THE YARRAGIL 4L THINNING EXPERIMENT -

1st Year's Results

1. **Summary**

The Yarragil 4L catchment was thinned early in 1983. This report summarises the results of that treatment up to early 1984. The catchment was thinned from 55% canopy cover to 20% (basal area of 35 m^2/ha to 11 m^2/ha). No increase was seen in streamflow however it is hypothesised that there has been a significant change in the water balance, with a substantial reduction in evapotranspiration and a substantial increase in soil moisture storage. There has been no change in stream salinity, turbidity, or groundwater salinity. Groundwater in the midslope borehole at 4L rose 0.9m, however there was no response in the valley borehole. Ninety m^3/ha of currently unsaleable bole wood was produced by the operation, compared to 20 m^3/ha of sawlog that was removed. Two-thirds of the unsaleable jarrah volume was assessed as potentially utilisable, and 62% of this volume was less than 50 cm in diameter. The utilisation of this resource would help reduce and offset the cost of the culling treatment and reduce the cost of disposal of debris from around the base of crop trees.

2. **Background**

The suggestion that thinning could be used in the northern jarrah forest to increase the production of both high quality water and timber was made nearly ten years ago. As a result a research programme was implemented to study the hydrology of the Yarragil catchment, some 20 km south-east of Dwellingup. This catchment spans the intermediate rainfall and salt zones and represents in microcosm much of the physical and hydrologic variability of this zone.

By 1976 a number of subcatchments were instrumented with V-notch weirs, continuous streamflow recorders, and a transect of bore-holes. The 4L catchment was later selected as a suitable catchment in which to do a thinning treatment because of the following characteristics -

(i) low soil salt storage;

(ii) low groundwater salinity;

(iii) dense stands of jarrah; and

(iv) low streamflow yields.

3. **Objectives**

The primary objective of the project is to test the hypothesis that a reduction in canopy cover will increase the production of both high quality water and timber.

We are quantifying the effect of the treatment on -

(i) streamflow quality and quantity;

(ii) groundwater quality and quantity;

(iii) total and merchantable wood yields;

(iv) wood growth and quality;

(v) canopy cover and density;

(vi) understorey density, regrowth and composition; and

(vii) extension of diseased areas.

4. Operations

The catchment was tree-marked so that a 20% canopy cover would remain. The catchment was then commercially logged in dry soil conditions, the operation extending from 28th January to the end of March 1983. Following this those trees not selected for retention were cull fallen in a non-commercial thinning operation which was completed by mid May. A tops disposal burn was completed over about two-thirds of the catchment in late winter. A crop tree relief operation involving the removal of debris from around the base of crop trees was done over the summer of 1983/84.

5. Results

5.1 Costs

The cost of the various operations was as follows -

5.1.1 Thinning (including banksias)

Materials	Wages	Plant	Total	32% Wages	Sub Total	20% Admin.	Total	Unit Cost
363	13919	1832	16114	4454	20568	4113	24681	215

5.1.2 Tops disposal burn (including track around catchment)

Materials	Wages	Plant	Total	32% Wages	Sub Total	20% Admin.	Total	Unit Cost
-	2811	104	2915	900	3815	763	4578	

5.1.3 Crop tree relief

Materials	Wages	Plant	Total	32% Wages	Sub Total	20% Admin.	Total	Unit Cost
994	19918	1250	22162	6373	28535	5707	34242	298

5.2 Streamflow quantity

No increase in streamflow is discernable from analysis of either monthly, annual or cumulative streamflow of 4L against a control catchment. Figures 1, 2 and 3 show these results.

5.3 Streamflow quality

There has been no significant change in stream salinity since the treatment (figure 4). The exceptionally high quality of streamflow with respect to turbidity has continued in the post-treatment period. All samples have had turbidity levels of <1 APHA unit.

5.4 Groundwater quantity

Compared to other midslope bores in the Yarragil catchment the midslope bore in 4L has risen 0.9 metres in the 12 months following the treatment (figures 4 and 5). No significant change has been detected in the valley bore (figures 4 and 6).

5.5 Groundwater salinity

There has been no significant change in the salinity of either the midslope or valley bore (figure 4).

5.6 Total and merchantable wood yields

In thinning to a 20% canopy cover (basal area of 11 m^2/ha) 90 m^3/ha of currently unsaleable bole wood was produced, compared to 20 m^3/ha of sawlog that was removed. Two-thirds of the unsaleable jarrah volume was assessed as potentially utilisable. Sixty two percent of this volume was less than 50 cm in diameter.

5.7 Other

No post-treatment remeasurement of other parameters have been made to date.

