Department of Conservation and Land Management (1993)

"Glenlee"

Dryland Salinity : Site Report
for piezometers located on "Glenlee"
Dick's Creek catchment, Yass N.S.W

by Cathy Nicoll

Yass Salinity Abatement Demonstration

FORWARD

Funding from the National Afforestation Program and the Natural Resources Management Strategy have enabled dryland salinity processes to be investigated in the Dick's Creek and William's Creek areas. This series of reports was prepared with the aim of simply collating the groundwater and soils data collected by staff funded by these programs over the past four years. A secondary aim is the provision of a very brief interpretation for landholders and departmental staff.

The author wishes to thank the following people for their invaluable contributions towards the data collection and interpretation in this report.

David Cosgrove	for collecting most of the groundwater and soils data contained in this report.
Lyn Polsen	for assistance with data entry.
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John Scown Keith Emery	for the land attribute mapping
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Ian Packer Jim Armstrong John Scown Bob Britten	for constructive criticism of the content and style of this report during its preparation.

Cathy Nicoll (1993)

Contents

Section 1

Site Summary

A Summary and Interpretation of Land and Groundwater Data

SITE SUMMARY: "Glenlee", Dick's Creek

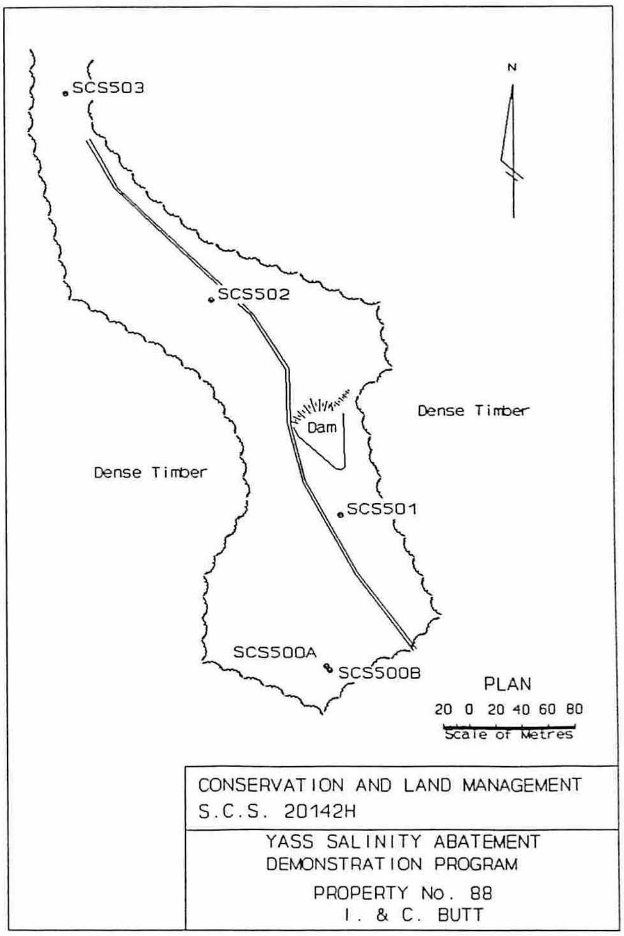


Figure A. Map showing location of bores.

Reason(s) for piezometer installation:

Monitor an unmodified, forested, potentially saline subcatchment.

Catchment Description:

Sideslopes and ridgetop are forested. The valley floor has a 3% slope, is cleared and is prone to surface waterlogging in winter.

Geology:

Ordovician metasediments.

Soils:

Red podzolics on sideslopes, with lithosols on steeper slopes and ridgetop. Soloths/solodics, derived from depositional material, on valley floor.

Landscape Situation:

The piezometers are located in a transect which begins at the top of the cleared part of a valley floor (SCS500A) and ends at the outlet of the subcatchment (SCS503). All piezometers monitor the groundwater in the soloth/solodic soils. There is no surface evidence for soil salinity.

DATA SUMMERY AND INTERPRETATION

Groundwater Data: (see Section 3 for data)

SCS500A and SCS502 contain water only during periods of high rainfall in winter, when the groundwater level can be within two metres of the surface. The rate and degree of groundwater increase (and decline) in these two bores indicates that these soils are well drained (high permeability) or that their capacity to store water (low porosity) is very low, or a combination of both.

None of the other bores ever contain water, including SCS500B, which is deeper than SCS500A and adjacent to it. While this may be a result of low porosity soils at depth, it also indicates that the shallow groundwater does not penetrate to any great depth at that site and that the deeper bedrock groundwater system is not interacting with the shallow system in any way. So at the surface, soils are freely draining and groundwater flow is downwards. However, all the recharge to the shallow groundwater system is either removed by lateral drainage, or it is removed by evapotranspiration. There is no evidence for deep, vertical drainage from the shallow groundwater system to the deep one.

The EC of the groundwaters is always less than 0.4 dS/m (non-saline) when measured, but this may reflect the fact that the groundwater is sampled only when it is diluted by the winter recharge.

Soil Sample Data: (see Section 4 for data)

The EC (1:5) ranges from 0 to 0.05 dS/m at the surface to 0.1 dS/m at depth, except for the soils taken from SCS503 for which the EC reaches 0.33 dS/m at 5 m depth.

The soils have an alkaline pH trend, increasing in pH from 6.0 at the surface to 8.0 to 8.5 at 2.0 to 3.0 m depth, then remaining at that pH to the depth of investigation.

EM-34 Results: (see Section 5 for data)

EM values range from 7 mS/m on the rocky ridges to 25 mS/m on the soloth/solodic soils on the valley floor. Once the EM value exceeds 10 dS/m, the presence of dust deposits in the landscape can be concluded (see Section 2 for further explanation).

Interpretation:

The high level of afforestation in this catchment, the presence of the soloth/solodic soils and the presence of the dust deposits indicate that the results obtained here approximate those of a potentially saline unmodified catchment. Significant characteristics of this catchment are the seasonal waterlogging in the valley floor (which may not occur if the valley floor was forested) and the accompanying large range in groundwater levels in shallow bores, indicative of low porosity and possibly high permeability soils in the surface layers.

The separation of the deep and shallow groundwater systems is indicated by the failure of the deeper bores to ever contain water. This may be a result of extremely low porosity and low permeability material at depth which is acting as a confining layer on the deep groundwater system. Alternatively, the high degree of afforestation in the catchment may be maintaining a low recharge regime so that the deeper groundwater system is not under sufficient pressure to penetrate the highly consolidated dust deposits in this valley. Installation of a bore into the bedrock and some soil porosity and permeability tests are necessary to aquire further information to determine which interpretation is the most accurate.

In the absence of the above information, it can only be suggested that this subcatchment should remain uncleared due to the presence of the dust deposits, which are currently thought to predispose a site to dryland salinisation.

Section 2

Dryland Salinity

An Explanation of Dryland Salinity in the Yass Valley

DRYLAND SALTING PROCESSES

Dryland salinity is a form of land degradation whereby rising groundwater levels cause salts to accumulate at the soil surface. This can lead to declining plant growth and to changes in the composition of a plant community as some plant species are more sensitive to salts. In extreme cases the areas become bare of vegetation and are prone to erosion. As well as killing vegetation, the salts enter the streams and rivers through rainfall runoff and through the groundwater system. This can devastate the ecology of a river and it reduces the quality of the water for domestic, industrial and agricultural purposes.

