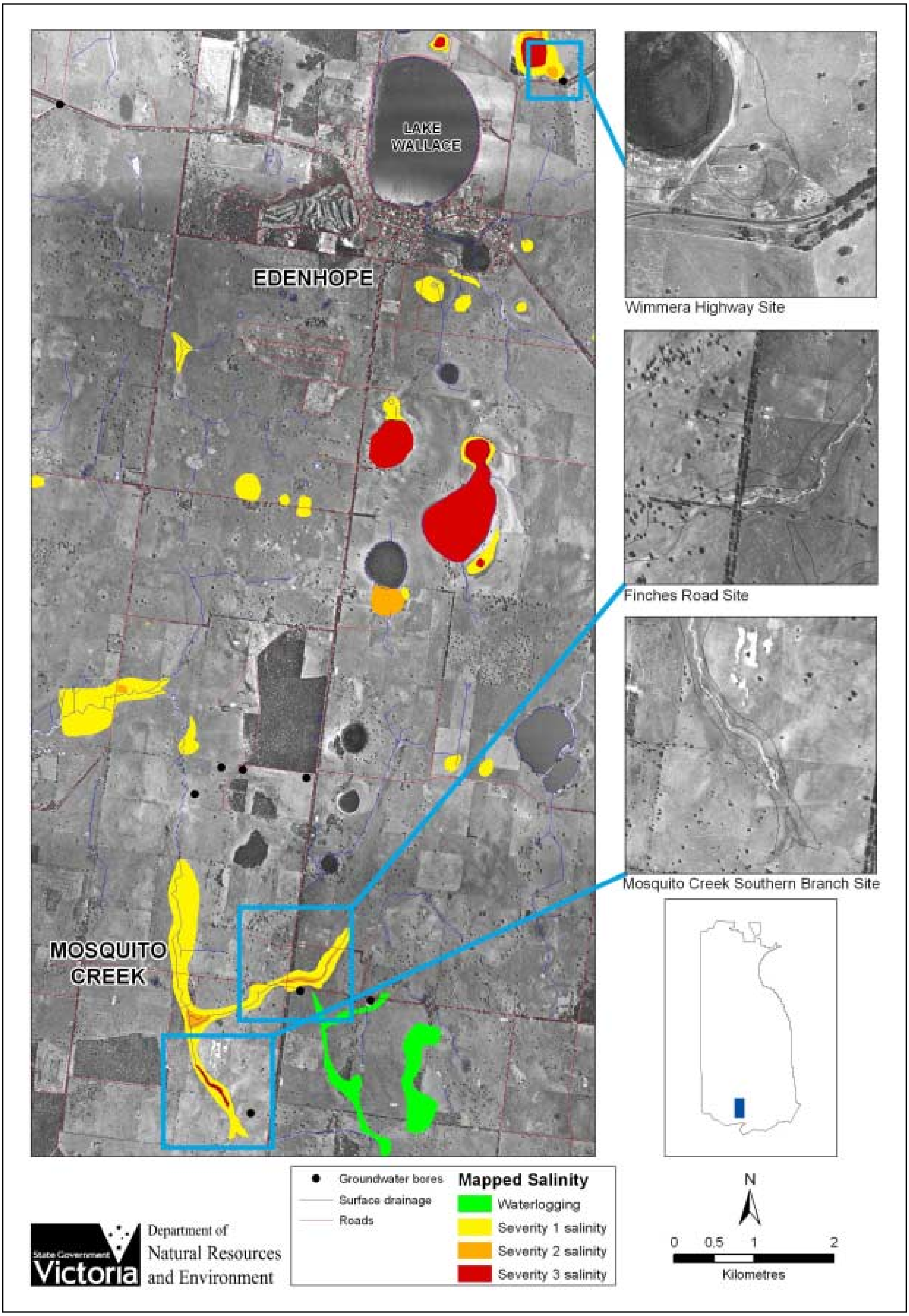

Figure 6 Location of the three sites investigated within the Edenhope study area

Finches Road Site

Table 2 Summary of the change in salinity at the Finches Road saline site

Decade	Presence of salt (✓/?)	Severity (1, 2 or 3)	Area of salt affected land (m^2)	Relative area of change
1940s	?	n.a.d	n.a.d	n.a.d
1970s	✓	2-3	27 145	n.a.d
1980s	✓	3	27 145	0
1990s	✓	n.a.d	n.a.d	↓
2000	✓	n.a.d	n.a.d	↓