6. Discussion

6.1 Costs

One single factor which would drastically change the cost of thinning in the northern jarrah forest is the economic utilisation of material which would currently be thinned to waste. Realizing the potential of this resource would help reduce and offset the cost of the culling treatment, reduce the cost of disposal of debris from around the base of crop trees, allow easier access, and reduce fire management problems as well as providing a valuable resource to the West Australian timber industry.

Results from this study have helped to stimulate research into the utilisation of regrowth jarrah trees.

6.2 Streamflow quantity

The lack of a streamflow response following a two-thirds reduction in cover is in marked contrast to the results of other catchment experiments reported in the literature. Moreover, all of these experiments have reported the largest increase in streamflow in the first year following treatment, with streamflows subsequently diminishing as the forest regrows. So perhaps the prospects of increasing streamflow by thinning jarrah stands is poor?

However, there is a feature of the jarrah forest that will make its response different from any reported in the literature. This is the soil, its depth and large soil moisture capacity.

The results from the clearing of Wights catchment near Collie help in the interpretation of our data. Sharma et al. (1982) reported that in the first year following clearing of Wights, soil moisture storage in the top 6 m increased by 220 mm in comparison to the still forested Salmon catchment. Also, analysis of streamflow from Wights (figure 7) shows that streamflow is still increasing in response to clearing 6 years earlier.

The 4L catchment was thinned late in the summer of 1983, therefore soil moisture deficits would have built up to normal levels. Most of the winter's rainfall goes into reducing these deficits before streamflow is generated. This is why the streams of the NJF flow for only a few months in late winter/early spring each year. Rainfall in the winter of 1983 reduced these soil moisture deficits i.e. increased soil moisture storage, but did not increase streamflow. Over the summer of 1983/84 there would be less soil moisture withdrawal in 4L than in adjacent forest, this is reflected in less groundwater depletion as shown in figure 5. Winter rain in 1984 would then have a greater chance of contributing to streamflow rather than to soil moisture storage.

6.3 Streamflow quality

No change in streamflow salinity would be expected until streamflow quantity increases and the source of streamflow changes. The jarrah forest is resilient to turbidity problems as long as point sources such as stream crossings are avoided. Non-point sources such as sheet erosion are likely to cause little problem because the periods of ground cover and soil disturbance, and streamflow increase are separated in time.

6.4 Groundwater quantity

An increase of 0.9 m in the 4L midslope bore in comparison to other midslope bores is quite a large response. Sharma et al. (1982) reported an increase of 1.55 m/year in Wights after clearing compared to the forested Salmon catchment. The response of the groundwater indicates that future catchment experiments should have more intensive monitoring of this element of the water balance.

6.5 Groundwater quality

Soil salt storage in this catchment is relatively low: 0.6 kg/m^2 (Herbert et al. 1978). However, the midslope borehole did intersect a salt bulge at around 10 m in depth. Groundwaters would have to rise a further 10 m before a change in groundwater salinity would be expected in this borehole.

6.6 Total and merchantable wood yields

See section 5.1.

7. Practical Experience Gained

The imposition of a single thinning prescription over a catchment composed of both even-aged and uneven-aged groups poses problems to both current and future management. Thinning of old-growth groups causes falling damage to residual trees, and further thinning will damage regrowth in these groups. Fire in these uneven-aged groups is a problem because of the great diversity of size classes retained, and thus the great diversity of susceptibilities to fire damage. It is more practical to thin the even-aged regrowth groups, and to clearfell and regenerate old-growth groups. The old-growth groups then become manageable even-aged regrowth stands.

Advances have also been made in the selection of trees for retention and in the method of treemarking (Abbott and Loneragan 1983, Bradshaw 1983).

8. References

Abbott, I. and Loneragan, O.W. 1983. Response of jarrah (*Eucalyptus marginata*) regrowth to thinning. Australian Forest Research, 13: 217-229.

Bradshaw, J. 1983. Silvicultural treatment of the jarrah forest for wood production. Forests Dept. of W.A. unpublished report.

Herbert, E.J.; Shea, S.R. and Hatch, A.B. 1978. Salt content of lateritic profiles in the Yarragil catchment, Western Australia. Forests Dept. of W.A. Research Paper 32.

Sharma, M.L.; Johnston, C.D. and Barron, R.J.W. 1982. Soil water and groundwater responses to forest clearing in a paired catchment study in south-western Australia. First National Symposium on Forest Hydrology: 118-123.