1. CAUSES OF DRYLAND SALINITY

Dryland salinity is caused by a combination of two factors: high groundwater levels and a source of salt.

1.1 High Groundwater Levels

Groundwater in the Yass Valley is contained in the fractures in the bedrock and in the soil and weathered rock (Figure A).

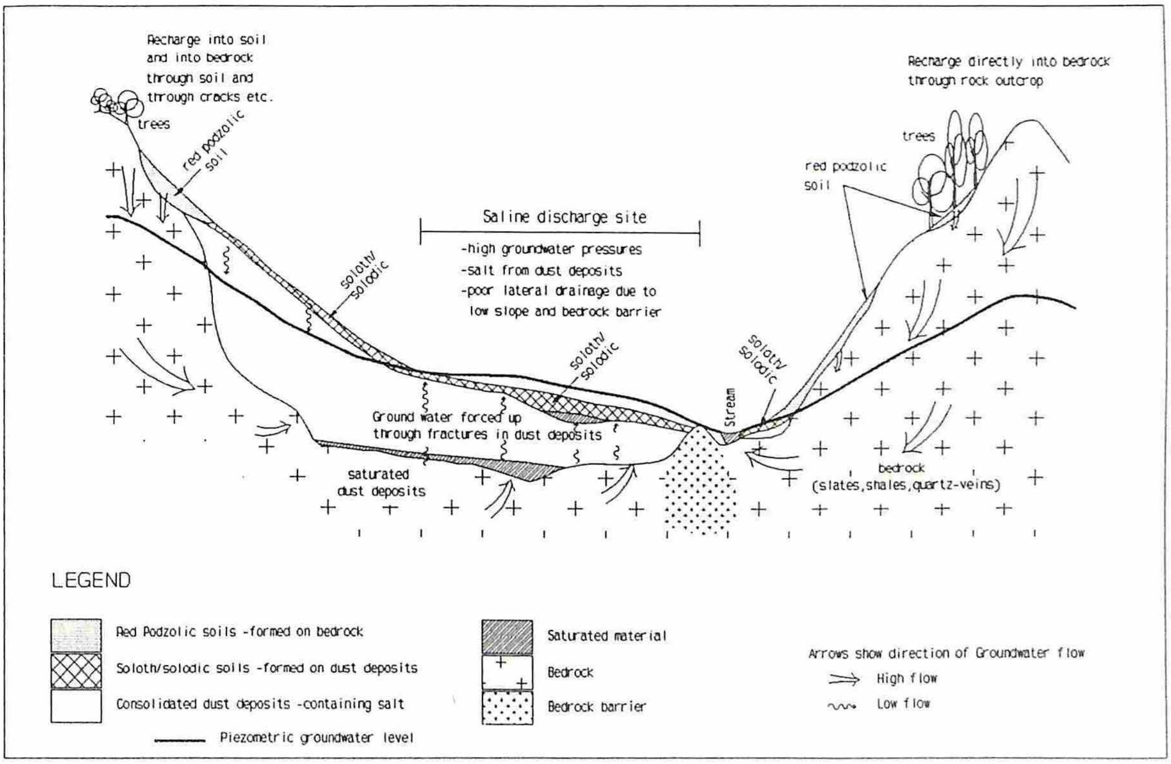


Figure A Salinisation processes in the Yass Valley.

Groundwater levels are influenced by the amount of water which enters the groundwater system (recharge) and the amount of water which leaves the groundwater system (discharge). In catchments where recharge and discharge are balanced there will be no long term net change in groundwater level.

(i) Variation Across Catchments

Both recharge and discharge can vary dramatically from one part of a catchment to another. The rate of recharge tends to be higher where soils are shallow or stony and where water can drain freely through the soil into the groundwater. Recharge, then, will be highest where there are fractures in exposed bedrock or old root channels which allow rainwater to bypass the soil profile to flow directly to the groundwater system. Where there is a heavy clay subsoil or some other impervious layer, recharge rates can be greatly reduced.

Discharge rates are highest where the groundwater system intersects the ground surface. This occurs naturally in watercourses and is the reason streams keep flowing through dry months of the year. Discharge is then determined by the amount of ground intersected by the groundwater system, the local permeability of the groundwater system and the groundwater pressure. A site where the area of ground intersected by the groundwater system is large and for which the permeability and groundwater pressure are high will experience high discharge. Conversely, a site for which the area of intersection is small, and for which the permeability and groundwater pressure are both low will experience low discharge.

Discharge can also be limited by other local site factors. A small catchment outlet in relation to the rest of the catchment can cause groundwater pressures to back up behind the catchment outlet, as if it were a dam, thereby reducing discharge. Other factors, such as high amounts of clay in the soils, and the presence of impermeable bands of rock or geological faults, can have the same effect.

Groundwater levels are highest in catchments for which recharge is high and discharge is low. In catchments modified by clearing, for example, recharge is greatly increased as there are fewer deep rooted trees to intercept and evaporate rainwater, allowing more rainfall to reach the groundsurface. The replacement pasture or crops generally have a much shallower root system than any of the original native plants (trees, shrubs or even native pastures) and so use less water from the soil profile. The consequence of this is that the soil is generally wetter and as the root zone from which plants can draw water is shallower, more water can get past the root zone into the groundwater system. In fact, recharge is increased by any land management practice which reduces the amount of vegetative cover, such as overgrazing or long fallow periods in cropping systems.

(i) Seasonal Variation

The amount of recharge can vary dramatically according to season. Recharge in the Yass Valley increases in winter due to both a lower evaporation rate and a higher amount of rainfall during winter. There is, therefore, not only more rainfall during winter, but it is more effective (i.e. more rainfall reaches the groundwater system). In summer, the hotter weather causes an increase in evaporation rates, so the trees and pastures use more water, the soil is dried out more, and a larger proportion of any rainfall is evaporated. These factors can cause summer recharge to decline to almost zero in some areas.

The amount of discharge is generally not seasonally dependent as it is determined more by the site specific factors described above. However, discharge is ultimately driven by recharge, as this determines the amount of groundwater available for discharge. There is more groundwater in the system during winter as a result of higher recharge, and this leads to an increase in groundwater levels. This can cause the area of ground intersected by the groundwater system to increase so that discharge can be greater in these months than in summer when groundwater levels are generally lower. The higher evaporation rates during summer appear to have little effect on discharge rates as there is a limit to how deep the effect of evaporation will go.

In catchments which have not been modified by clearing, groundwater levels can fluctuate seasonally by 2 m to 5 m or even more (Figure B). Groundwater levels are typically higher during winter, when recharge exceeds discharge, and they are lower in summer when recharge is much reduced (to almost nothing) and is much less than discharge.