n.a.d. = no available data

The salinity observed at Finches Road (see Plate 5) is apparent in the 1970s photographs, and occurs as white strips of bare land adjacent to the northern branch of the Mosquito Creek drainage line. It can be clearly defined and is interpreted to be of moderate – high severity (Class 2-3). During the 1980s, airphoto interpretation suggests the spread of salinity to be minor but with a marked change in the severity. During the early 1980s a revegetation program was implemented to combat the salinity at this site. By the 1990s there was a marked increase in tree/scrub cover surrounding the drainage line. The evidence of salinity appears to have reduced significantly, its extent rarely deviating from the creek. It is evident that the revegetation scheme has been more successful outside the perimeter of defined salinity of previous decades, with growth occurring within this boundary being patchy and stunted (i.e. salt–affected). Similar responses are evident in the most recent airphoto (2000) where vegetation growth is more prominent further away from the creek and the occurrence of salting also appears to have reduced.

Plate 5 Saline site along the Mosquito Creek drainage line, Powers Creek Road

Mosquito Creek-Southern Branch Site

Table 3 Summary of the change in salinity at the Mosquito Creek saline site

Decade	Presence of salt (✓/x/?)	Severity (if known, 1, 2 or 3)	Area of salt-affected land (m^2)	Area of change (m^2) (↑↓)
1940s	?	n.a.d.	n.a.d	n.a.d
1970s	✓	2	18 310	n.a.d
1980s	✓	3	27 995	↑ 9685
1990s	✓	n.a.d	n.a.d	↓
2000	✓	n.a.d	n.a.d	↓

n.a.d. = no available data

This site (Mosquito Creek-Southern Branch) occurs upstream of where the drainage from Finches Road merges with Mosquito Creek. The first occurrence of recognisable salinity (1970s airphoto), appears as two discrete patches, one occurring along the creek and the other abutting the eastern side of the drainage further upstream. By the 1980s salinity has spread significantly and developed all the way along the drainage line. There also appears to be an increase in severity (possibly from Class 2 to 3) and salinisation appears to be developing on the surrounding land. During the 1990s this salt encroachment decreased considerably, retreating back towards the drainage line. The salinity has a significant but not greater extent at the same locations where salt was identified in the 1970s, although is far more prolific along the drainage line compared to the extent 20 years ago. In 2000, the area of salinity is similar, however, the severity of salinity has decreased. The impact on the land surrounding areas of less severe salting appears to have been reduced to the extent where vegetation growth is not limited.

Wimmera Highway Site

Table 4 Summary of the change in salinity at the Wimmera Highway site, east of Edenhope

Decade	Presence of salt (✓/x/?)	Severity (1, 2 or 3)	Area of salt affected land (m^2)	Area of change (m^2) (↑↓)
1940s	?	n.a.d.	n.a.d.	n.a.d.
1970s	✓	1	14 801	n.a.d.
		2	10 853	n.a.d.
1980s	✓	1	38 415	↑ 23 614
		2	11 088	↑ 235
1990s	✓	1	19 334	↓ 19 081
		2	2 731	↓ 8 357
2000	✓	1	19 334	0
		2	2 371	0

n.a.d. = no data available

Situated north-east of Edenhope along the Wimmera Highway, this site shows signs of two types of salinity with differing severity. In the 1970s three saline sites of class 2 severity were identified within a perimeter of lower severity salinity. Small patches of undefinable salinity also appear to occur outside this boundary. In the 1980s the spread of salinity outside the original perimeter increased significantly, retreating again by the 1990s and remained at this reduced extent in the 2000 airphoto.

The photo of the site (see Plate 6) was taken during late summer (February 2002) and does not show any significant visible indicators of salinity. Closer inspection did show that sea barley grass (a low severity salinity indicator species) is quite prolific throughout this area of the crop (see Plate 7). In 1996 a 'Watertable Watch' bore was constructed when large areas of bare land were evident throughout the crop (see Plate 8). Field site investigations throughout mid – late 2001 revealed that the impact of salinity is not as severe as it has been in the past.

Plate 6 Location of the Wimmera Highway saline site

Plate 7 Sea barley grass is significant within the crop at the Wimmera Highway site

Plate 8 The Wimmera Highway site in 1996 when a 'Watertable Watch' bore was installed; note bare patches and occurrence of higher severity salt indicator species (dark patches)

Rainfall trends in the West Wimmera

Historical rainfall data recorded for the Edenhope and Telopea Downs study areas was analysed to assist in the understanding of the relationship between climate and change in salinity.

