Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

AOKAUTERE BASINS: A STUDY IN MORPHOMETRY

A thesis presented in partial fulfilment of the requirements for the Degree of Master of Arts in Geography at Massey University

by NANYANG LEE

1973

ACKNOWLEDGMENTS

I gratefully acknowledge the following individuals and organisations: Dr. J.L. McArthur who supervised and offered valuable advice and criticism throughout the study; Geography Department of Massey University for providing a field work vehicle and equipment; farm owners of the study area for giving permission to carry out field work on their farmlands; Aerial Mapping Ltd. of Hastings, City Council of Palmerston North and the Manawatu Catchment Board for supplying information and topographic maps; Wellington Meteorological Office for providing the required climatic data; Messrs. C.T. Liew and A. Fleming for assistance in field work; and all the people who have assisted in the course of study.

TABLE OF CONTENTS

	page
ACKNOWLEDGRMENTS	ii
TABLE OF CONTENTS	iii
LIST OF TABLES	v
LIST OF FIGURES	vi
LIST OF PLATES	viii
CHAPTER I INTRODUCTION	1
I.1 Location Of The Study Area	1
I.2 Aim	1
I.3 Data	2
I.4 Techniques	2
I.5 Previous Research	3
CHAPTER II CLIMATE AND GEOLOGY	6
II.I CLIMATE	6
II.1.1 Temperature	6
II.I.2 Rainfall	7
II.I.3 Wind	7
II.II GEOLOGY	10
II.II.1 Stratigraphy	10
II.II.2 Relief And Geomorphological History	12
CHAPTER III BASIN CHARACTERISTICS - AREAL AND LINEAR	17
III.1 Stream Numbers	18
III.2 Stream Lengths	20
III.3 Pasin Areas	21

	page
III.4 Frequency Distributions (f Leng And Areas	gths 23
III.5 Relation Between Area And Lengt	th 26
III.6 Drainage Density And Constant C Channel Maintenance	Of
III.7 Basin Shapes	29
III.8 Summary	32
CHAPTER IV BASIN CHARACTERISTICS - RELIEF	36
IV.1 Drainage Basin Relief	36
IV.2 Erosional Surfaces	38
IV.3 Total Relief	39
IV.4 Relief Ratio	40
IV.5 Relation Between Drainage Densi And Relief Ratio	Lty 42
IV.6 Channel Gradient	45
IV.7 Maximum Slope Angle	46
IV.8 Hypsometric Integral	47
IV.9 Correlation Of Relief Variables	52
IV.10 Summary	55
CHAPTER V CONCLUSIONS	58
REFERENCES	61

LIST OF TABLES

			page
Table	1	Mean ind Extreme Temperatures	8
	2	Earth Temperatures At Four Inches And Three Feet	8
	3	Number Cf Days Of Ground Frost	8
4 5	4	Rainfall In Inches	9
	5	Wind Force	9
	6	Wind Frequency And Force	9
	7	Drainage Density (Mi/Mi ²)	28
	8	Constant Of Channel Maintenance (Mi ² /Mi)	29
	9	Elongation Ratio	31
i i	10	Average Total Relief (Feet)	40
	11	Relief Ratio	41
	12	Observed Average Values Of Relief Ratio, Drainage Density And Length Of Overland Flow	44
	13	Expected Average Values Of Drainage Density And Length Of Overland Flow Derived From The Observed Relief Ratio	44
	14	Average Channel Gradient	45
1	15	Percentage Frequency Distributions Of Hypsometric Integral Of First And Second Order Basins, Alton And Bolton Creeks	48
3	16	Average Hypsometric Integrals	49
	17	Table Of Correlation Coefficients	53

LIST OF FIGURES

			following page
Figure	1	Location Of The Study Area	1
	2	Topographic Map of Alton And Bolton Basins	1 .
	3	Mean Temperatures (OF)	7
	4	Monthly Rainfall (Inches)	7
	5	Mean Annual Percentage Frequency And Force Of Wind Directions	7
	6	Palmerston North Area: Geology	10
	7	Northwest-Southeast Cross Section Of The Tiritea Formation	14
	8	Cross Profile Of The Cliff Stream Terraces	15
	9	Relation Of Stream Order And Number	18
	10	Relation Of Stream Order And Averag Length	e 21
¥:	11	Relation Of Stream Order And Averag Area	e 22
	12	Histograms Showing Log Distribution Of Channel Lengths	s 23
	13	Histograms Showing Log Distribution Of Basin Areas	s 24
	14	Relation Of Channel Length To Basin Area, Alton First Order	26
	15	Relation Of Channel Length To Basin Area, Alton Second Order	26
	16	Relation Of Channel Length To Basin Area, Bolton First Order	26
	17	Relation Of Channel Length To Basin Area, Bolton Second Order	26
	18	Frequency Distribution Histograms Of Elongation Ratio	31

		following page
Figure 19	Relation Of Basin Order And Average Total Relief	40
20	Relation Of Basin Order And Relief Ratio	41
21	Relation Of Drainage Density To Relief Ratio, Alton Creek, First Order	43
22	Relation Of Drainage Density To Relief Ratio, Alton Creek, Second Order	43
23	Relation Of Drainage Density To Relief Ratio, Bolton Creek, First Order	43
24	Relation Of Drainage Density To Relief Ratio, Bolton Creek, Second Order	43
25	Relation Of Basin Order And Channe Gradient	45
26	Frequency Distribution Histograms Of Channel Gradient	45
27	Frequency Distribution Histograms Of Maximum Slope Angle	47
28	Selected First-Order Hypsometric Curves	49
29	Selected Second-Order Hypsometric Curves	51
30	Third-Order Hypsometric Curves	51
31	Fourth-Order Hypsometric Curves	52

LIST OF PLATES

		following page
Plate 1	Cliff Stream Terrace	15
2	Headwater Drainage Areas	29
3	The Middle Reaches Of Alton Creek	39
4	Slope Break Between The Interfluve Surface And Valley Side Slope	50