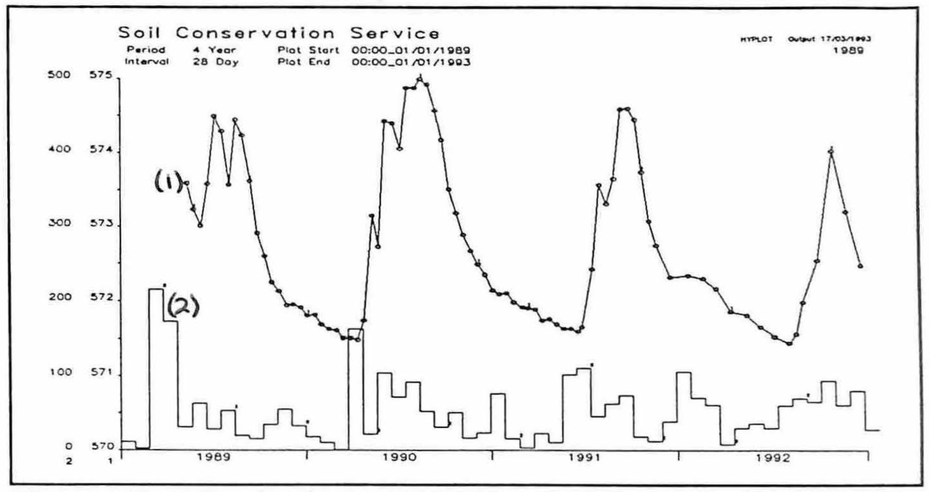


Figure B. Typical groundwater level variation(1) for an uncleared catchment (in m above sea level). Monthly rainfall is marked as (2).

This general seasonal pattern can vary markedly, as demonstrated by the groundwater levels in Figure B. Groundwater levels were highest in 1990, when 56% of the annual rainfall occurred in late autumn to early spring: the coldest months in the Yass area. In 1992, groundwater levels were much lower than in 1990 even though the annual rainfall total was higher in 1992 than in 1990. Only 36% of the annual rainfall for 1992 occurred in the coldest months. This left the majority of the rainfall for the warmer months, when recharge rates are much lower due to evaporation. This demonstrates that recharge rates can be more dependent on the amount of seasonal rainfall than on the amount of annual rainfall.

(iii) Consequences of High Groundwater Levels

When recharge rates in a catchment have been increased by activities such as clearing, and have remained high for a long enough period, groundwater levels increase throughout the catchment. High groundwater levels are evident first as areas subject to seasonal waterlogging, which are in relatively low points in the landscape, such as in valley floors. Also present may be a landscape feature, such as a narrowing of the catchment outlet or an impermeable band of rock, which constrains water flow in some way. Groundwater is discharging at these points, and although the rate of discharge may increase marginally, it may not be sufficient to keep pace with the increased recharge rate. Groundwater levels in these cases will keep increasing and the area affected by waterlogging may increase and become perennially waterlogged.

Waterlogging due to high groundwater levels can generally be seen once the groundwater level is within 2 m of groundlevel, as water from the watertable can then move upward to the surface through capillary action. The amount of seasonal variation of the groundwater level is then severely reduced, and if groundwater levels keep increasing to above groundlevel so they become artesian, then the amount of seasonal variation can be as small as only a few centimetres (Figure C).

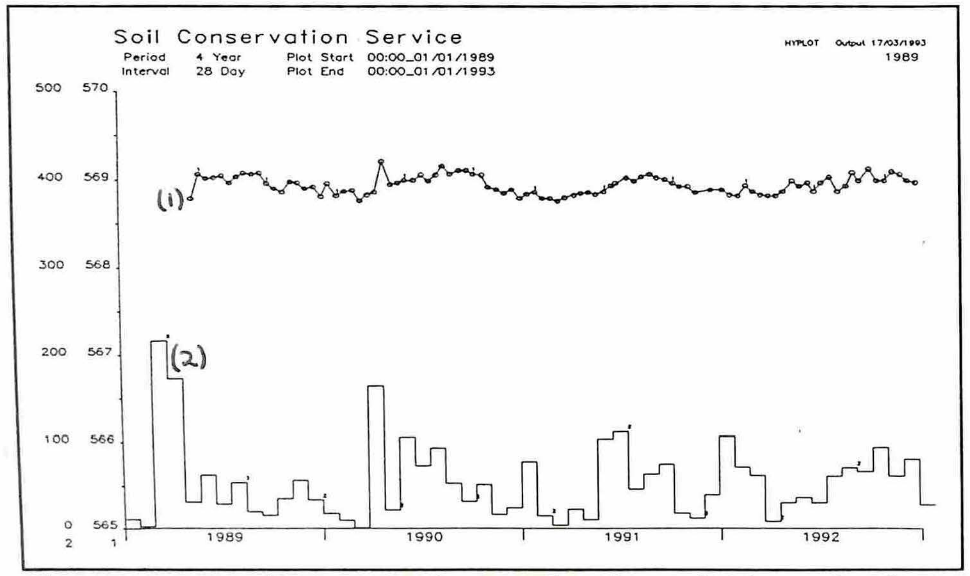


Figure C. Typical groundwater level variation (1) for a piezometer with artesian groundwater levels on a saline discharge site.

Once groundwater levels are this high, management solutions aimed at reducing waterlogging will either be directed at:

- reducing recharge, by establishing treelots or deep rooted perennial pastures for example; or
- increasing discharge, by removing groundwater from the discharge site, thereby lowering the groundwater pressure and the area of land intersected by the groundwater system at that site.

1.2 A SOURCE OF SALT

The second major factor necessary for dryland salinity to develop is a source of salt in the catchment. Where there is no significant source of salt in the soil or rock there may be no salinity problem, but there can be a waterlogging problem if groundwater levels are high. Where there is a salt source the salts can be mobilised by the upwards movement (or discharge) of groundwater. When the water containing the salt reaches the surface, the water evaporates and leaves the salts behind. These salts accumulate and reduce plant growth, eventually killing the plants.

The salt source in the Yass Salinity Abatement Demonstration Area is found in extensive deposits of silty clay. This clay was transported by wind (as salt-laden dust) from Inland Australia in the last Ice Age and was deposited over the entire landscape. The onset of wet climatic conditions at the end of the Ice Age would have caused the deposited dust to be washed down existing drainage lines, collecting any bedrock fragments encountered in its path, (accounting for the gravel included in the clay deposits), to accumulate at constrictions in the landscape and at natural low points, such as on footslopes and in drainage lines. These dust deposits have settled into a very consolidated mass containing large amounts of salt and through which water moves very slowly (Figure A).

The soils which develop on these dust deposits are called soloths or solodics. The topsoil (A horizon) of these soils consist of a thin, acidic organic layer which is underlain by a pale, sandier layer (bleached A_2 horizon). The subsoil (B horizon) is several metres thick. It is a yellow dispersible mixture of clay and silt and is generally quite alkaline (pH of 8.0 to 9.0).

If groundwater levels become high the extent of these dust deposits defines the maximum likely extent to which salinity can extend at any particular site. Often this limit will not be reached due to other factors, such as slope. When the slope exceeds 5%, it is considered that the surface and near surface drainage will be sufficient to carry away excess water.

