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REPORT ON THE WAIMAKARIRI STREAM-BED RESURVEY

by

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January 1967

INTRODUCTION

The Waimakariri River and its tributaries exhibit aggradational features typical of many river systems draining the Canterbury high country east of the southern alpine divide.

Factors such as the regionally uniform greywacke lithology, the steep topography, the particular structure, composition, and history of the vegetation, the past and present patterns of land use and the climatic extremes associated with alpine country have resulted in high rates of erosion.

Downslope movement of detritus and its subsequent removal by streams showing varying degrees of competence has resulted in changes in river-bed levels and active stream-bed channels. These changes in stream-bed morphology are assumed to have been rapid. However, no quantitative data actually exists on either the tempo or the magnitude of change involved, particularly with respect to upper catchment tributaries.

In order to obtain some quantitative assessment of stream-bed profile change fifty permanent transects were established across selected Waimakariri headwater tributaries during the summer of 1960-61. Forty seven of these same transects were relocated and remeasured in January 1967. End pegs of three transects could not be located leaving forty four profiles effectively remeasured. In addition to these three transects being replaced six new transects were established; two across the main Poulter River, three across the Esk, and one across a lower tributary of the Esk. The distribution of transects throughout the catchment is shown in Fig. 6.

SURVEY METHOD

A surveyor's level and staff together with a 100 foot tape were used to establish transects across tributaries entering the main rivers. The transects were placed either at appropriate distances upstream from confluences or at points downstream from major breaks in slope. Readings from the staff were taken at significant changes in level across the transect, the distance from the appropriate end peg noted, reduced levels computed and the resulting profile plotted on graph paper. Variations in level from profiles recorded in 1961 could then be calculated.

RESULTS

Results are tabulated in Tables 1 and 2. A summary of the more pertinent observations follow.

Over the whole catchment, twenty profiles exhibited aggradation, six had degraded, while eighteen showed no effective net change. In many cases stream-bed profiles had changed in cross-sectional appearance but scour and fill processes had balanced with the result that aggradation or degradation could not be quantitatively detected. Greatest net aggradation (1.70 feet) was recorded from a tributary of the Cox River (Poulter Catchment). The largest degradational change (2.10 feet) occurred in a tributary below Whitewater stream in the Broken River Catchment.

Distances of lateral shift of principal stream channels and amount of bank retreat were calculated. The maximum channel shift of 102 feet occurred in the Cattle Creek (Grant River) tributary of the Esk River. Undercutting of banks leading to collapse and widening of stream-beds was recorded in eleven cases, the maximum of 13 feet occurring in the Upper Waimakariri River.

FEATURES OF INDIVIDUAL CATCHMENTS

Upper Waimakariri Catchment:

For present purposes the Upper Waimakariri Catchment includes all streams draining into the main river system upstream of the Poulter River.

High gradient streams in headwater regions (Greenlaw stream, up river) of the watershed have maintained reasonably constant bed levels with no noticeable trend towards profile change. At one point in the Upper Waimakariri stream, bank collapse has widened the bed by 13 feet (Fig. 2a), but this is not a common feature of the river beds in the area. However, the streams draining the lower reaches of the catchment (Greenlaw stream down river to the Poulter mouth) show greater instability with respect to profile change. Of eleven transects, six showed aggradation, one had degraded while four showed no effective change. Five of the seven transects showing change drain country that has been burnt and grazed. Maximum aggradation of 1.20 feet was recorded from a tributary below the Andrews River (Fig. 1a), while the Anti-crow River had degraded 0.70 feet (Fig. 1c).

The Poulter Catchment:

The Upper and East Poulter river systems remain well vegetated in comparison with the lower reaches and with the Waimakariri Catchment as a whole. Little marked change in tributary stream-bed levels were apparent from resurvey data. Of sixteen profiles remeasured, five had aggraded, two showed degradation and nine remained unchanged. Casey Creek (Fig. 4a) and a tributary of the Cox River showed level rises of 1.30 feet and 1.70 feet respectively. However, these changes do not seem to be characteristic of the catchment generally and stream-bed fluctuations are probably not

as frequent throughout the Poulter as in other Waimakariri watersheds. Maximum degradation of 1.40 feet occurred in the Minchin River (Fig. 3c). Lateral stream channel shift and bank collapse were not obviously significant processes.

The Esk Catchment:

Past burning and continued grazing has depleted much of the forest and grassland cover throughout the catchment. Only five transects were established in 1961. In 1967 four had shown aggradation; the Nigger stream transect exhibited a level rise of 0.9 feet. The remaining stream, the Ant, showed no detectable change. Largest channel shift was recorded from this catchment where the Cattle Creek (Grant River) tributary has shown a movement of ~~202~~ 102 feet in the position of its principal channel (Fig. 3b). Indications are, however, that this stream, along with many others, may at any time occupy any one of several channels across its profile. Nevertheless Cattle Creek has probably one of the most unstable beds of all streams within the Waimakariri Catchment. Steady supply of detritus from eroding headwaters coupled with highly fluctuating flow conditions cause scour and fill processes to alternate at the same time ensuring continued downstream movement of material. Thus a stream profile may show little quantitative change with respect to aggradation or degradation yet material may be effectively moved downstream.

This particular case for Cattle Creek may equally apply to other mid and lower tributaries within the Esk Catchment. Additional transects have been established at Packety Creek and across the main Esk River.

The Broken River Catchment:

The tributaries of the Esk and Broken River Catchments showed the greatest change in bed levels since the initial survey.

As in the case of the Esk watershed, the country constituting the drainage basin of the Broken River has been subjected to burning and extensive grazing. It is perhaps significant that all transects showed a change in level. Of eight profiles remeasured, five had aggraded and three had degraded. The greatest magnitude of change was recorded from a tributary below Whitewater River where degradation of 2.10 feet had occurred (Fig. 4b). Aggradation of 1.10 feet was recorded from a tributary below Winding Creek, the 1961 profile having been entirely planed off. A lateral main channel shift of 38 feet had resulted (Fig. 5).

SUMMARY

Past land use in the form of fires and grazing has modified much of the cover over areas within the Waimakariri Catchment. This modification has occurred mainly south and east of a line drawn from Bull Creek in the N.E. across to the Andrews River and up the main Waimakariri to the Anti-crow River in the S.W. (Fig. 7).

A point emerging from the present resurvey is that 75% of measured streams draining country south-east of this line showed a net change in level, as aginst 40% showing change north-west of this line. The average magnitude of change was greater in the former instance. A larger number of streams had aggraded rather than degraded in both cases. Similarly, the instances and amount of lateral channel shift and bank retreat was greater to the south-east than to the north-west of the line. Relevant details are shown in Tables 1B and 2B.

Because of the limited number of transects and the short interval of time between measurements the results indicated cannot be regarded as conclusive. Trends towards aggradational change in streams draining particular classes of country could be inferred but conclusions at this point may be misleading or even erroneous. However, the transects have been established and a start made in the collection of quantitative data. It is hoped subsequent remeasurements will clarify present uncertainties regarding suspected trends revealed by the respective surveys, and the order of magnitude with which these trends occur.