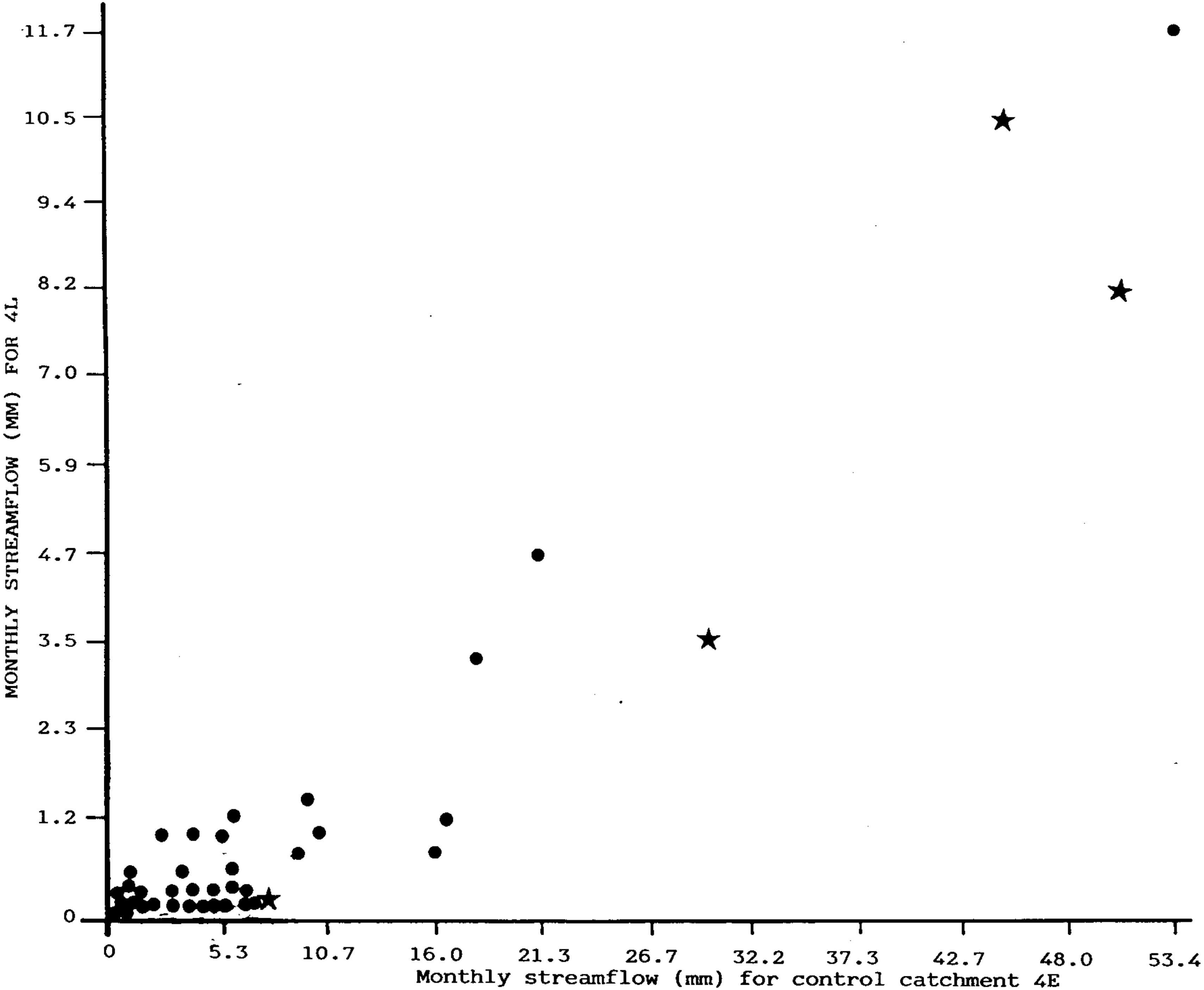

FIGURE 1: The effect of thinning on monthly streamflow from 4L (★ post-treatment data)