In addition to providing a source of salt the dust deposits have a significant effect on groundwater flow. Because water movement through this material is so slow, the deep groundwater contained in the bedrock is kept under pressure and it is effectively separated from water moving through the shallow topsoil layers.

The consequences of this is that as recharge to the groundwater system increases, the deep groundwater pressure builds up until it can force its way through cracks and old root channels in the dust deposits, collecting salt on the way to the surface. It also means that parts of the dust deposit are permanently saturated, so that salts can be dissolved into the groundwater and then brought to the surface. In addition to that, the groundwater contained in the topsoil layers cannot drain downwards at all, due to the pressure from the groundwater moving upwards from below. As a result, the shallow groundwater can only leave the site by draining laterally into erosion gullies or streams. Otherwise, where lateral drainage is poor and slopes are less than 5%, the shallow groundwater remains onsite and slowly evaporates. This causes prolonged waterlogging and salinity to increase.

2. PREDICTING THE OCCURRENCE OF SALINITY

In the Yass district dryland salinity has developed in catchments where groundwater levels have risen due to recharge being increased by clearing of native trees and pastures. The specific site which becomes saline is located where the soil is of the soloth/solodic type. There is also often some impediment to groundwater flow such as a narrow valley outlet, or a sudden rise in the level of the top of the bedrock, so that it is closer to the surface and acts like an underground dam wall, possibly forcing water to discharge on the uphill side (Figure A). These bedrock dams may also have acted as a retaining wall when the dust material was deposited and so prevented it from eroding away.

The dust deposits on which the soloth/solodic soils form are so extensive that they can be found under many footslopes of a slope less than 5% and in many drainage depressions. The salinity potential of a site can therefore be determined by examining the soil in those lower parts of the landscape. However, since being deposited, some of the dust deposits in the valleys have been eroded out and replaced with richer, alluvial material which is not considered to present a salinity risk due to both the lower salt content and the freer drainage. This complicates the interpretation of the landscape.

Other ways of locating the limits of the saline dust deposits are by soil surveys and analysis and by the use of field instruments such as electromagnetic equipment which give an indication of the relative amounts of salt and clay present in the soil profile. These tools can be used in association with groundwater data and landscape information to determine the presence of high groundwater levels, saline dust deposits and hence potential salinity problems.

Acknowledgements

Much of the research necessary to determine the mechanisms described in this section was done by staff from the Department of Conservation and Land Management, Dr. I. Acworth and students of the University of N.S.W. and J. Bradd, J. Turner and D. Waite from the Australian Nuclear Science Technology Organisation.

Section 3

Groundwater Graphs

Groundwater Level, pH and and Electrical Conductivity

EXPLANATORY NOTES

This section presents groundwater data from the piezometers on this site. There are three graphs for each piezometer:

A. Groundwater level (1), in m above sea level, for SCS...

B. Electrical Conductivity (dS/m) of groundwaters (1) for SCS...

C. pH (1) of groundwaters for SCS...

The (1) in each of these captions refers the reader to the correct line on the graph. This enables the piezometer data to be clearly distinguished from the total monthly rainfall data, which are shown as (2) on each of the graphs.

The groundwater level is given in metres above sea level as this is the Australian standard reference. The depth below ground level can be easily calculated by looking up the groundlevel (given in the subsection titled "Piezometer Data") for the piezometer in question and comparing it to the waterlevels on the graph. Further comment on this is provided in the Notes about the Graphs. If the other site factors are present (see Section 2 for further details) then groundwater levels within 2 m of groundlevel are considered to be capable of inducing dryland salinity.

The Electrical Conductivity (or EC) is a measure of the total concentration of salt present in the groundwater, and so can indicate the groundwater salinity. A higher number means the water is more saline. The salinity classes in general use are described below.

Less than 0.5 dS/m	Fresh water	Suitable for drinking
0.5 to 1.0 dS/m	Marginal water	
1.0 to 3.0 dS/m	Brackish water	Unsuitable for drinking
more than 3.0 dS/m	Saline water	
50.0 dS/m	Sea water	

EC gives no indication of the type of salt present. This must be determined by separate tests.

The pH is a measure of the acidity or alkalinity of the groundwater. Any value less than pH 7.0 is acidic. Any value greater than pH 7.0 is alkaline. The optimum range for human consumption is pH 6.0 to pH 8.5

GROUNDWATER GRAPHS FOR SCS500A

Refer to Figures A to C on the facing page.

Piezometer Data:

Depth to bottom of piezometer:	2.4 m
Screen:	1.4 m to 2.4 m below groundlevel
Groundlevel (altitude):	728.34 m above sea level
Situation:	Drainage depression (2% - 5% slope)

Notes About the Graphs:

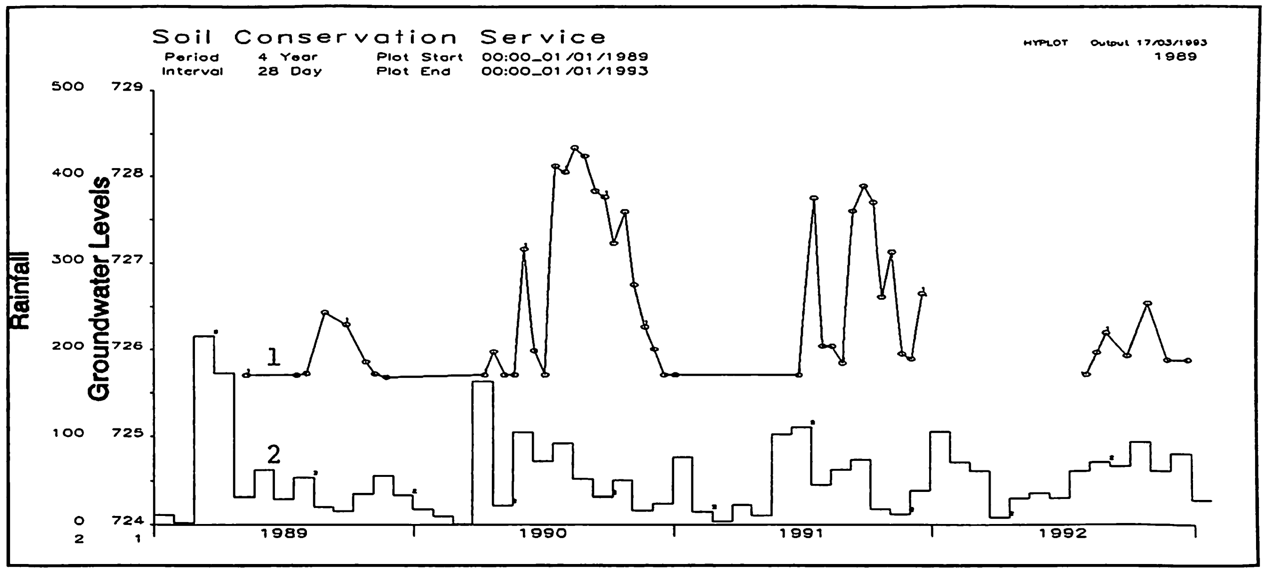
1. (Figure A) The piezometric waterlevel responds rapidly to seasonal rainfall conditions. In winter 1990, the groundwater level increased by 2.5 m in two weeks. This was followed by a decline almost as rapid, when the groundwater level fell to more than 2.8 m below groundlevel (at which point the bore became dry). The waterlevel was within 2 m of groundlevel only during wet winter and spring months.