ACKNOWLEDGEMENT

Thanks are due to the Tussock Grasslands & Mountainlands Institute, Lincoln College, for permission to modify Fig. 6 and reproduce Fig. 7.

TABLE 1

Stream Bed Elevation Changes 1961-67

1A

Catchment	No. of Transects Remeasured	Transects Aggraded	Transects Degraded	Transects Unchanged	Mean Change in level
Upper Waimakariri	15	6	1	8	+ 0.20'
Esk	5	4	0	1	+ 0.30'
Poulter	16	5	2	9	+ 0.18'
Broken River	8	5	3	0	+ 0.06'
Waimakariri Catchment	44	20	6	18	+ 0.19'

1B

S.E. of Anti-crow Bull Creek Line	24	14	4	6	+ 0.22'
N.W. of Anti-crow Bull Creek Line	20	6	2	12	+ 0.15'
Waimakariri Catchment	44	20	6	18	+ 0.19'

TABLE 2

Distances of Channel Shift and Bank Retreat - 1961-67

2A

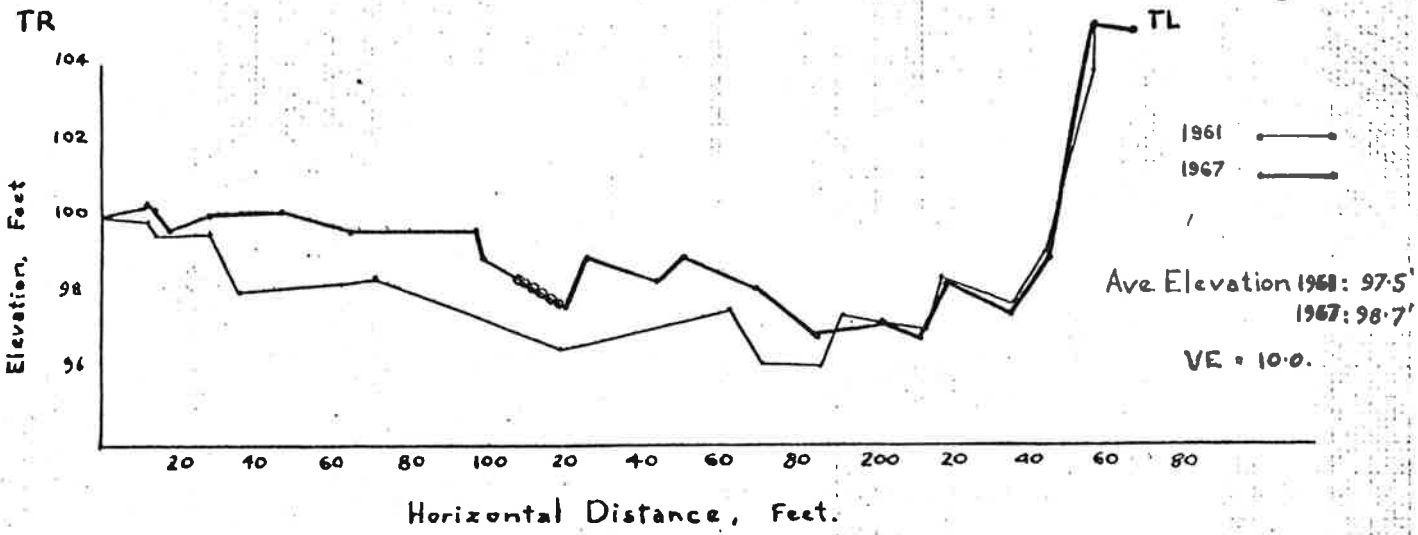
Catchment	No. of Transects Remeasured	Instances of Channel Shift	Amount of Channel Shift	Instances of Bank Retreat	Amount of Bank Retreat
Upper Waimakariri	15	8	25.27'	5	1.80'
Esk	5	3	50.80'	5	5.80'
Poulter	16	7	15.87'	0	insignif.
Broken River	8	6	12.38'	2	1.75'
Waimakariri Catchment	44	24	22.41'	12	1.59'

2B

S.E. of Anti-crow Bull Creek Line	24	15	27.21'	9	2.21'
N.W. of Anti-crow Bull Creek Line	20	9	16.65'	3	0.85'
Waimakariri Catchment	44	24	22.41'	12	1.59'

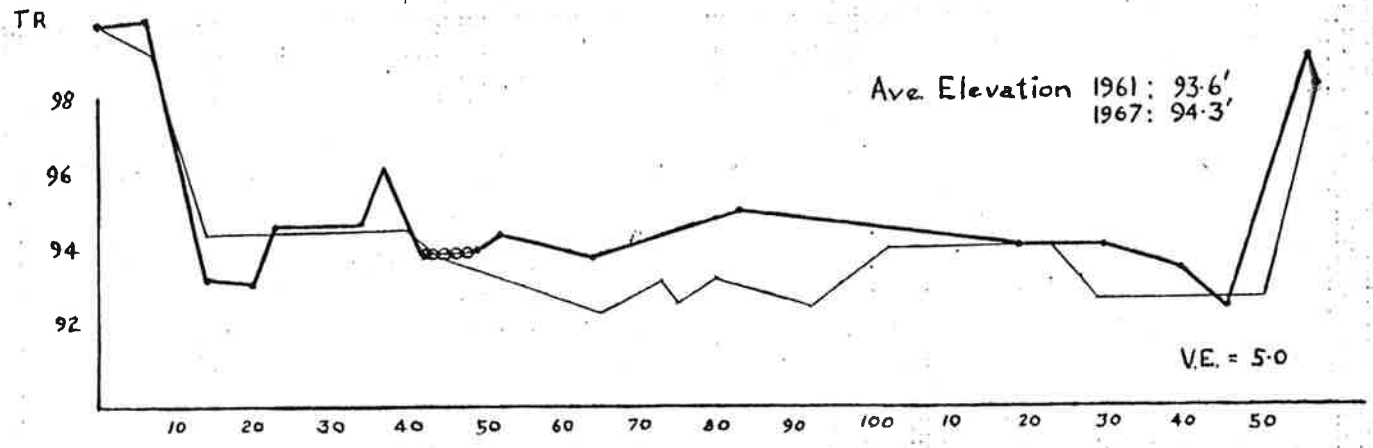
Upper Waimakariri Line 1

Fig. 1a



Upper Waimakariri Line 9.

Fig. 1b



Upper Waimakariri Line 10 Anti Crow Stream.

Fig. 1c.