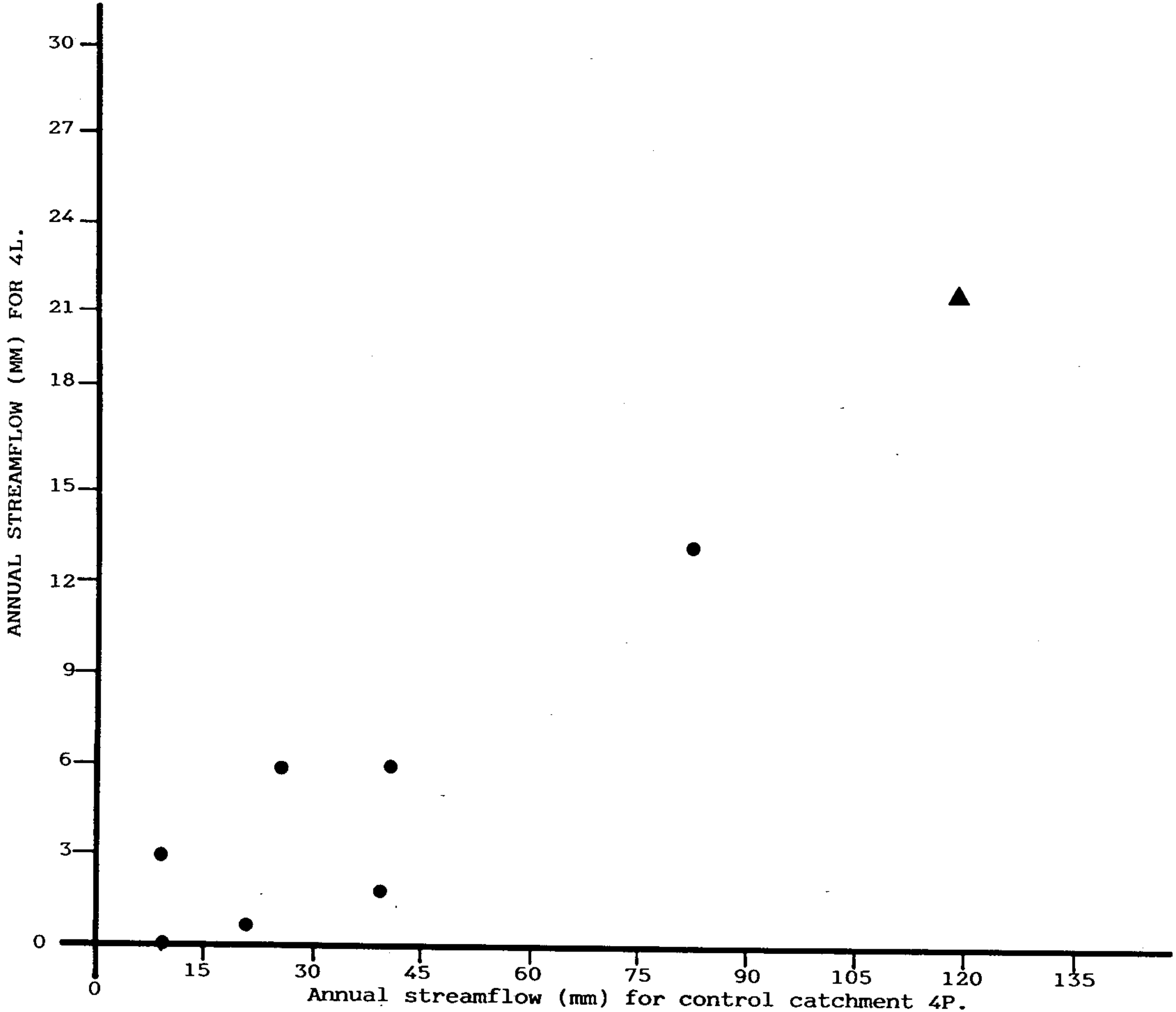

FIGURE 2: THE EFFECT OF THINNING ON ANNUAL STREAMFLOW FROM 4L (▲POST-TREATMENT DATA).