   The above pattern was consistent over the four years monitored, with the actual maximum groundwater level recorded being smaller in 1989, 1991 and 1992 due to the lesser amounts of winter rainfall received in those years.

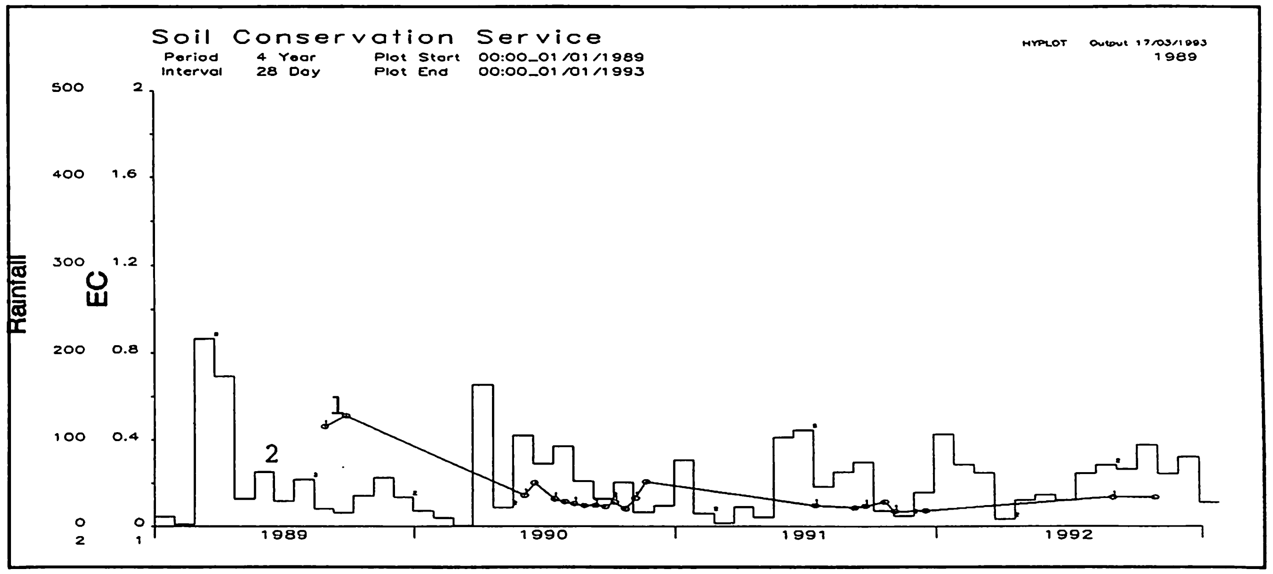
2. (Figure A) There is insufficient evidence for a long term trend in groundwater levels to be concluded.

3. (Figure B) The electrical conductivity (EC) of the groundwater was fresh for the period monitored. The EC ranges from 0.08 dS/m to 0.50 dS/m. No seasonally related EC variation can be inferred as water samples could not be taken when the bore was dry.

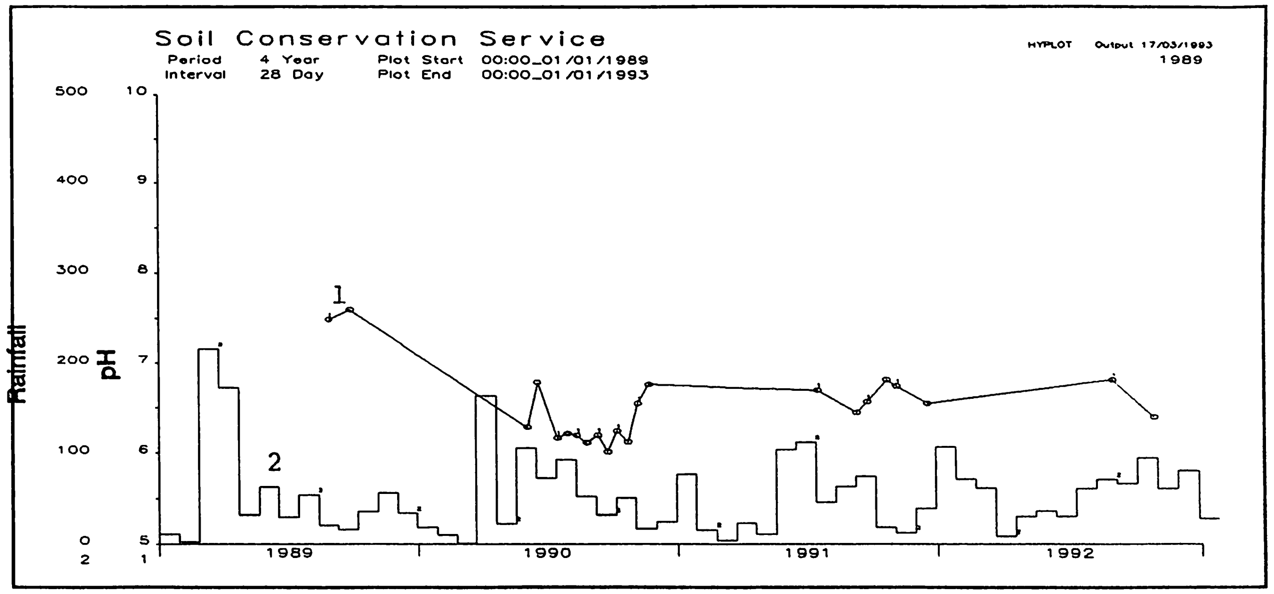
4. (Figure C) The pH ranges from acidic (pH 6.0) to alkaline (pH 7.6), with the more acidic values measured in during the wet winter and spring months of 1990. As for the EC, no seasonally related pH variation can be inferred as water samples could not be taken when the bore was dry



A. Groundwater level (1), in m above sea level, for SCS500A



B. Electrical Conductivity (dS/m) of groundwaters (1) for SCS500A



C. pH (1) of groundwaters for SCS500A

SCS500A: Groundwater levels and water quality (1)
Monthly rainfall is shown on all graphs as (2)

GROUNDWATER GRAPHS FOR SCS502

Refer to Figures A to C on the facing page.

