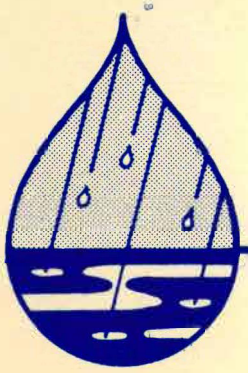

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UNSATURATED SALT STORAGE IN FORESTED AND CLEARED AREAS OF THE DARLING RANGE

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1. INTRODUCTION

It is generally accepted that rises in the groundwater table following the clearing of native vegetation lead to substantial increases in stream salinities. However until recently there has been little direct data to support the theory of rising groundwater tables although several projects are now in progress where the groundwater levels were monitored prior to clearing and are being monitored following clearing to determine rates of groundwater rise.

One possible means of inferring groundwater rises is to compare the percentage of salt stored above the water table in the forested and cleared states. If the theory of rising groundwater tables is correct this percentage should change significantly following clearing.

This report examines the proportions of salt stored in the unsaturated zone of the profile for a number of forested sites and contrasts this with a particular site which has a long clearing history.

2. DATA EXAMINED

Fifteen forested sites from the Northern Darling Range were selected for analysis. Annual average rainfalls range from a minimum of 750 at Lemon and Cowcher Road to a maximum of 1350 mm at Huntly (Figure 1).

Only data from valley and lower slope landscape positions are included. The 17 cleared site cored holes at Stenes occupy lower slope and valley positions.

3. RESULTS

3.1 Forested Sites

Data for the 15 forested sites are listed in Table 1. The percentage of salts above the water level was estimated from total salt storage and the average water rest level during April-June annually. This information is the site averaged proportion of salt stored in the unsaturated zone of the profile.

The percentage of total salt in the unsaturated zone is plotted against average annual rainfall on Figure 2. A linear relationship between the two variables is apparent and this was investigated statistically.

The following results: -

$$Y = -0.0947 X + 157.5$$

where Y = % salt above water level

X = average annual rainfall (mm)

and the coefficient of determination = 0.61.

TABLE 1

PERCENTAGE OF SALT ABOVE THE WATER LEVEL FOR FORESTED HOLES

Site No.	Site Name	No. of Holes	Rainfall (mm)	% of Salt Above W.L.	Total Storage (kgm^{-2})
1	Huntly	2	1350	30.5	3.95
2	Del Park	2	1300	32.5	1.24
3	Wermup	4	1250	23.1	-
	Dwellingup Transect				
4	Site 1	2	1300	62.5	5.72
5	Site 2	1	1250	15.0	2.52
6	Site 3	1	1125	45.0	4.67
7	Site 4	3	1100	54.0	6.05
8	Site 5	1	1050	70.0	11.01
9	Site 6	2	975	76.5	19.82
10	Wights	2	1150	71.0	4.52
11	Yarragil	7	1000	41.3	-
12	Kirup	1	1000	51.0	14.12
13	Helena (Hutt & Wellbucket)	5	825	86.4	-
14	Lemon	2	750	81.5	31.09
15	Cowcher Road	2	750	91.0	23.26

The statistical significance of predicting the proportion of salts from rainfall was illustrated by calculating the 95% confidence band which is shown on Figure 2. Both the slope and the intercept of the linear equation were determined to be significant at the 95% level.

TABLE 2

PERCENTAGE OF SALT ABOVE WATER LEVEL

FOR CLEARED SITE BORES AT STENES

Bore No.	Landscape Position	% Salt Storage Above Water Level	Total Salt Storage (kgm^{-2})
6128015	Valley	0.9	40.7
6128021	"	1.0	22.2
6128022	"	11.9	2.8
6128023	Lower Slope	5.8	86.9
6128024	Valley	0.1	28.8
6128025	"	0.0	87.4
6128026	"	7.3	47.8
6128028	"	8.9	51.5
6128030	Lower Slope	21.7	52.5
6128042	"	4.5	39.9
6128046	Valley	1.8	58.4
6128047	"	0.0	60.2
6128057	Lower Slope	5.4	36.7
6128061	Valley	4.8	52.4
6128065	Lower Slope	3.9	45.4
6128377	Valley	6.2	62.2
6128378	Lower Slope	3.9	58.5
Mean :		5.2	49.1
Std. deviation :		5.4	20.9

The 95% confidence limits for the mean of this sample are 2.19% and 8.21%.

3.2 Cleared Site

The statistics for the 17 bores at Stenes are listed in Table 2. Average annual rainfall at this site is 725mm. Mean unsaturated zone salt storage is 5.2% with a standard deviation of 5.4%. The minimum and maximum are 0% and 21.7% respectively.