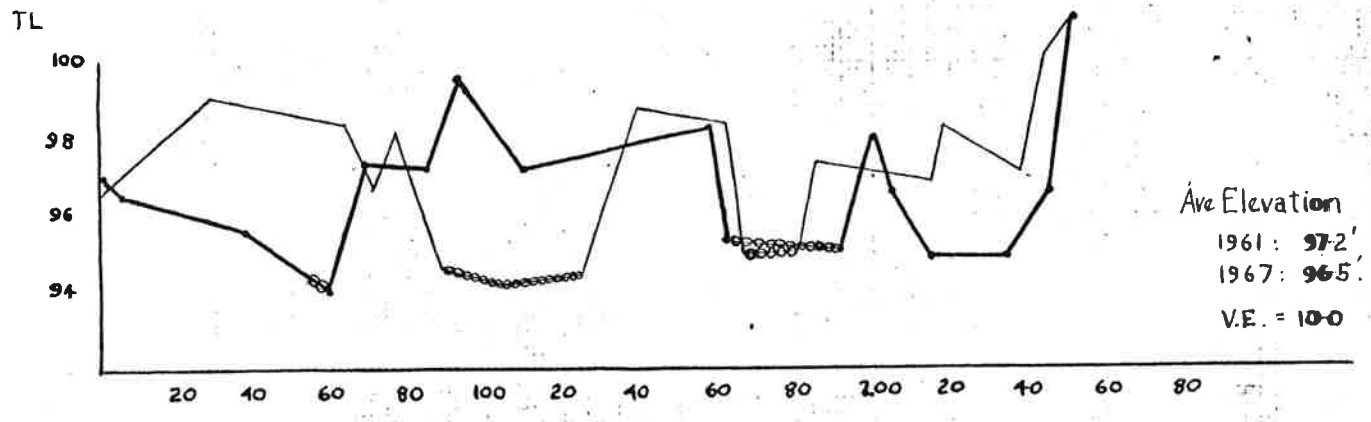


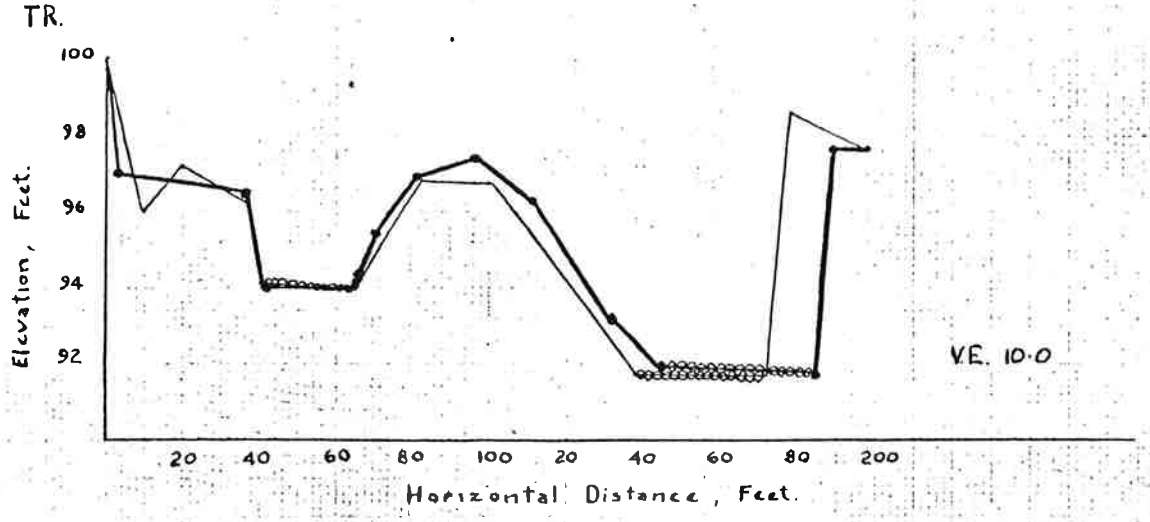
Figure 1

Relative Levels: 1961.

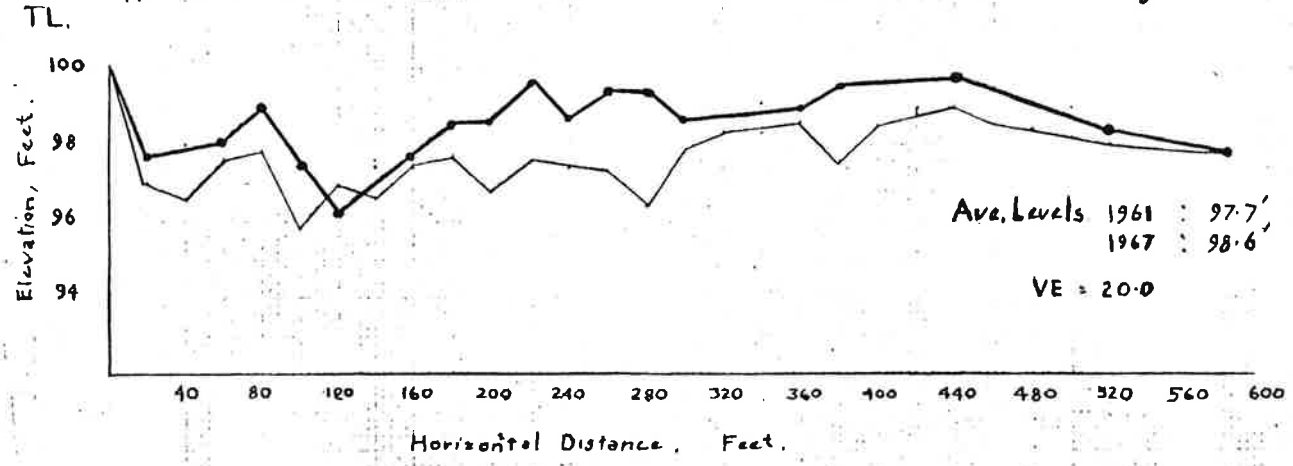
1967.

Active Channels:

Upper Waimakariri Line 14 Fig. 2a



Upper Waimakariri Line 15 Bruce Stream. Fig 2b



Esk Line 1 Nigger Stream. Fig 2c

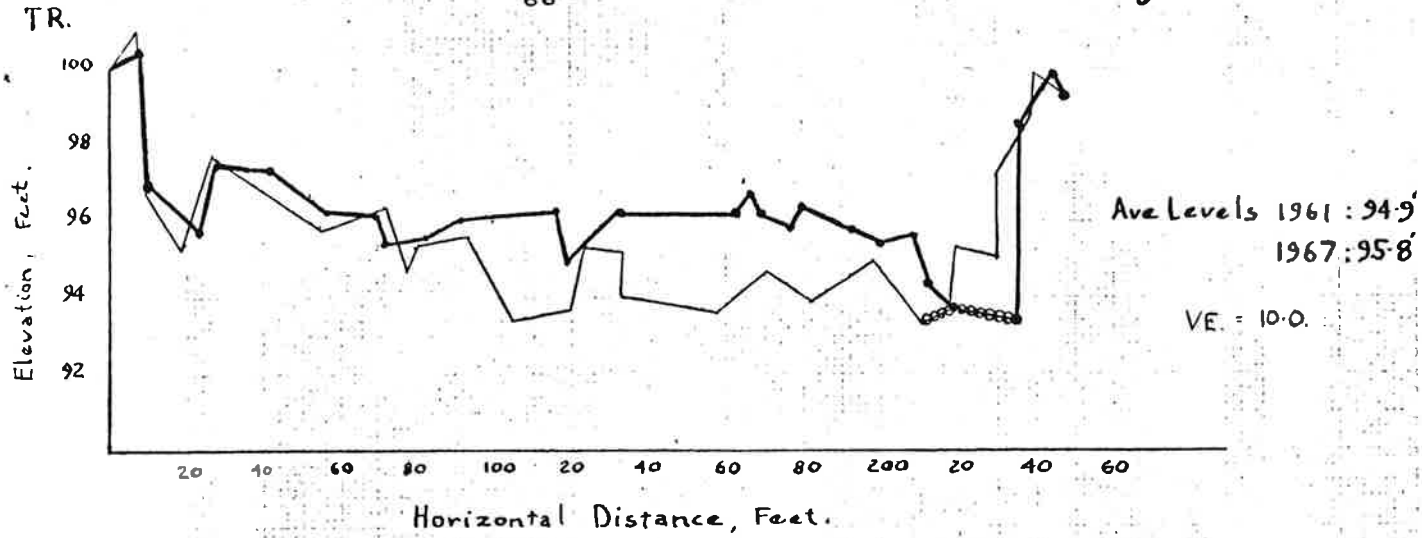
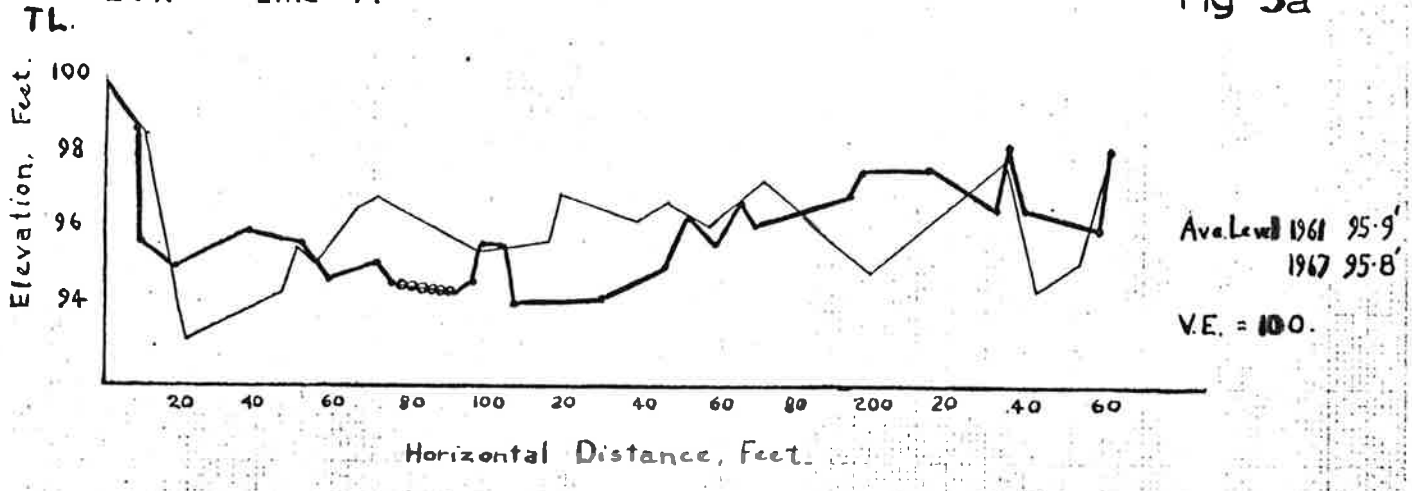