Piezometer Data:

Depth to bottom of piezometer:	3.3 m
Screen:	1.8 m to 3.3 m below groundlevel
Groundlevel (altitude):	707.90 m above sea level
Situation:	Drainage depression (2% - 5% slope)

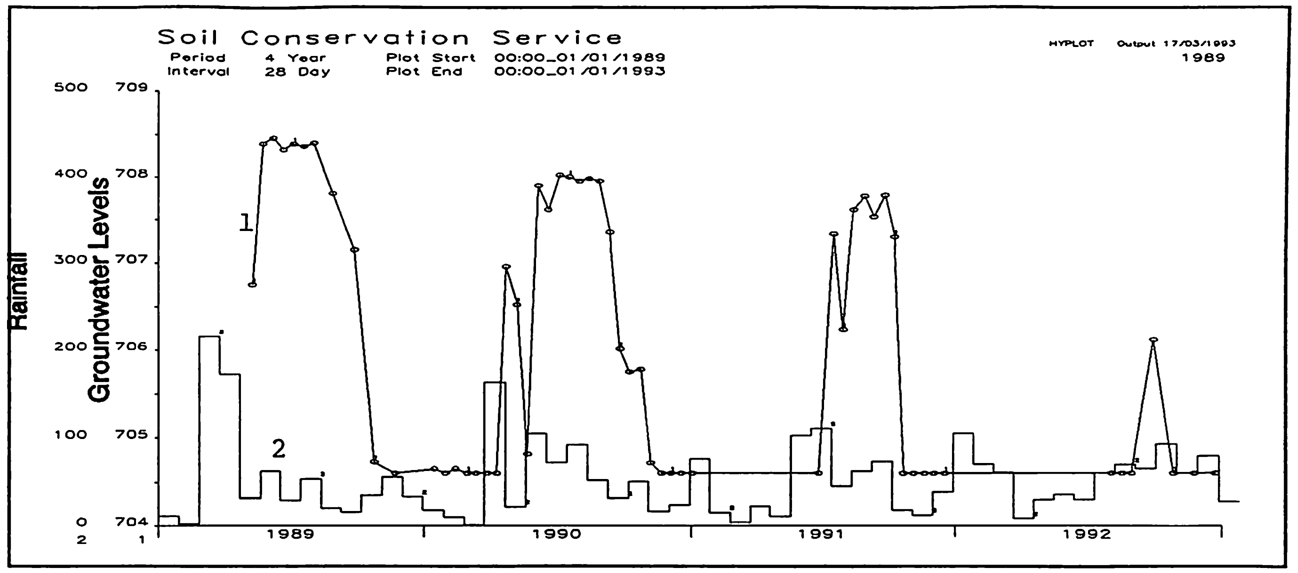
Notes About the Graphs:

1. The piezometric waterlevel varies by at least 4 m per annum in response to seasonal rainfall, ranging from 0.6 m above groundlevel in the wet winter and spring months to more than 3.4 m below groundlevel in the dry summer and autumn months, when the bore is dry. The increase in piezometric level in response to the onset of rainfall is very rapid, with increases of more than 3 m occurring over 2 weeks. The decline in waterlevel can be almost as rapid.

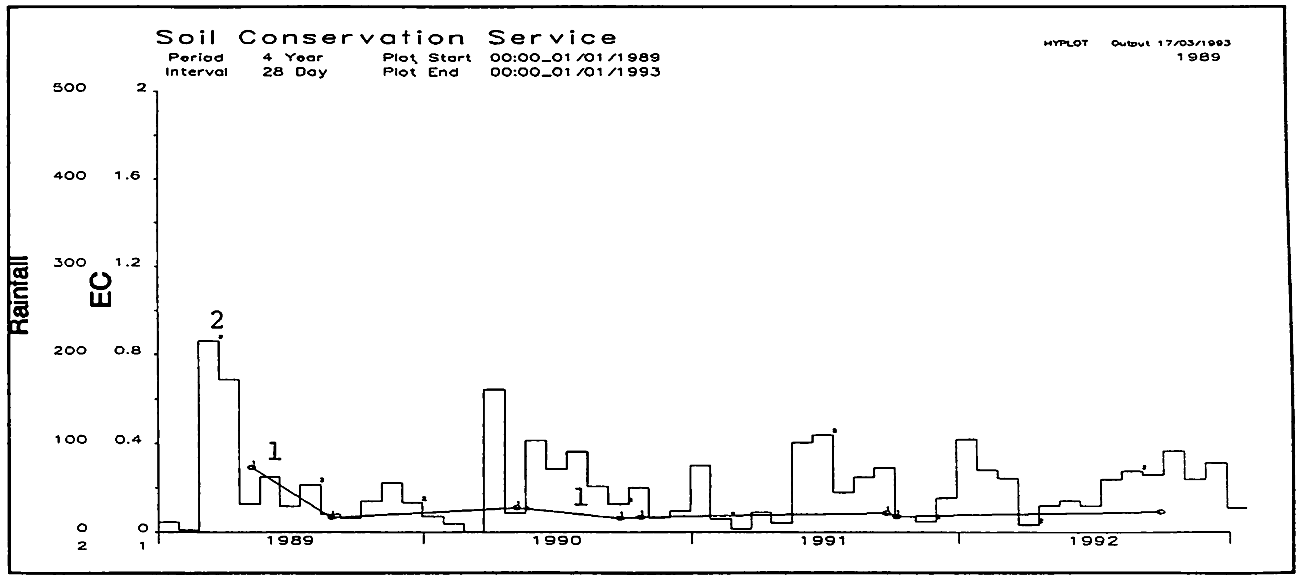
   The maximum piezometric level observed during each wet season (i.e. in the winter or spring months) declined from 1989 to 1992. While the decline in maximum groundwater level from 1990 to 1992 was observed in many other piezometers in similar landscape positions in the area, the decline in maximum waterlevel from 1989 to 1990 was not observed elsewhere. This anomaly is attributed to a process specific to this particular site, such as an extraordinarily high drainage rate, allowing the loss of the April 1990 recharge from the groundwater system during the following (dry) month.

2. (Figure B) The electrical conductivity (EC) of the groundwater was fresh for the period monitored, ranging from 0.06 dS/m at the minimum to just over 0.3 dS/m. There is a minor seasonal variation, such that a decline in EC levels corresponds with increases in the piezometric levels. This is due to dilution by groundwater accessions.