Edenhope

Rainfall at Edenhope has been monitored since 1969 (see Figure 7). The bar graph represents the deviation of rainfall (residual rainfall) from the long-term average rainfall (approximately 610 mm/yr) recorded at the monitoring station (no. 079011). The line graph shows the cumulative additions of deviations from the average rainfall, allowing a greater insight into the trends occurring due to these climatic variations.

Between 1969 and 1975 an increasing trend of annual rainfall occurred, with the majority of years having above average rainfall. Following this wetter period, rainfall trends reduced until 1982 (which received 390 mm of rainfall) causing a significant drop in the cumulative graph. Above average rainfall prevailed again until 1986, followed by mainly below average rainfall preceding an above average rainfall year in 1992. From 1993 to 2000, all annual rainfall recorded for the Edenhope area has fallen below the average for the monitoring station, resulting in a sharp decline in the cumulative rainfall to -440 mm.

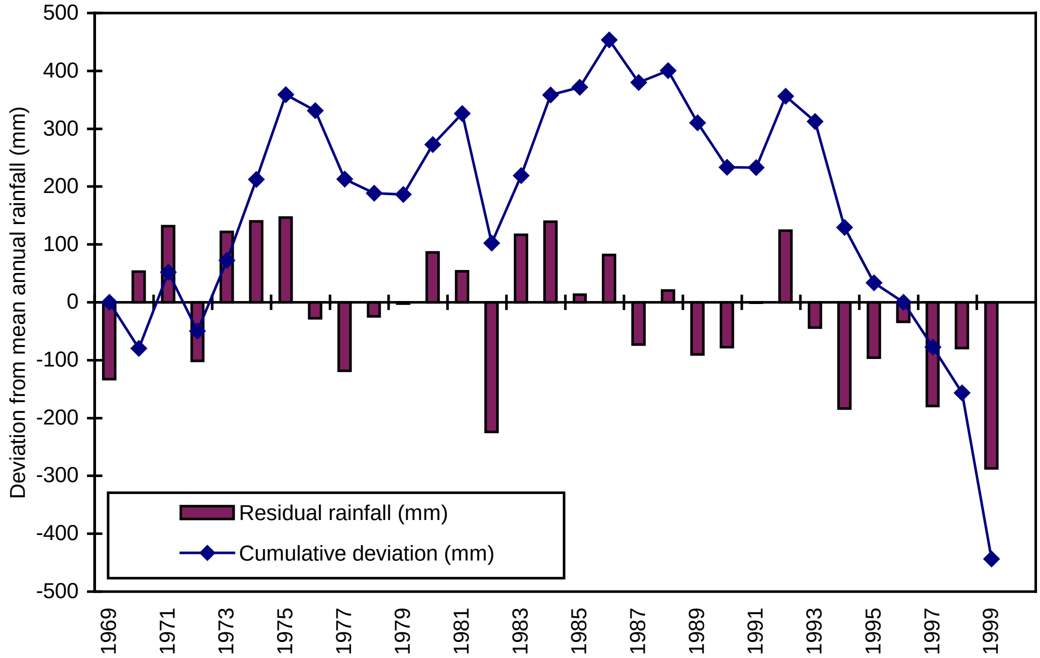

Figure 7 Yearly residual and cumulative rainfall at Edenhope (rainfall station no. 079011), source: Bureau of Meteorology and MetAccess 1998)

Telopea Downs

Rainfall monitoring at Telopea Downs (station no. 077093) (Figure 8) began in 1969, but lapsed in 1992 and has not been monitored since. In order to assess more recent trends, rainfall data from the Kaniva monitoring station (no. 078078) was also analysed.

Rainfall trends recorded in the Telopea Downs region began with an increasing cumulative deviation from 1969-76 followed by more stable conditions. 1982 received lower than average rainfall. Between 1983 and 1987, a period of stable climate existed, after which cumulative rainfall fell due to subsequent years of below average rainfall. Kaniva rainfall trends (see Figure 9) show a falling trend has been sustained.