Figure 2

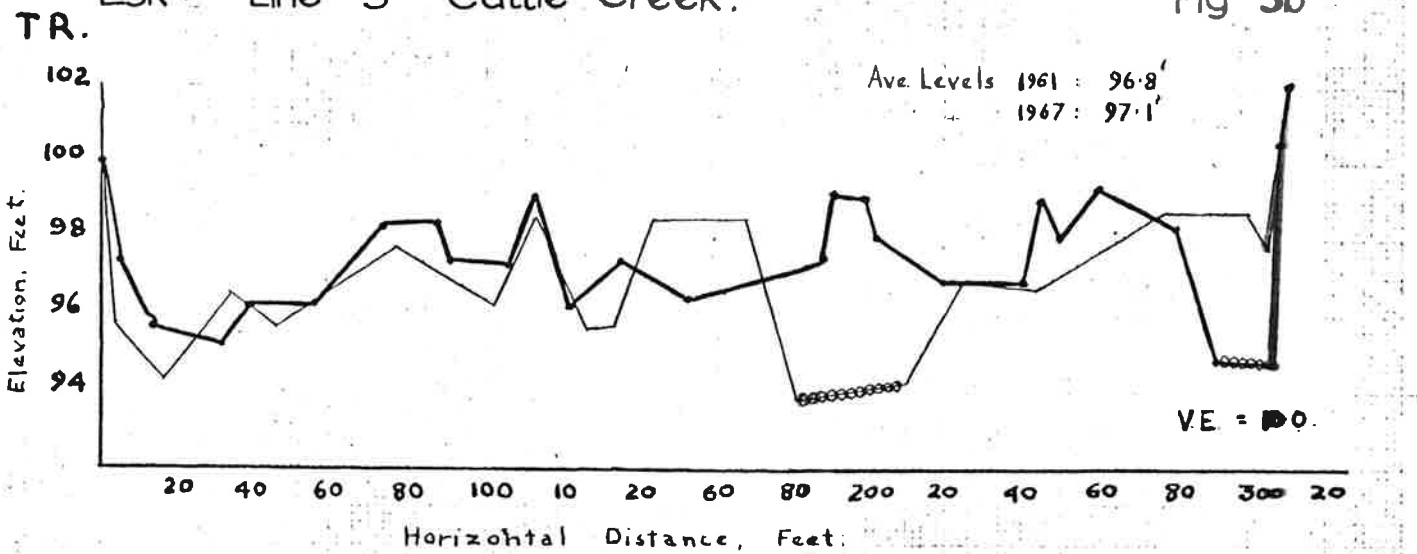
Relative Levels 1961 ——
1967 ●——●

Active Channels ∞∞∞

Esk Line 4. Fig 3a



Esk Line 5 Cattle Creek. Fig 3b



Poulter Line 2 Minchin River. Fig 3c

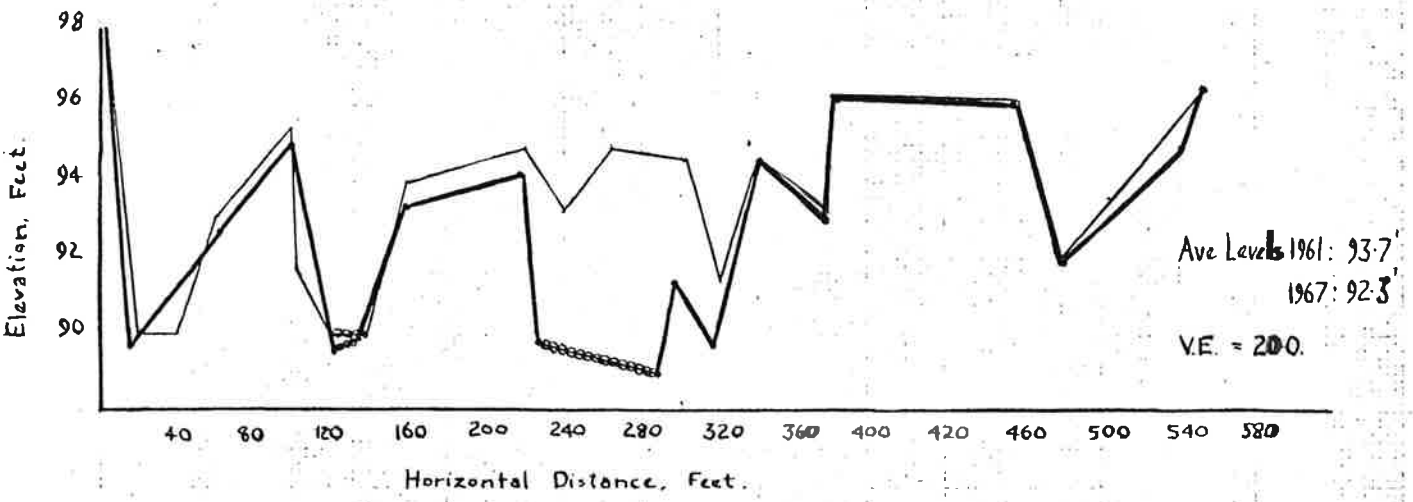
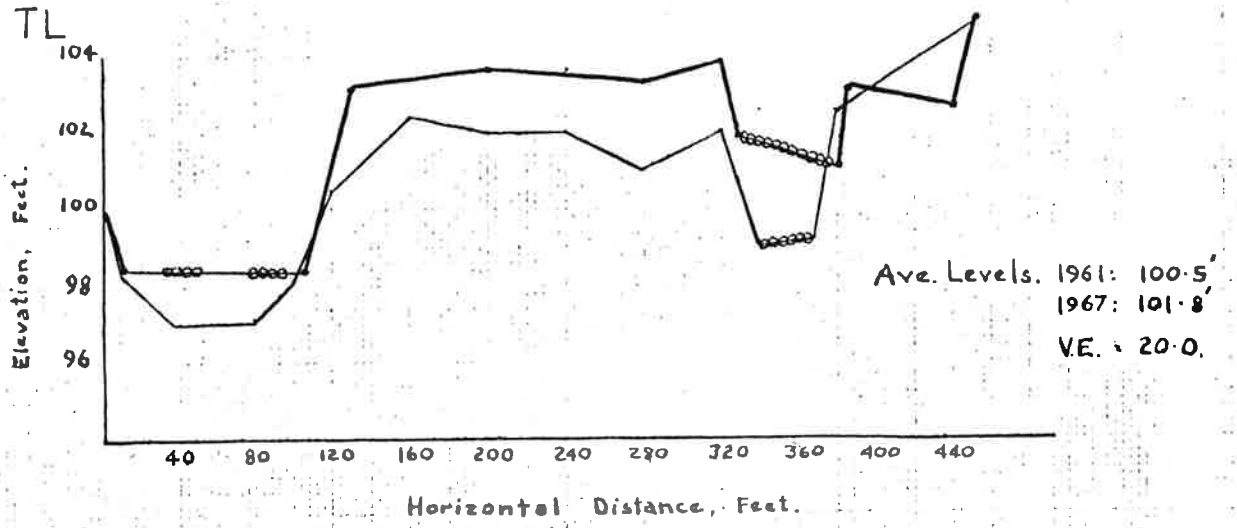


Figure 3

Relative Levels 1961 ——
1967 ——

Active Channels ooooo

Poulter Line 11 Casey Stream. Fig 4a.



Broken River Line 10 Fig 4b.