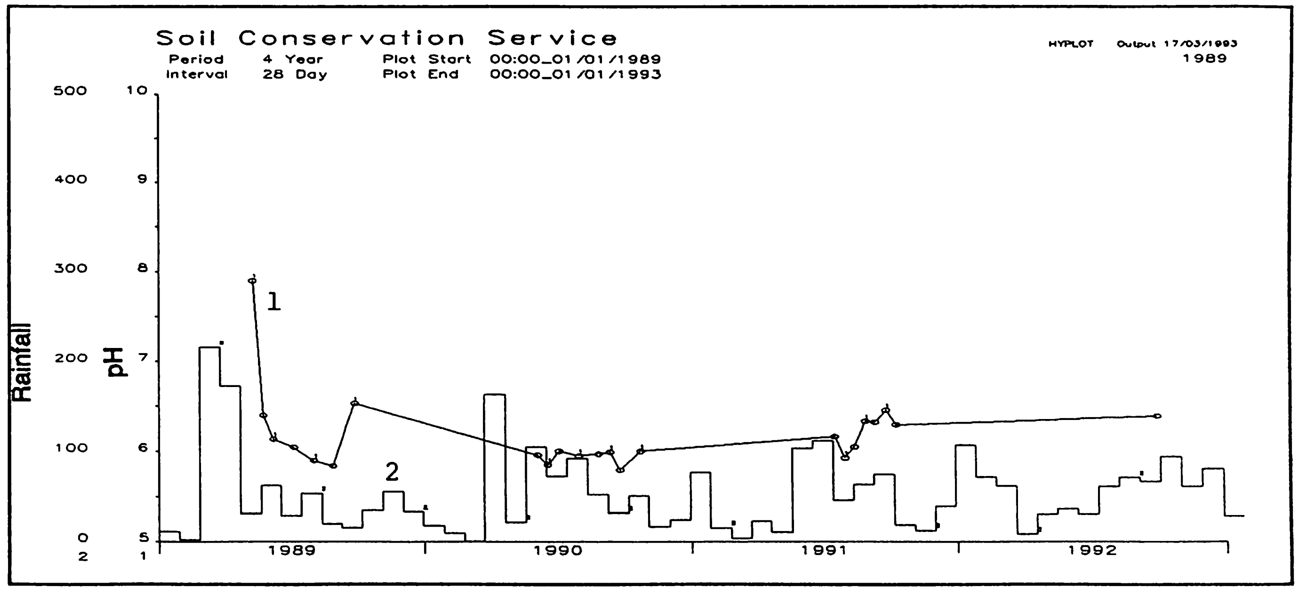
3. (Figure C) The pH ranges from acidic (pH 5.8) to alkaline (pH 7.9), with no obvious seasonal variation.



A. Groundwater level (1), in m above sea level, for SCS502



B. Electrical Conductivity (dS/m) of groundwaters (1) for SCS502



C. pH (1) of groundwaters for SCS502

SCS502: Groundwater levels and water quality (1)
Monthly rainfall is shown on all graphs as (2)

Section 4

Soil Analyses

Soil Chemistry and Texture Results

SOIL ANALYSIS RESULTS

The soil electrical conductivity (EC) increases with depth in all the soil profiles from this transect. The surface parts of the soil profile are all less than 0.1 dS/m and so can be considered to be non-saline. These surface soils are also acidic, with a pH of between 6.0 and 7.0. Both the EC and pH of the soils were measured from a 1:5 soil:water suspension, and have not been corrected for texture (Table A of this section). The EC and pH data are presented in graphs starting overleaf.

Soil Electrical Conductivity Analyses

SCS500A and SCS502 (which are the only piezometers to contain water) maintain the low salinity level for the entire depth of sampling, so that the soil EC never exceeds 0.1 dS/m, and soil from SCS500B (adjacent to SCS500A) also maintains a constant, low EC for the top 2.5 m of the profile. The low EC levels recorded here may reflect the seasonal flushing experienced at each of these sites and so indicates a low degree of salt accumulation, at least in the upper parts of the soil profile.

The EC for soils from SCS500B and SCS501 increases with depth to reach maximum levels of 1.5 dS/m at 7.0 m depth. This is still regarded as non-saline. The soil EC at SCS503 also increases with depth to reach 0.35 dS/m at 5.0 m depth, which is much more saline.

Soil pH Analyses

The pH of soil from SCS500A reaches pH 9.0 by 2.0 m depth, indicating a possible accumulation of basic salts such as sodium bicarbonate at the point monitored by this bore.

The pH for SCS502 is much lower, never exceeding pH 8.0.

The pH for soils from SCS500B, SCS501 and SCS503 all increase from acidic surface pH levels to a pH of 8.0 to 8.5 by 2.0 m depth. This low alkalinity and high EC indicates a likely accumulation of basic salts such as calcium carbonate.

Conclusions

The soils in this valley have been mapped as soloth/solodic soils, which are proposed to have formed on dust deposits (see Section 2 for further explanation). The soil chemical data are further evidence for this interpretation.

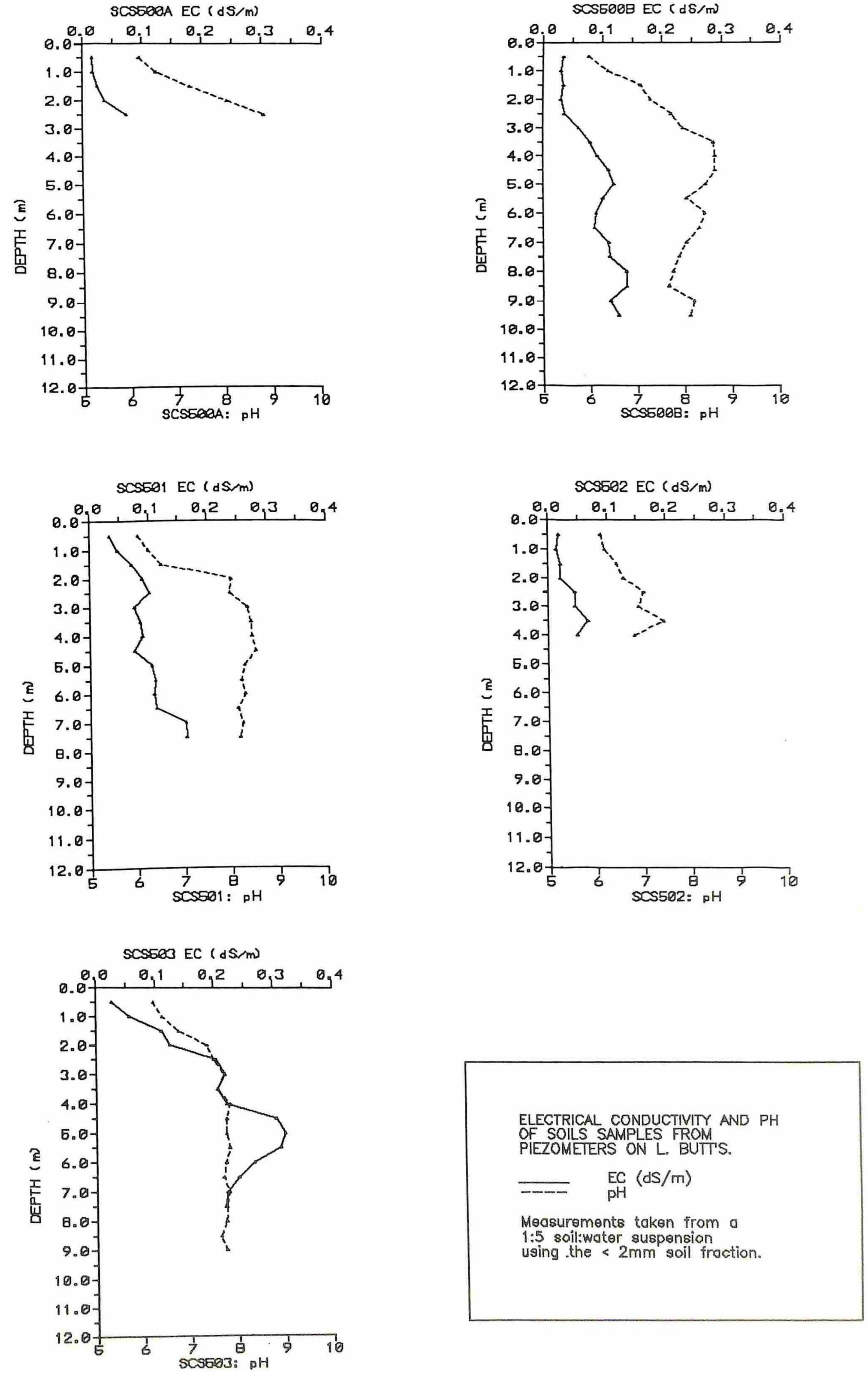
TABLE A: Field textures for soil samples from piezometers