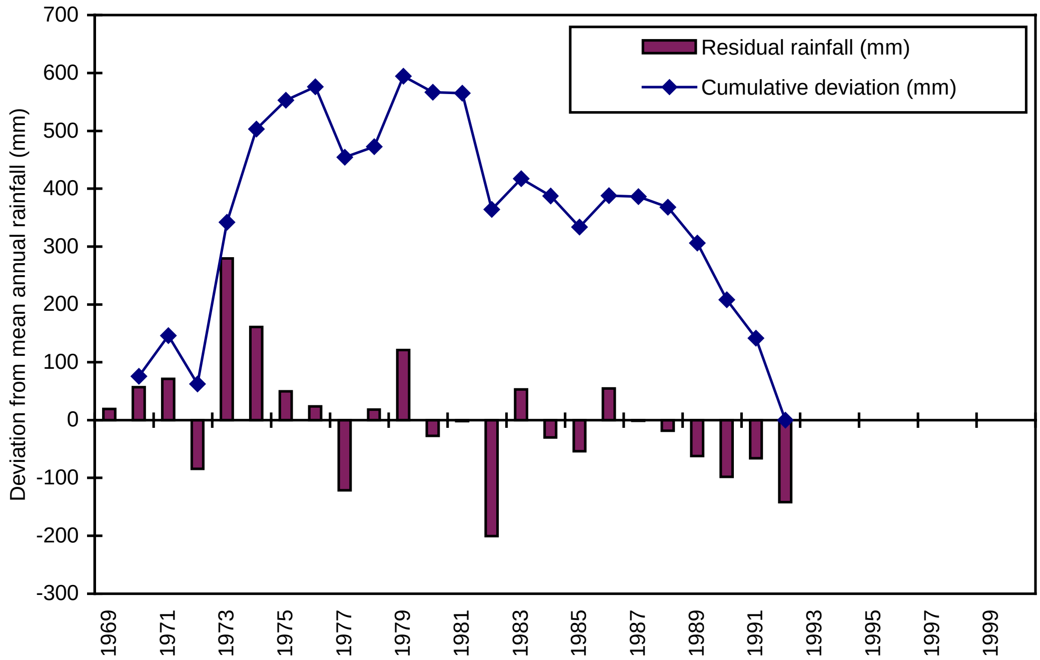

Figure 8 Yearly residual and cumulative rainfall for the Telopea Downs rainfall station (no. 077093), source: MetAccess 1998)

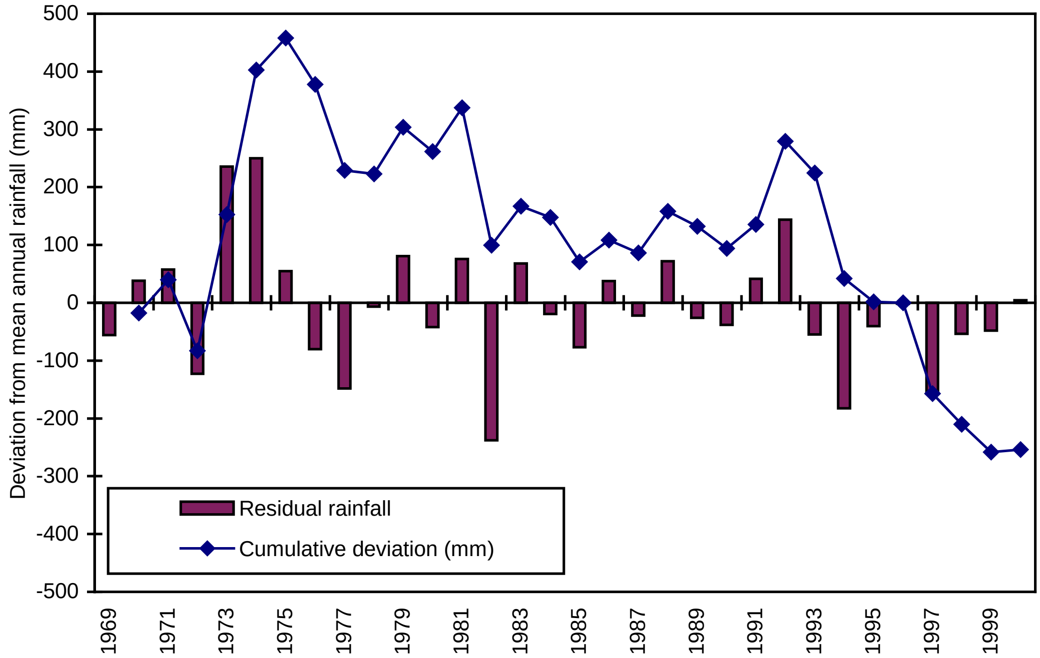

Figure 9 Yearly residual and cumulative rainfall for the Kaniva rainfall station (no. 078078), source: Bureau of Meteorology and MetAccess 1998)

Groundwater trends

Groundwater trends across the West Wimmera were analysed to help understand the causes of salinity in the West Wimmera. Groundwater monitoring data is limited in this region, however there are several bores with 20 to 30 years of monitoring record. Three representative time-series hydrographs for bore nos. 98285, 2355 and JOA13 are presented in this report. Figure 10 shows the location of these monitoring bores.