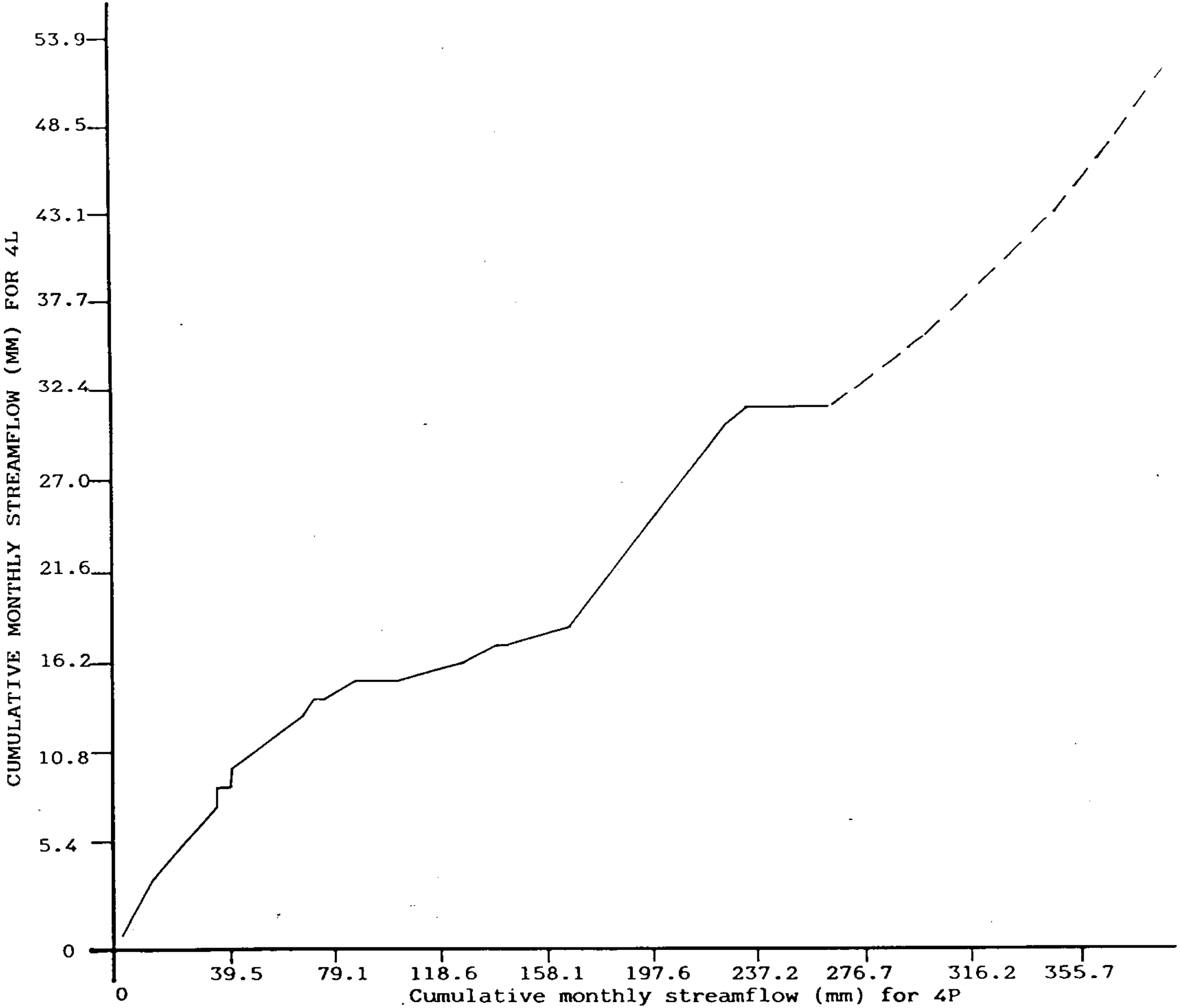

FIGURE 3: EFFECT OF THINNING ON CUMULATIVE MONTHLY STREAMFLOW FOR 4L (---POST-TREATMENT DATA)