Sample Depth (m)	Soils sampled from piezometer number:				
	SCS500A	SCS500B	SCS501	SCS502	SCS503
0.0 - 0.5	CL	FSCL	SiC	SCL	SiMC
0.5 - 1.0	FSMC	SC	MC	SCL	MC
1.0 - 1.5	FSMC	FSCL	MC	C (g)	MC
1.5 - 2.0	FSMC	SC	MC	FSMC	MC
2.0 - 2.5	FSMC	SC	SC	FSMC	MC
2.5 - 3.0	LC	SC	SCL	FSMC	MC
3.0 - 3.5		MC	SCL	FSMC	MC
3.5 - 4.0		SC	SCL	FSMC	SC
4.0 - 4.5		SCL	SCL		SC
4.5 - 5.0		SCL	SCL		SC
5.0 - 5.5		SCL	SCL		FSCL
5.5 - 6.0		SCL	SCL		SC
6.0 - 6.5		SCL	SCL		SC
6.5 - 7.0		SCL	SCL		FSCL
7.0 - 7.5		SCL	SCL		SC
7.5 - 8.0		SCL			SCL
8.0 - 8.5		SCL			SCL
8.5 - 9.0		SCL			SCL
9.0 - 9.5		SCL			

KEY TO SYMBOLS USED

Symbol	Field Texture	Conversion Factor (*)	% Clay
SCL	Sandy clay loam	10	20% - 30%
CL	Clay loam	9	30% - 45%
FSCL	Fine sandy clay loam	9	
SC	Sandy clay	9	
SiC	Silty clay	9	
LC	Light clay	9	
C	Clay	9	
FSMC	Fine sandy medium clay	8	
SiMC	Silty medium clay	8	45% - 55%
MC	Medium clay	7	45% - 55%
(g)	Gravel inclusions		

(*) The conversion factor is the number by which the EC (1:5) is multiplied to obtain a more standardised measure of EC which allows for the soil texture. This allows different soils to be compared. In this report, the factors are used to convert the standard salinity limits into EC (1:5) values which relate directly to the soil EC and pH graphs elsewhere in this section. (Conversion factors are taken as per Taylor, 1993 pers. comm.)



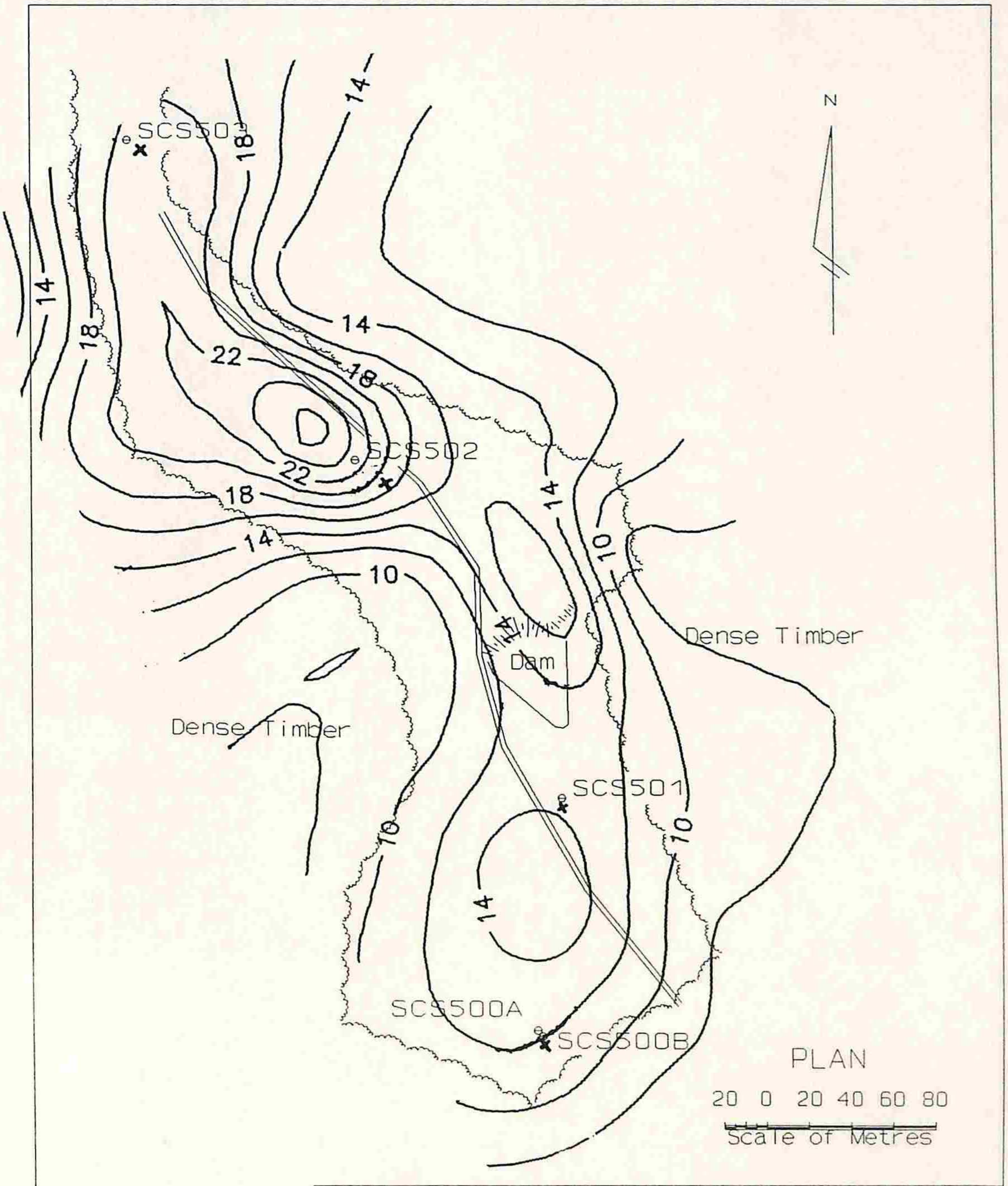
ELECTRICAL CONDUCTIVITY AND PH OF SOILS SAMPLES FROM PIEZOMETERS ON L. BUTT'S.

Measurements taken from a 1:5 soil:water suspension using the < 2mm soil fraction.

Section 5

Electromagnetic Maps

EM-34, 10 m spacing



CONSERVATION AND LAND MANAGEMENT
S.C.S. 20142H

YASS SALINITY ABATEMENT
DEMONSTRATION PROGRAM

PROPERTY No. 88
L. & C. BUTT

Electrical Conductivity: 'Glenlee'

EM-34 (10m) survey: units mS/m