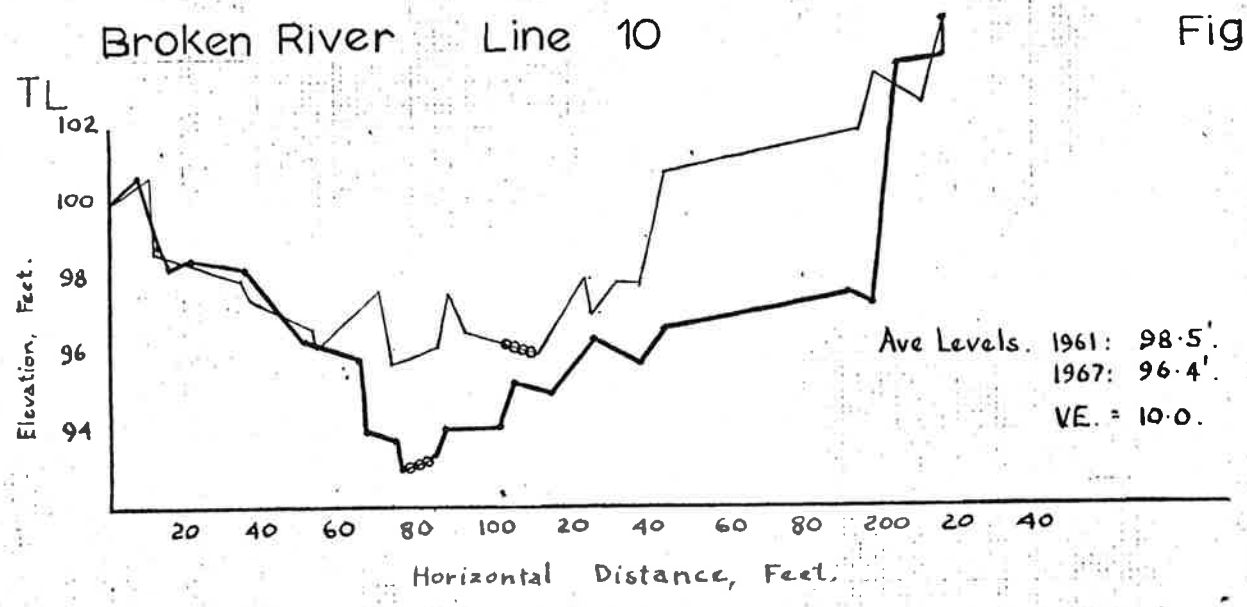


Fig 4c

Broken River Line 1

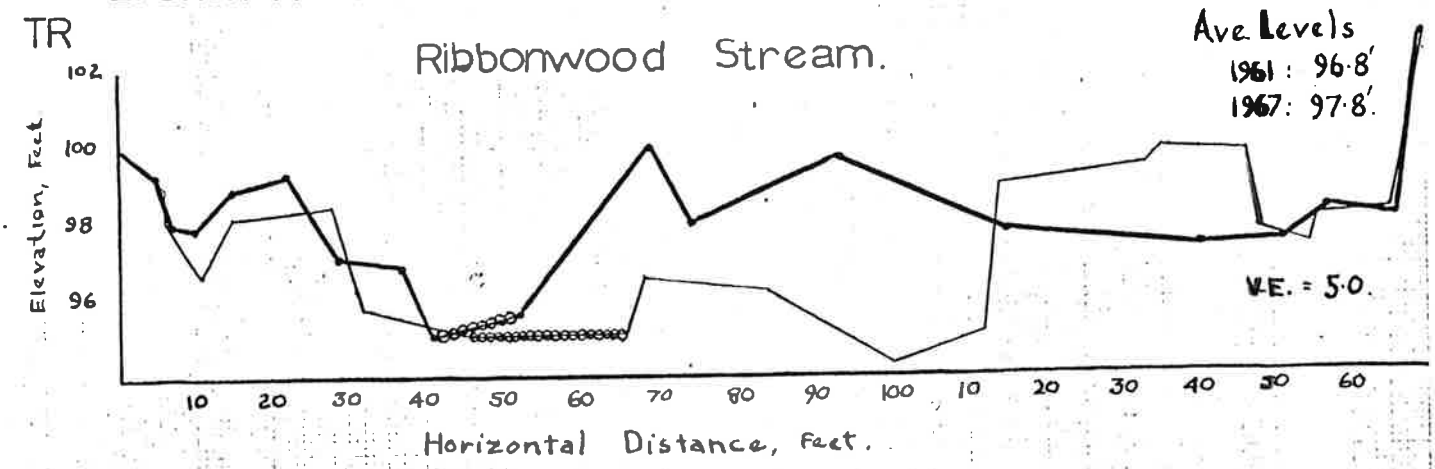


Figure 4.

Relative Levels 1961 ——
1967 ●——●

Active Channels ●●●●●●●

Broken River Line 4. Fig 5

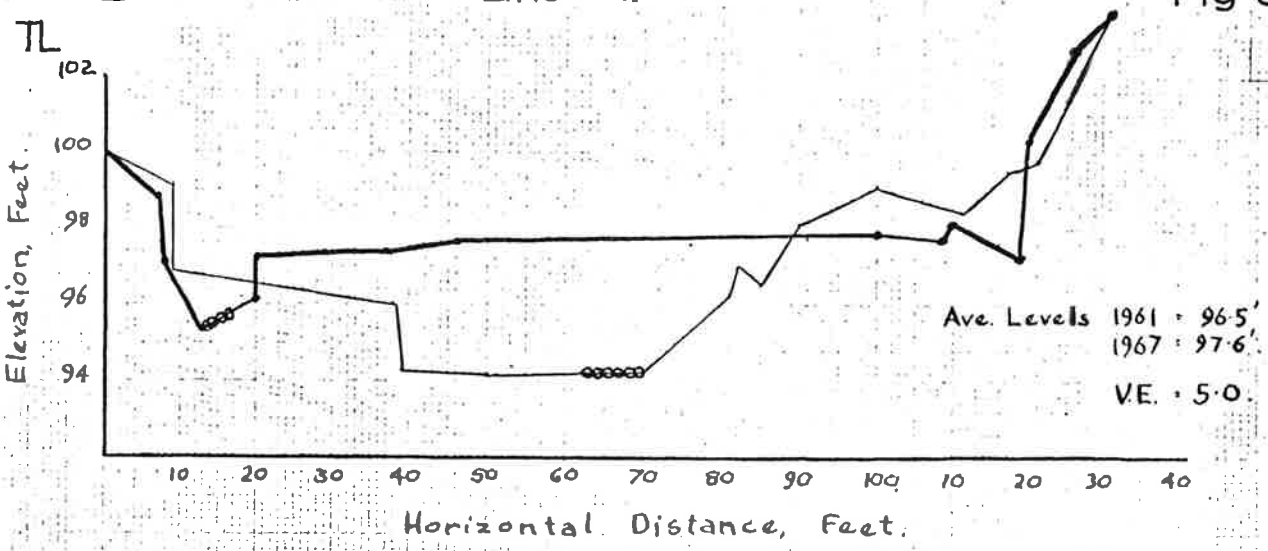


Figure 5

Relative Levels. 1961 ——
1967 ——

Active Channels. ●●●●●●

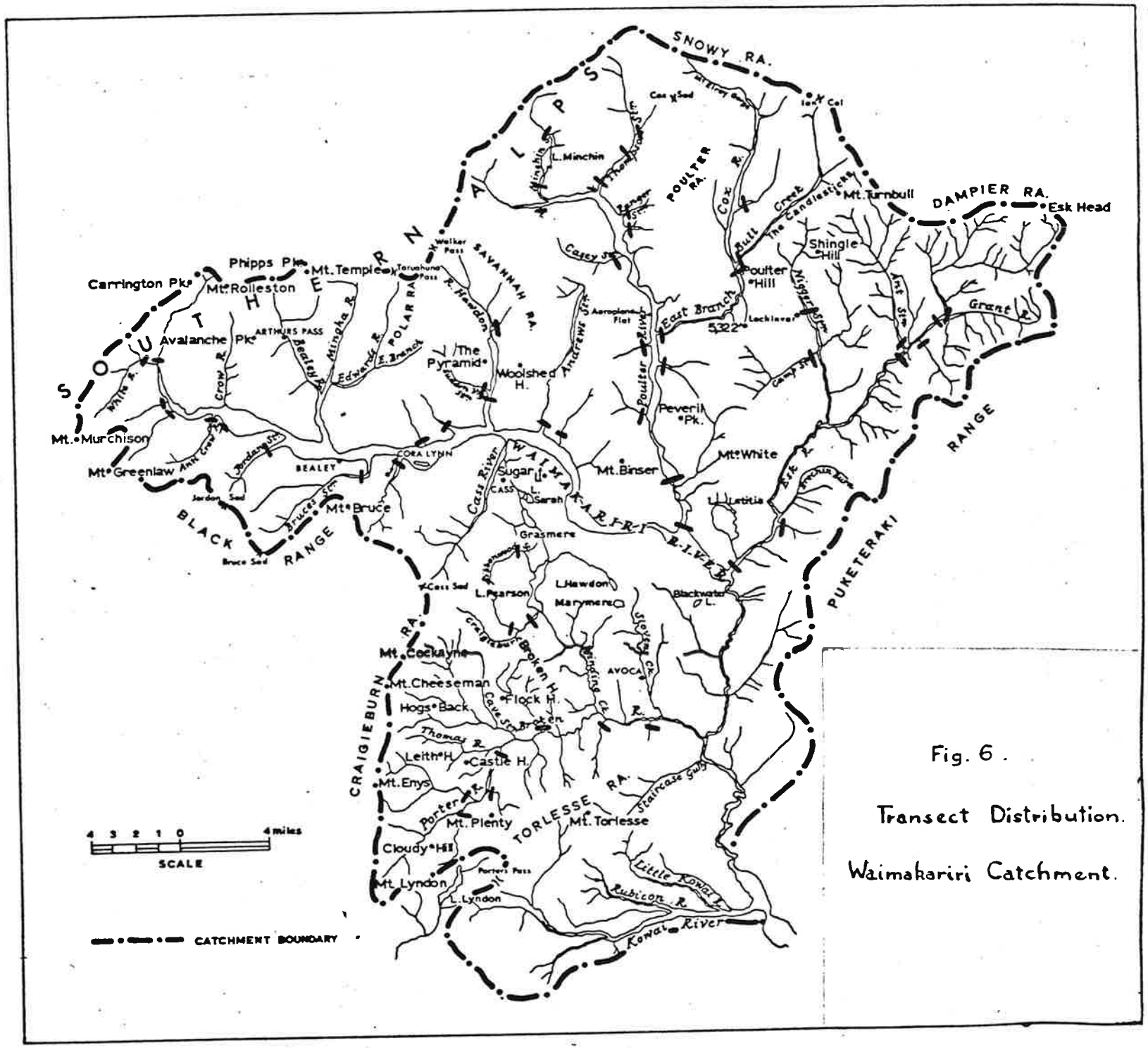


Fig. 6.