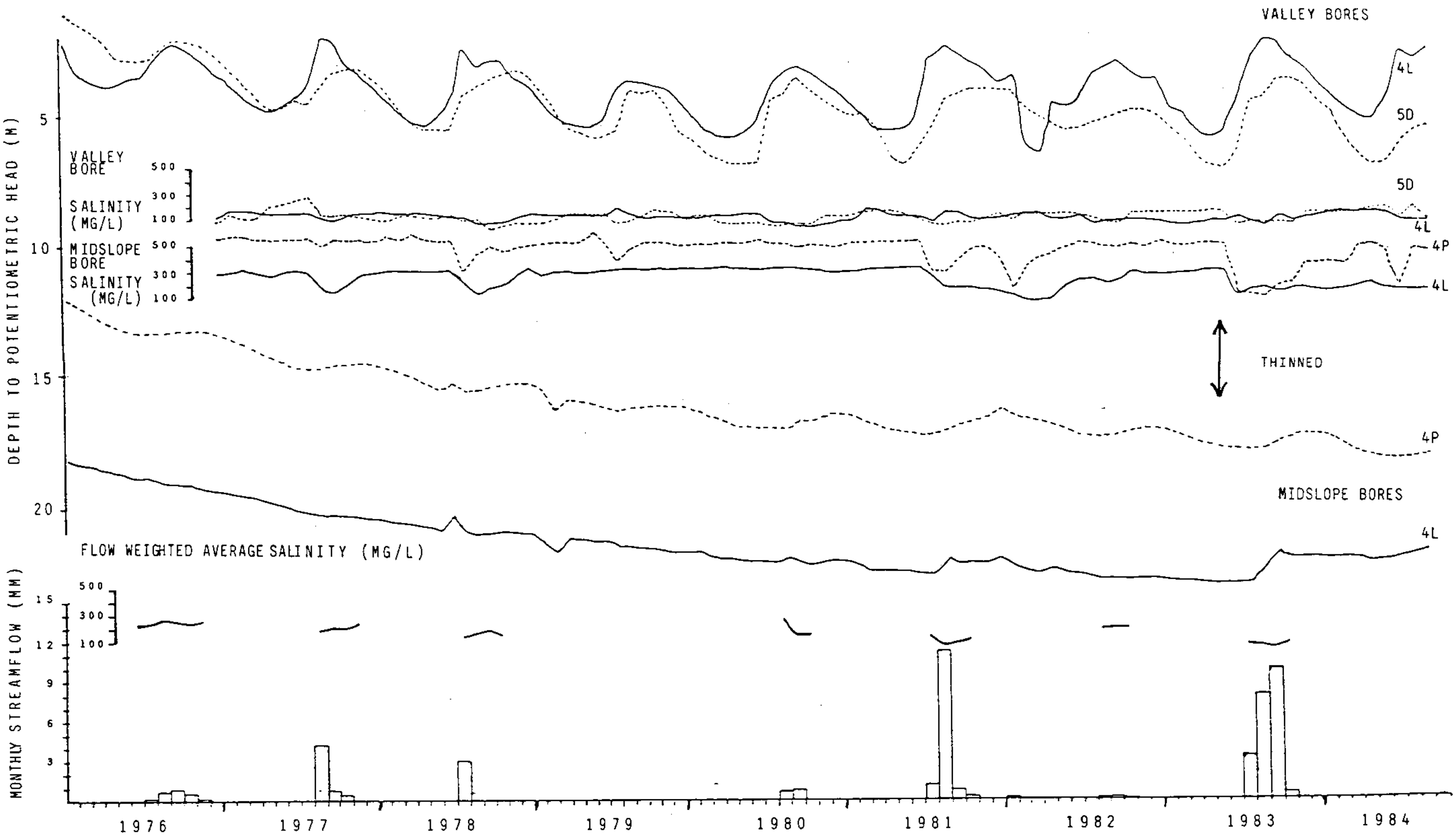

FIGURE 4: TRENDS IN STREAMFLOW (MM), STREAM SALINITY (MG/L), DEPTH TO GROUNDWATER (M), AND GROUNDWATER SALINITY (MG/L) FOR YARRAGIL 4L AND CONTROLS BOTH BEFORE AND AFTER THINNING.