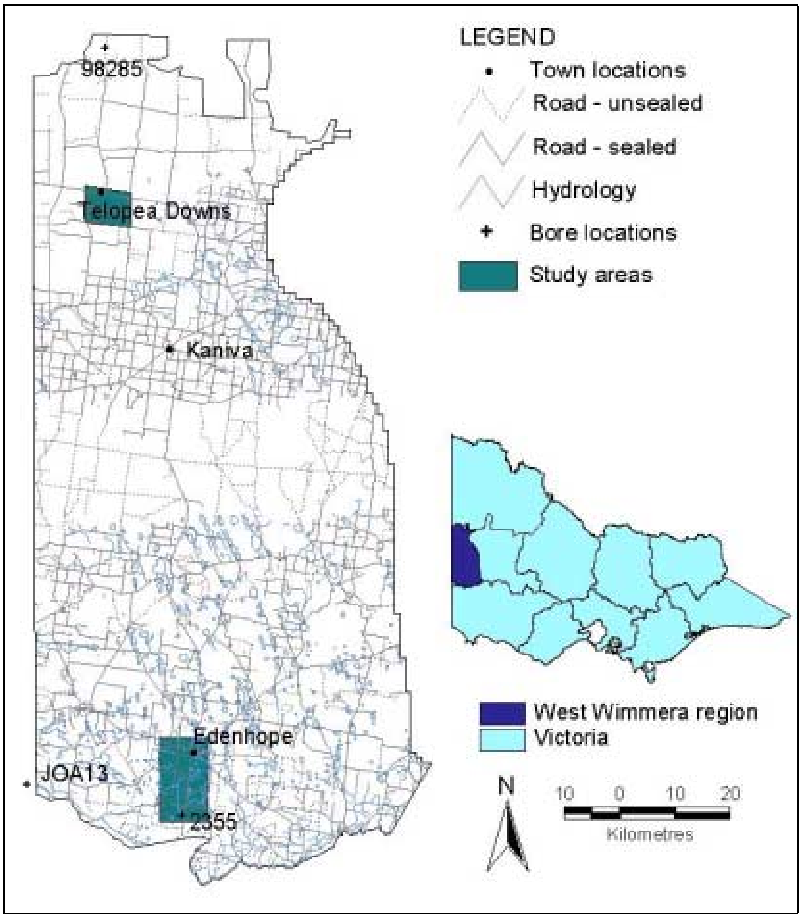

Figure 10 Location map of monitored bores, the data of which was analysed for this report

The hydrograph of bore 98285 (Figure 11) depicts an 11-year record of a shallow groundwater trend in the Telopea Downs region. It can be seen that from 1991–1997, water levels have fluctuated between approximately 1–2 m from surface. A subsequent significant fall occurred during 1997–1998. The current waterlevel is approximately 1.25 m below the initial 1990 water level for this bore.

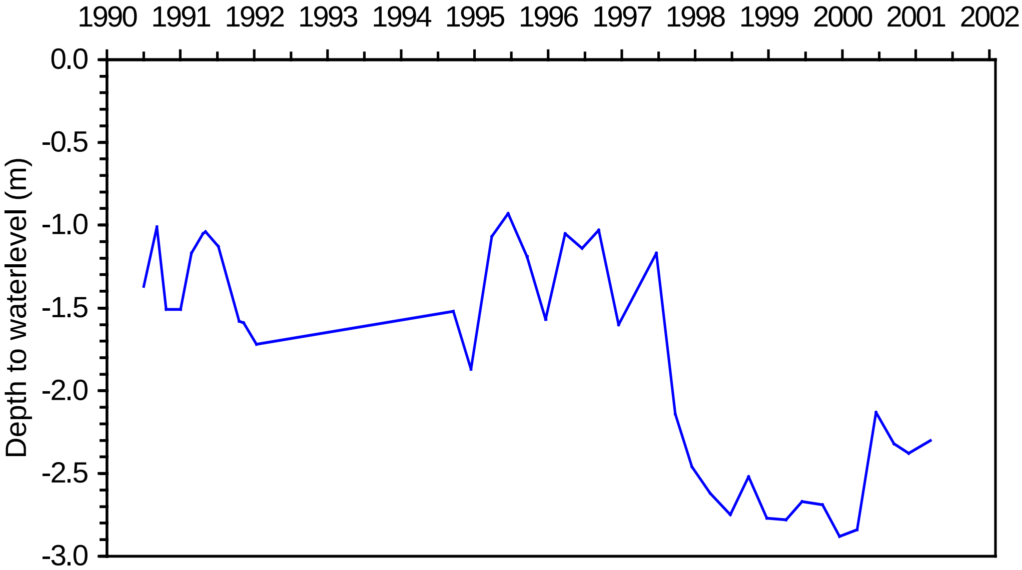

Figure 11 Groundwater level data for bore no. 98285 (Telopea Downs)