4. DISCUSSION

Use can be made of the regression to obtain an estimate of the probable preclearing proportion of unsaturated zone salt storage at Stenes. For an average annual rainfall of 725mm, the proportion may have been 88.8%, with upper and lower confidence limits of 70% and 100% respectively.

Clearly the very large difference between the estimates of between 70-100% and 2-8% of pre and post clearing suggests a major change of groundwater levels. By combining a knowledge of salt stored above the water level from a forested to cleared site it is possible to infer the amount of groundwater table rise. For Stenes this estimate was 11.5 m.

5. CONCLUSIONS

A significant linear, inverse relationship was found between average annual rainfall and the proportion of salt stored in the unsaturated zone.

For a cleared site, the analysis indicated a significant decrease in the proportion of salt in the unsaturated zone relative to that expected for forested sites in the same rainfall zone.

This evidence therefore indirectly supports the theory of rising groundwater levels following a landuse change from forest to agriculture.

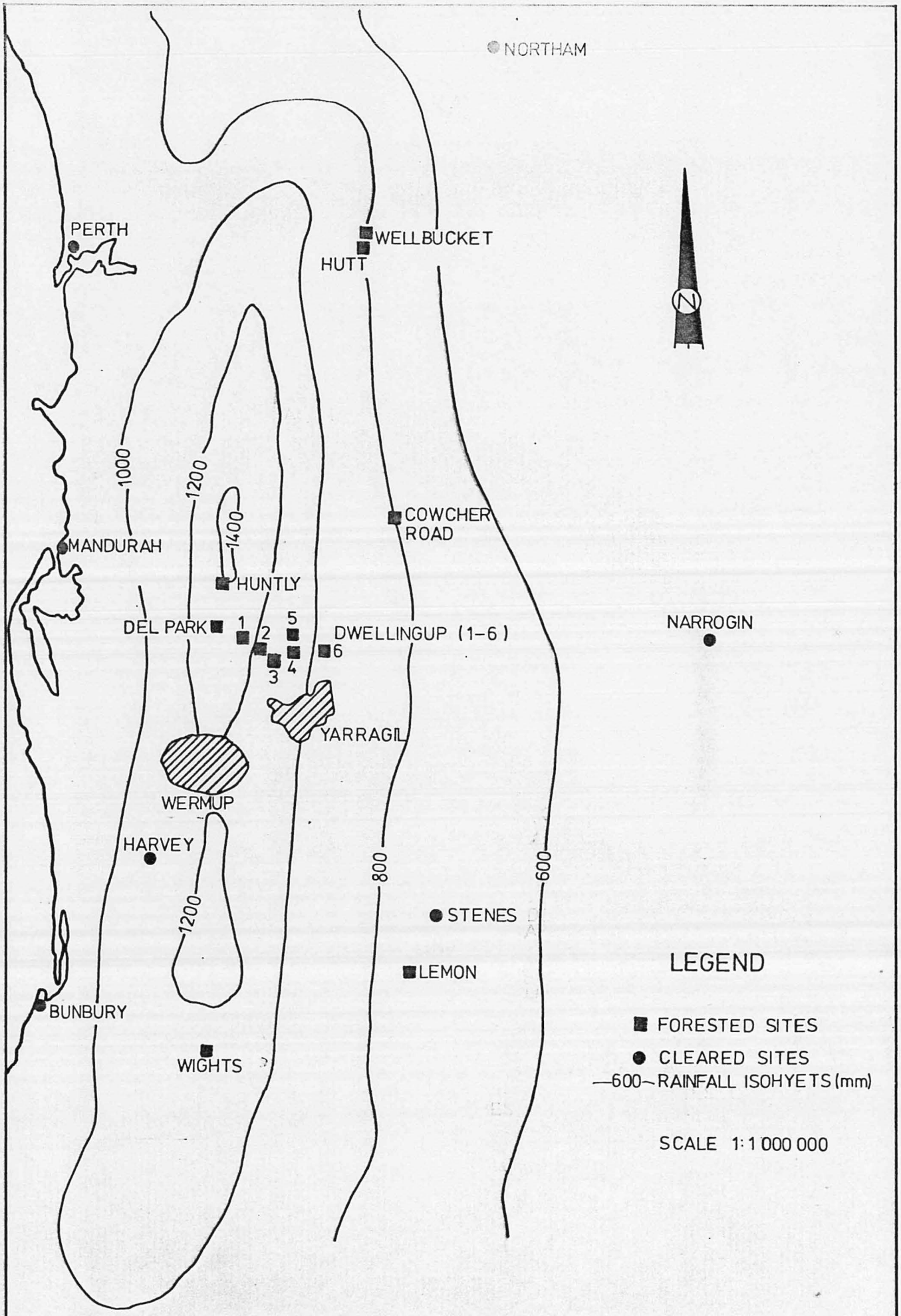

Figure 1 LOCATION OF SALT STORAGE SITES

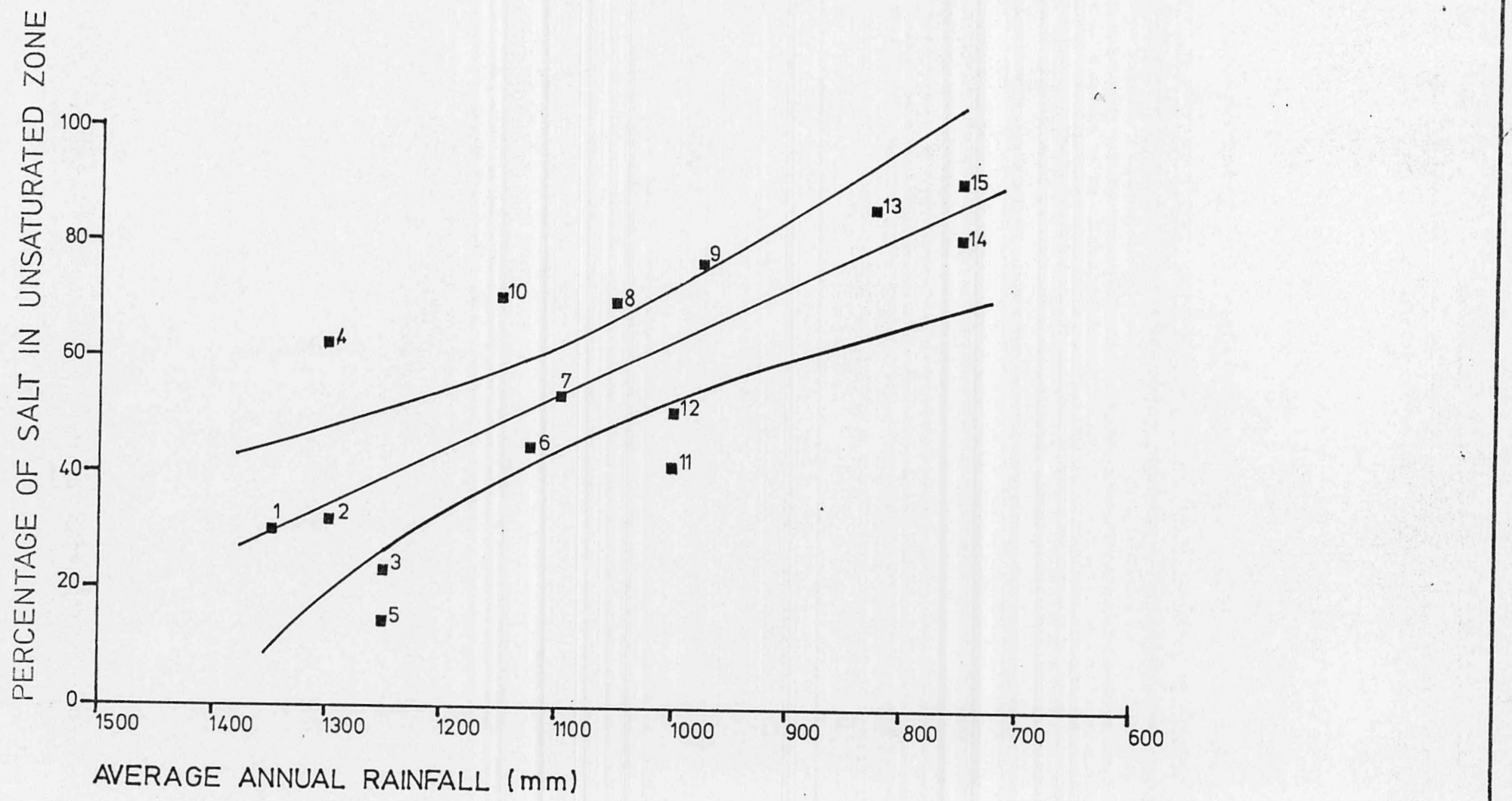

Figure 2 UNSATURATED SALT STORAGE VERSUS ANNUAL RAINFALL