Transect Distribution.

Waimakariri Catchment.

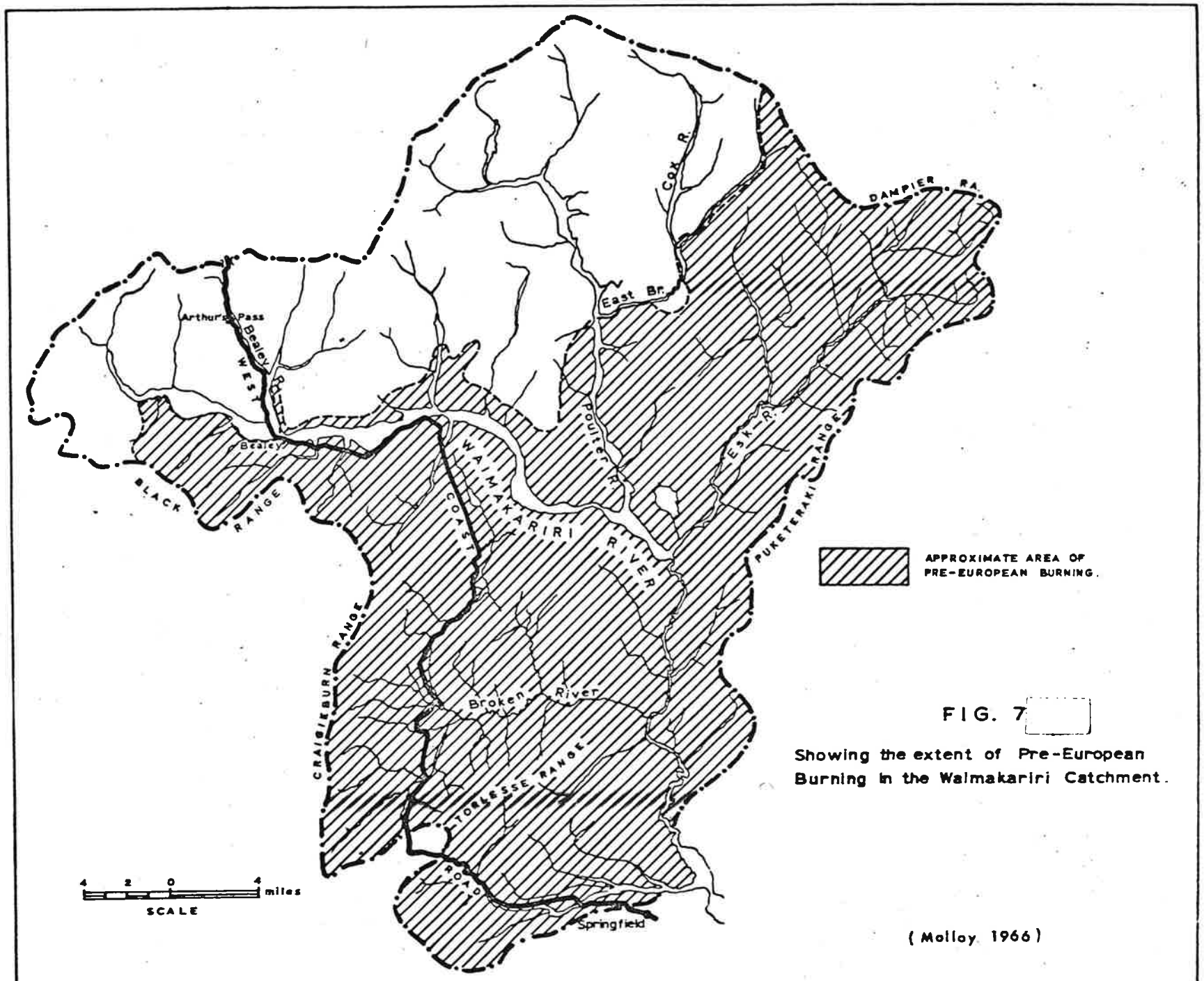


FIG. 7

Showing the extent of Pre-European Burning in the Waimakariri Catchment.

(Molloy 1966)

Fig. 8a: The broad anastomosing pattern of the middle reaches of the main Waimakariri River, upstream of the Hawdon River confluence.

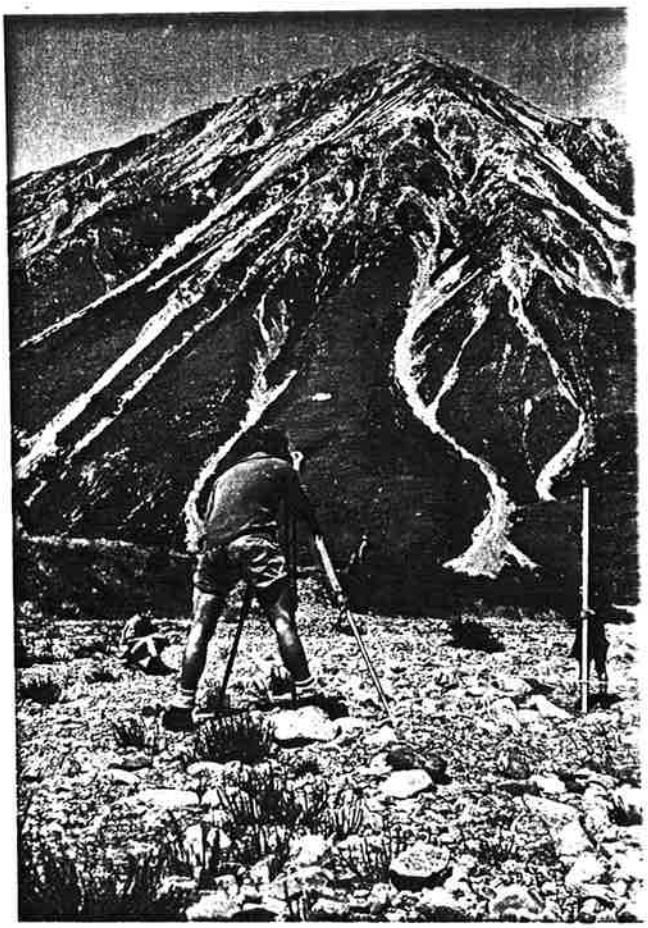


Fig. 8b: A 3 man party using a surveyor's level and staff to measure a stream-bed profile. Peveril Peak (Poulter Catchment) in background.

Figure 9.