Bore 2356 (Figure 12) is located on Finches Road adjacent to the upper reaches of Mosquito Creek. The watertable has remained close to the surface from the beginning of the record in 1982, although a slight reduction in waterlevel is apparent from 1998 onwards. This trend is evident in a number of monitored bores in the Edenhope area.

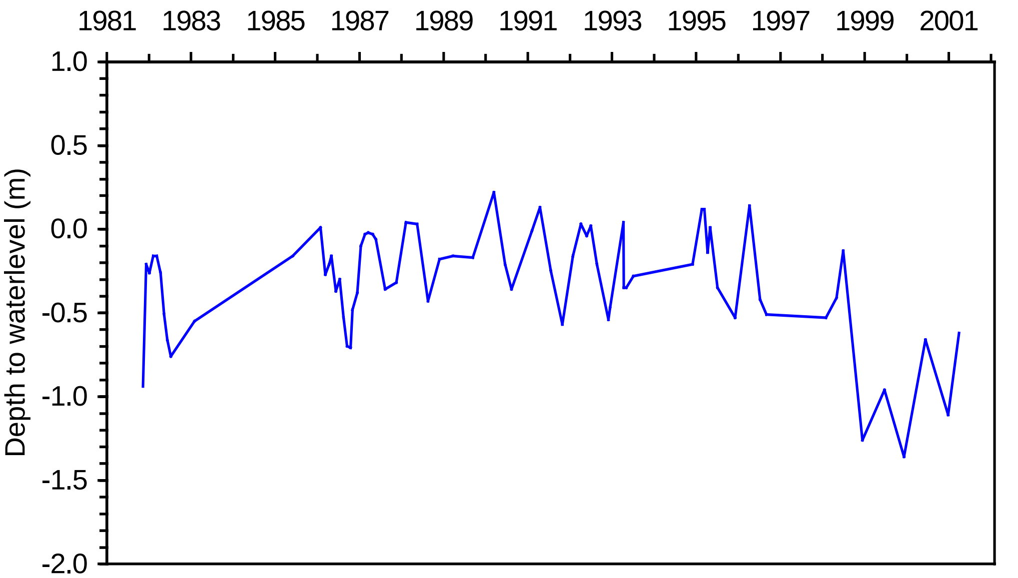

Figure 12 Groundwater level data for bore no. 2356 (Finches Road)

Bore JOA13 occurs further downstream along Mosquito Creek, across the South Australia-Victoria border. Further downstream within the Mosquito Creek catchment, the 11 year record (see Figure 13) shows that water levels have been steadily falling since 1990 (at approximately 11 cm/yr).

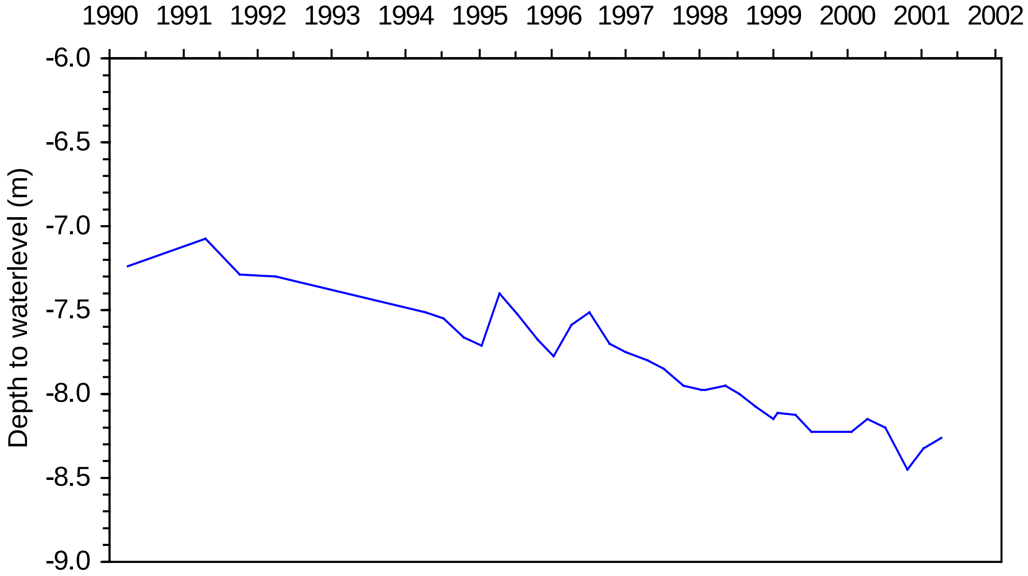

Figure 13 Groundwater level data for bore JOA13 (Joanna-S.A.) (source: Department for Water Resources, South Australia)