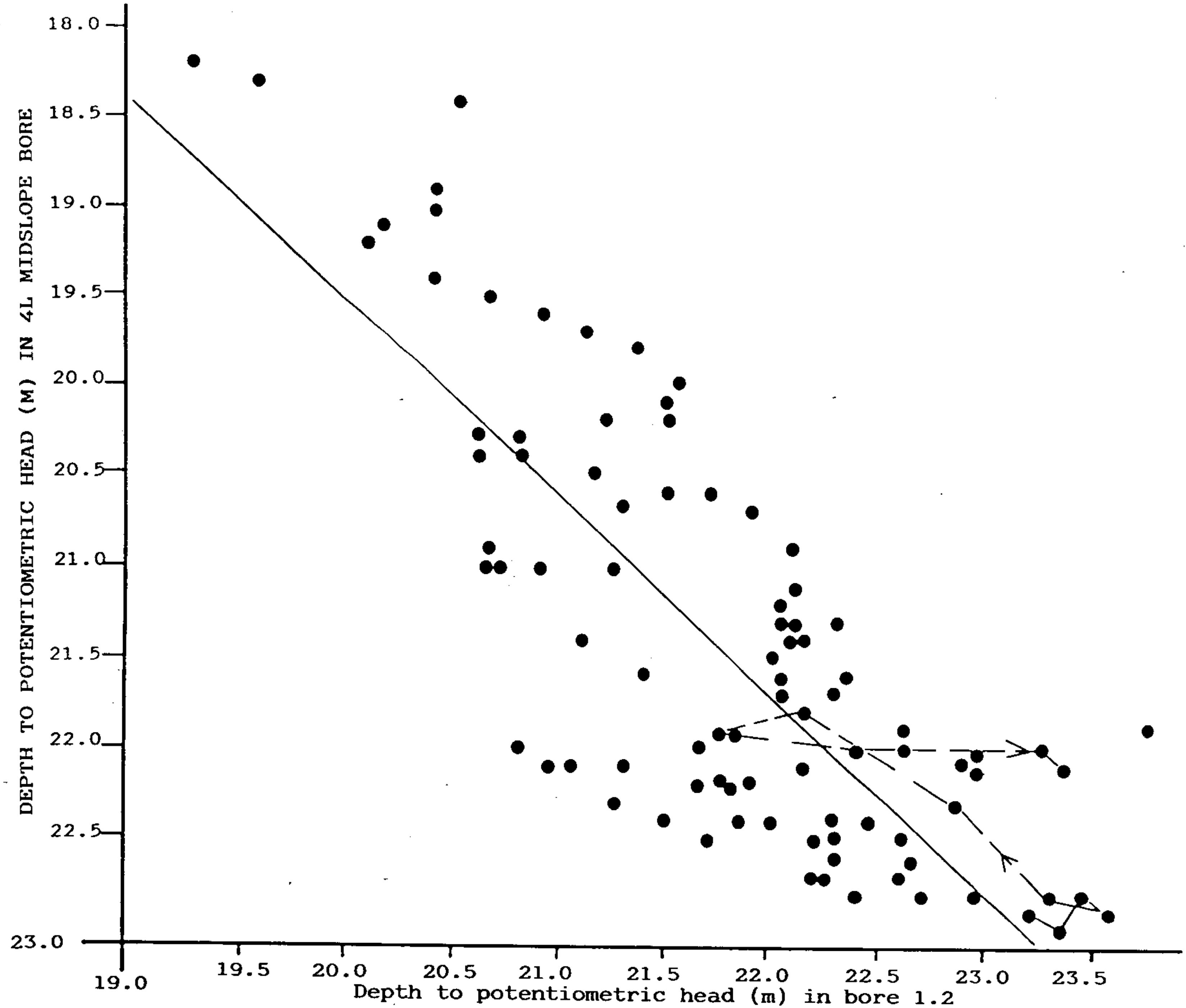

FIGURE 5: EFFECT OF THINNING ON MIDSLOPE GROUNDWATER LEVEL IN 4L (--POST-TREATMENT DATA)

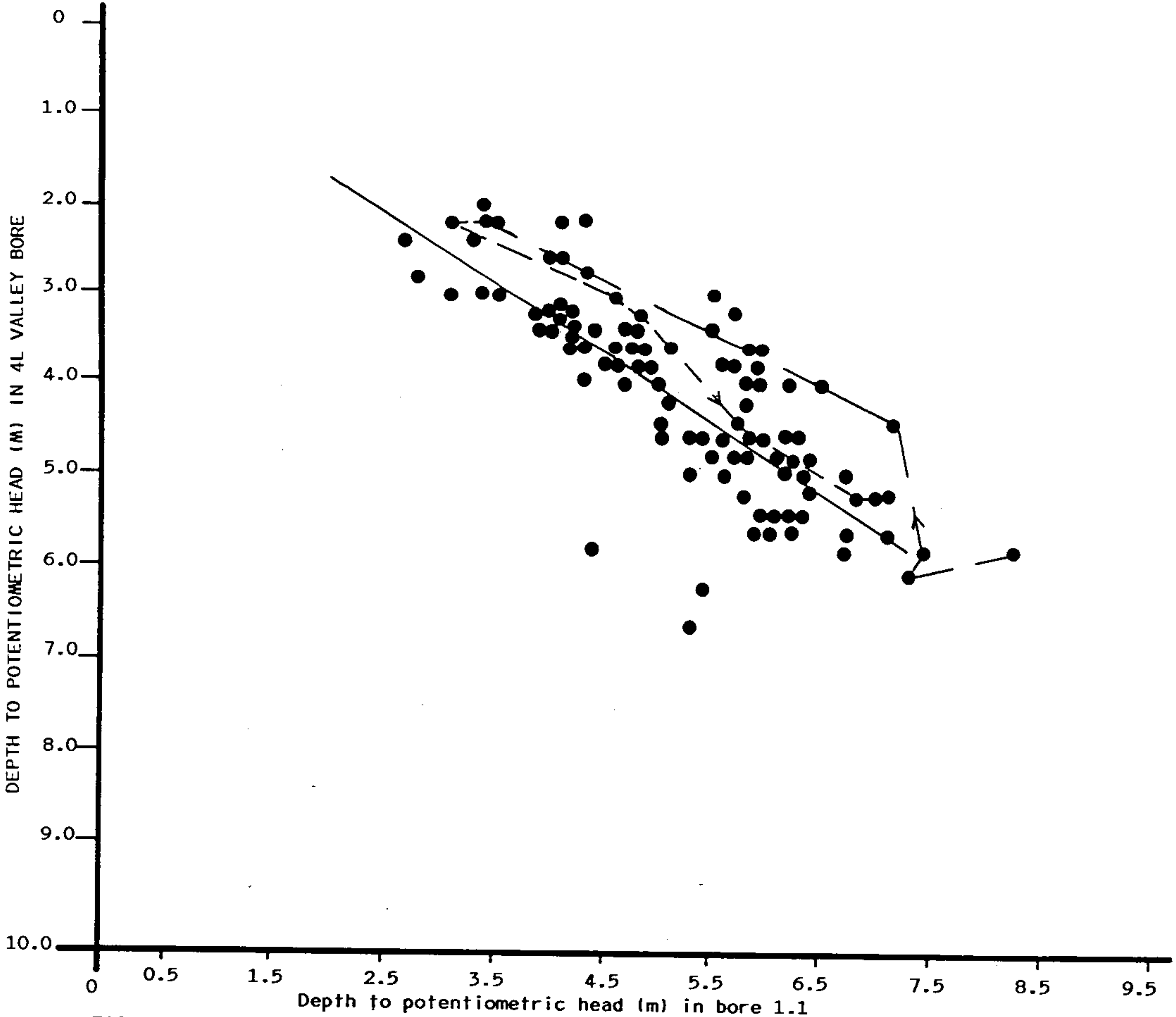

FIGURE 6: EFFECT OF THINNING ON VALLEY GROUNDWATER LEVEL IN 4L. (— POST-TREATMENT DATA)