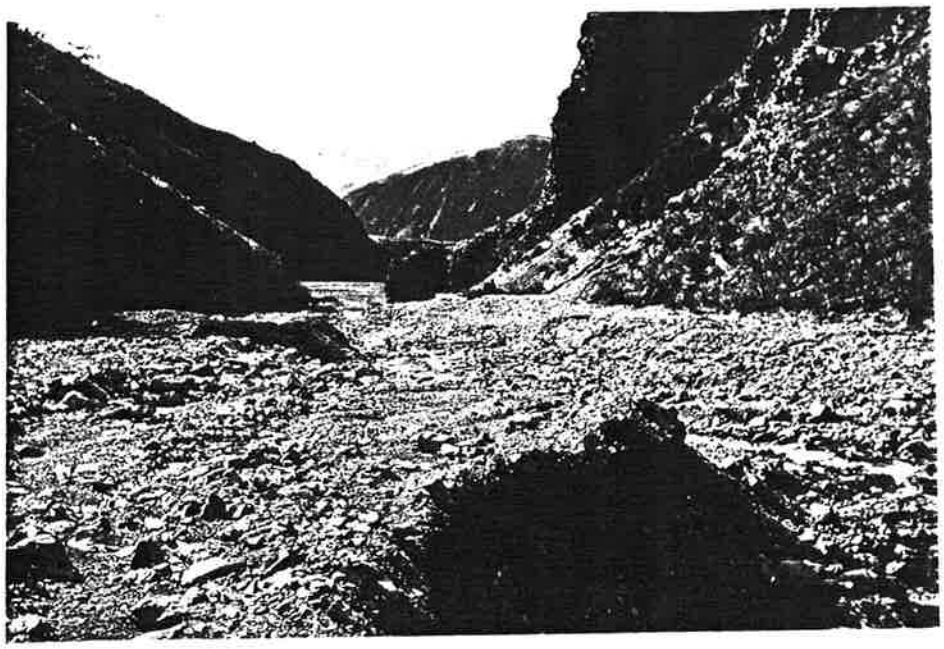


Fig. 9a

Photo: W.J. Wendelken, 21.4.58

Fig. 9b

Photo: 10.7.67

Although essentially qualitative, comparative photographs are a useful tool in assessing stream-bed change.
The freshly deposited gravels of Fig. 9a have since been modified or removed.
Stream-bed vegetation in the lower photograph comprises mainly hard and silver tussocks.
Both photographs from the middle reaches of Ribbonwood Stream.
(Broken River Catchment)

Figure 10

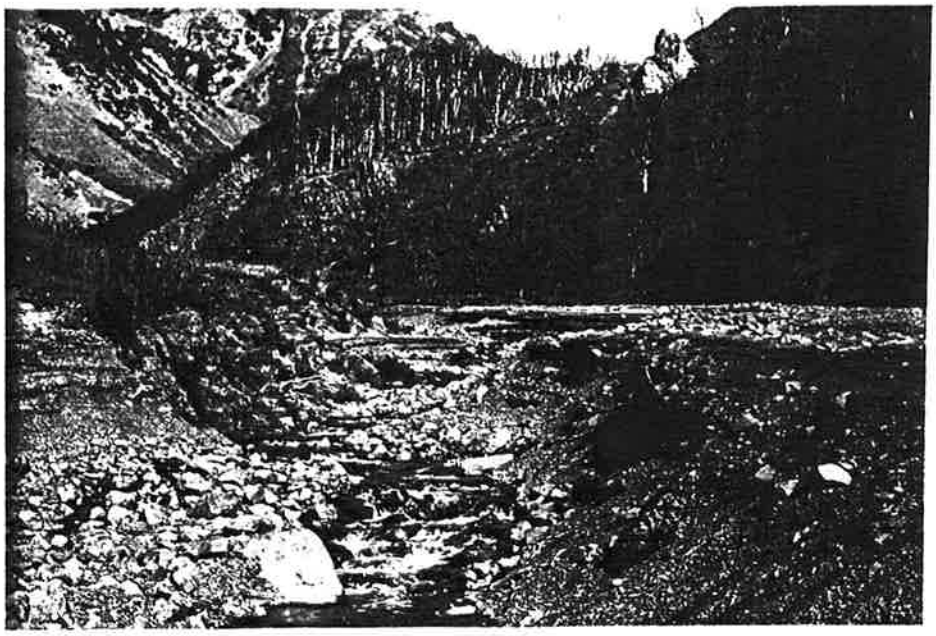


Fig. 10a

Photo: W.J. Wendelken, 21.4.58

Fig. 10b.
Photo: 10.7.67

Comparative photos, again from Ribbonwood Stream.
The large stream-bed boulder in Fig. 10b can be recognised in Fig. 10a.
The transect line, some 15 chains downstream from this point, showed a level rise of 1.0 feet since the original survey.

Figure 11

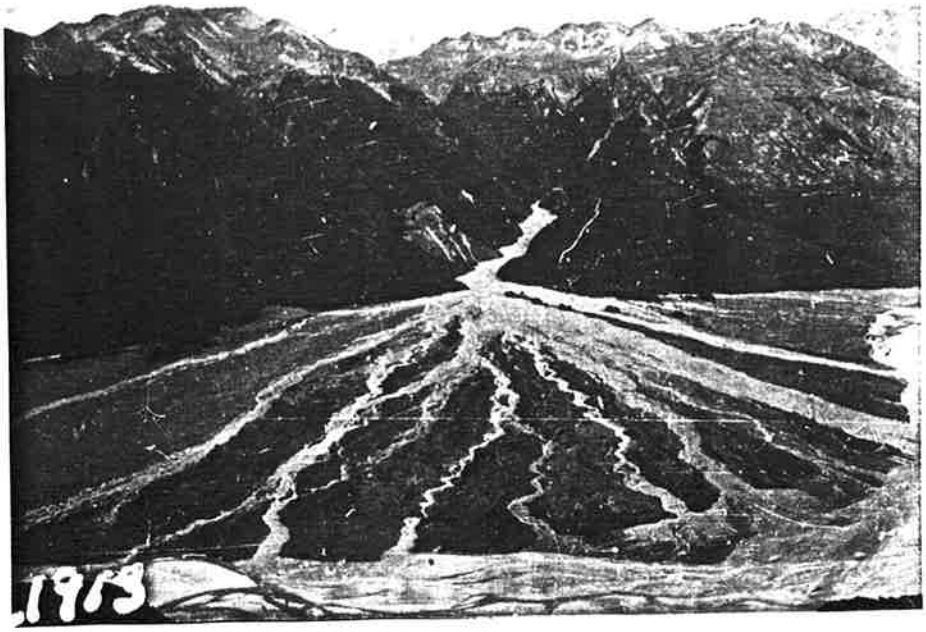


Photo:
W.J. Wendelken,
24.1.67

Fig. 11a: The Jordan River in high flow, January 1957. The profile transect is established 10 chains upstream from the bush edge.

Fig. 11b: The Jordán Transect in January 1967. The profile showed no detectable change in level from that of the original survey.

Photo: A.R. McGerty 12.1.67