DISCUSSION

Limitations

Salinity identification and delineation with airphoto series was possible for most selected sites. Limitations with airphoto interpretation include:

- Differing resolutions can inhibit definition of land cover, especially for the 1940s airphoto series which had a coarse resolution in comparison to the succeeding data series.
- Difficulties during orthorectification led to some areas not having a 1940s airphoto image, as landmarks were difficult to identify on the older photos.
- The time of the year that the photo was taken, as seasonal land use and climatic factors can affect saline indicators making clear identification of salinity difficult (late spring–early summer is regarded as the preferred time for identification).
- Difficulties in discriminating between waterlogging and salinity.
- Low severity salinity was indefinable at some saline sites.

These factors, or a combination thereof, may influence results interpreted from aerial photographs. Where possible, groundwater level data and climatic data were analysed to test the validity of visual interpretations.

A limited search of historic salinity information did not reveal any early identification or record of salinity. Further research was outside the scope of this study. Investigations into human-induced salinity and the first appearance of salinity in the West Wimmera were thus restricted.

Telopea Downs

The majority of salinity in the Telopea Downs area is dominated by low severity land degradation and is located below the break-of-slope. This suggests that local groundwater processes dominate, with recharge across the sandy soils occurring relatively rapidly and accumulating in lower parts of the landscape. Shallow, unconfined sand aquifers are also less likely to have thick capillary fringes compared to similar aquifers of lower permeability (for example, clay aquifers). Upward pressure is therefore minimal, reducing the risk to land lying above. When rainfall infiltrates and flushes any existing salt from the profile, the rapid drainage of the sandy soils may still allow uninhibited plant growth.

The change in extent of salinity appears negligible when analysing airphoto images of the past 50 years. This is most likely due to the restriction of break-of-slope salinity to the lower parts of the landscape. High evaporation rates may also limit expansion onto undegraded land.

Present climatic conditions of below average rainfall may be reducing the visual impact of salt in the landscape. Salinity degradation due to local groundwater processes are likely to intensify during wetter periods, where there is a greater accumulation of water in the landscape.

The site close to the Telopea Downs Hall is the only mapped site that has evidence of moderate salinity. Assuming the occurrence of tree stumps at this site is in situ, tree growth would suggest that this site has not always been saline. It is likely that this site is underlain by an iron hardpan, possibly close to the surface, that is inhibiting deeper drainage. Development of this hardpan layer is likely due to water accumulation in these low-lying areas. This may be of concern for other areas where break-of-slope salinity is occurring, as it could lead to more serious degradation of these sites.

The increasing use of clay spreading in the region to increase the land productivity of these sandy sites will increase plant water use and may impinge on water movement to lower landscape positions, inadvertently reducing the risk of salinity.

Edenhope

Salinity occurrence in the Edenhope area is more diverse than in the Telopea Downs region. Mapped salinity shows that the severity of the salting ranges from high – low throughout the area. The results from all three sites assessed in this report show that there is a strong correlation between land use, climate and salinity. Salinity is seen to increase not only in extent, but also in severity, from the 1970s to the 1980s, reflecting the wetter climate that prevailed during these decades. With the onset of the drier climate of the past 10 years, a marked decrease in the impact of visible salinity from airphoto images is observed.

Analysis of the 1940s aerial photograph was mostly unsuccessful in the area as the poorer resolution did not permit detection or delineation of salinity. Low severity salinity was also difficult to identify on all of the airphoto series, making the results very biased towards salinity of higher severity.

Groundwater flow out of the Mosquito Creek Catchment has been steadily decreasing since the 1990s, most likely a response to climatic change. Not all groundwater trends correlate to climate in the Edenhope area, as groundwater levels are still rising at an alarming rate in the vicinity of Lake Wallace. Land salinisation as a result of the rising watertable is not yet evident within this area.