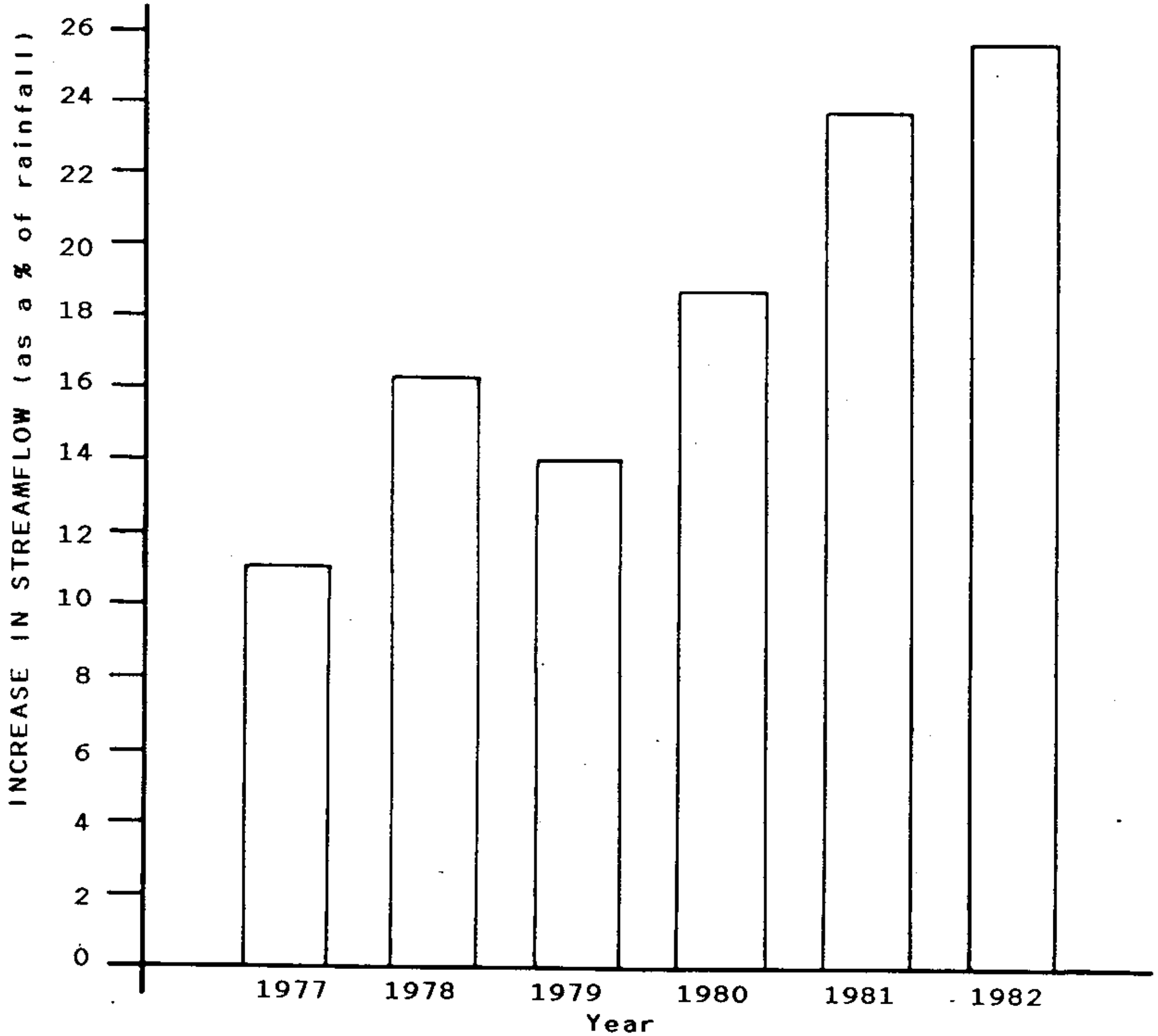

Figure 7: Increase in streamflow following clearing of Wrights catchments. (Pre-treatment calibration: Wrights = 0.8942 Salmon -0.0295).