CONCLUSION

Based on aerial photograph interpretation (and field checking), it is concluded that there has been a visible change in severity and/or extent of land salinisation at both Telopea Downs and Edenhope. Aerial photograph interpretation at Edenhope sites revealed that salinity increased and peaked in the 1980s, and has reduced in extent and/or severity since. This trend is largely reflective of climate variation. At Telopea Downs, evidence from airphoto interpretation and field investigations strongly suggest that currently saline sites had pre-existing tree cover, thus salinity and waterlogging must not have been as prevalent before land clearance in the 1950s.

Although these observations imply that salinity has effectively reduced, either in severity or extent across the West Wimmera, it is most likely a consequence of the current drier climate. The risk to land still exists, as salinity could increase again during another wetter period. Implementing a pro-active approach to salinity problems by identifying high recharge areas and rehabilitating and revegetating where necessary with deep rooted perennials, may prevent the return of worsening conditions.

RECOMMENDATIONS

The following recommendations are made based on the information presented above:

- Conduct a landholder survey to investigate local knowledge regarding the first appearance of salinity, in order to attempt to identify primary and secondary saline sites.

- Conduct a detailed research of historic records, such as land lease papers, parish plans and files, to investigate written documentation of early salinity observations.

- Tree planting with appropriate native species above the break-of-slope at salt-affected areas, so as to intercept surface and sub-surface water flow to low-lying areas.

- Tree planting with appropriate native species along drainage lines to reduce the impacts of both salt and erosion.

- Conduct a detailed study of the hydrogeological processes impacting on Lake Wallace, Edenhope.

- Determination of the extent of the local perched aquifers at Telopea Downs.

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REFERENCES

Barr, N. & Cary, J. (1992) Greening a brown land: the Australian search for sustainable land use. MacMillan Education Australia.

Blake, L. (1981) Tattyara: a history of Kaniva District. Shire of Kaniva. Unpublished report.

Bozon, J. & Matters, J. (1995) Spotting soil salinity. A Victorian field guide to salt indicator plants. Department of Conservation and Natural Resources Victoria.

Fergusson, J. (1984) Bush battalion: the AMP Society's Ninety Mile Desert development in South Australia. AMP Society: Adelaide.

Hocking, M. (1999) Depth to watertable map of the Edenhope area. Map sheet only. Centre for Land Protection Research, Department of Natural Resources and Environment, Victoria.

Hocking, M. (1998) Salinity in the West Wimmera. Technical Report No. 46. Centre for Land Protection Research, Department of Natural Resources and Environment, Victoria.

Hocking, M. (1997) Groundwater drilling in the Millicent Coast for the Wimmera Salinity Management Plan – 1996/7. Folio Report No. 1997/17. Centre for Land Protection Research, Department of Natural Resources and Environment, Victoria. Unpublished Report.

Hocking, M. (1996) Groundwater trends in the Wimmera: 1995/6. Monitoring Report No. 11. Centre for Land Protection Research, Department of Natural Resources and Environment, Victoria.

Hocking, M. (1995) Stream EC surveys of the Mosquito Creek Catchment – 1995. Monitoring Report No. 8. Centre for Land Protection Research, Department of Conservation and Natural Resources, Victoria.

LCC 1979 Report on the South-western area, district 2. Land Conservation Council, Victoria.

LCC 1996 Historic places, special investigation, South-western Victoria descriptive report. Land Conservation Council, Victoria.

Luke, G. and Hocking, M. (2000a) Hydrogeological assessment of salinity processes in the Telopea Downs region. Technical Report No. 68. Centre for Land Protection Research, Department of Natural Resources and Environment, Victoria.

Luke, G. and Hocking, M. (2000b) Dryland salinity control options in the West Wimmera. Technical Report No. 69. Centre for Land Protection Research, Department of Natural Resources and Environment, Victoria.

MetAccess, (1998) Analysing weather records. CSIRO Australia. (Post 1998 data supplied by the Bureau of Meteorology)

Mintern, C. and Hocking, M. (2001) Distribution of gross recharge across the west Wimmera. Technical Report No. 79. Centre for Land Protection Research, Department of Natural Resources and Environment, Victoria.

Muller, B. J. and Hocking, M. (2002) Shallow groundwater trends for the West Wimmera. Monitoring Report No. 46. Centre for Land Protection Research, Department of Natural Resources and Environment, Victoria.

Nathan, E. (1998) Dundas landscapes and Dryland salinity. M. App. Sci. thesis, University of Ballarat (unpublished).

Strudwick, D. (1992) The historical development of saline groundwater discharge in the Lower Wimmera River Catchment, Victoria. Technical Report No. 2. Centre for Land Protection Research, Department of Conservation and Natural Resources, Victoria.