

NATAL TOWN AND REGIONAL PLANNING REPORTS

VOLUME 17

**The Water Resources of the Coastal Areas
of Northern Natal and Zululand**

Submitted to the Town and Regional Planning Commission

by

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TOWN AND REGIONAL PLANNING COMMISSION, NATAL, 1971

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Explanatory Note

CONVERSION TO THE METRIC SYSTEM

This report was originally submitted for publication in advance of the adoption of the Metric System in South Africa.

Unfortunately, various technical difficulties arose which resulted in its final production being delayed, with the result that the report was overtaken by the adoption of the metric system. As printer's plates had already been prepared for the 73 maps and diagrams contained therein, conversion of the extensive

data would have entailed preparation of new plates at considerable expense and labour.

In the interests of economy and the avoidance of even further delay it was decided to publish the report in its original form. Readers are requested to refer to the following conversion tables extracted from the third edition of *Basic Guide to the Metric System in South Africa*, published in April 1970.

LENGTH

Metres, Yards, Feet, Inches, Cape Feet

metres	yards	feet	inches	Cape feet
1	1.093 61	3.280 84	39.370 1	3.176 034
0.914 4	1	3	36	2.904 165
0.304 8	0.333 333	1	12	0.968 055
0.025 4	0.027 777 8	0.083 333	1	0.080 671
0.314 858 1	0.344 333	1.033	12.395 888	1

VOLUME

Cubic Metres, Kilolitres, Acre Feet, Morgen Feet, Gallons (Imp.)

cubic metres or kilolitres	acre feet	morgen feet	gallons (Imp.)
1	0.000 810 71	0.000 383 038	219.969
1 233.48	1	0.472 47	271 328
2 610.71	2.116 54	1	574 275
0.004 546 09	0.000 003 686	0.000 001 741 3	1

*Cubic Decimetres, Litres, Cubic Feet,
Gallons (Imp.)*

cubic decimetres litres	cubic feet	gallons (Imp.)
1	0.035 314 7	0.219 969
28.316 8	1	6.228 84
4.546 09	0.160 544	1

Foreword

by Mr. R. C. C. Bennett,

Chairman, Town and Regional Planning Commission, Natal

Natalians have long been conscious that the province is singularly well endowed with water resources. In the early stages of development it is seldom necessary to measure these resources as suitable sites can invariably be found for the establishment of development projects which will rely on run-of-the-river flows. With continually increasing population and the consequently escalating demands for crops and manufactures, however, a stage is reached where complete rationalization of the available resources becomes imperative. It is then essential to measure the water resources with accuracy and to formulate sound plans for storage to ensure that adequate water shall be available at all times for both human and industrial needs. This is one of the functions of planning.

Such rationalizations are regional in character. The water requirements of Durban and Pietermaritzburg had placed some strain on the Mgeni river by 1956, when the Commission undertook the task of ascertaining the water resources and water requirements within the Mgeni river catchment. Its report on this investigation was published in 1961, in volume 7 of the Natal Town and Regional Planning Reports. The recommendations made therein were accepted by the Government and the river will be regulated in accordance with them. No other river in Natal was as much in need of a rational development plan as the Mgeni, but the Commission considers that flow and storage values should be known for all the major rivers of the Province, thus facilitating detailed consideration of all development projects which fall within its purview.

The Commission regards the Tugela Basin as a development region and is aware of its potentialities and the water which can be made available for their realization. The same data was not, however, available for the North Coast of Natal and Zululand, but with the appointment of the Water Plan Commission, it was thought desirable that more precise information should be submitted. This report, prepared on the instructions of the Commission, by J. A. Chew and Bowen, Consulting and Chartered Water Engineers, is the result.

The Commission is pleased to be able to publish this addition to its series of planning reports and trusts that it will influence the ordered development of the Province.

R. C. C. BENNETT,

Chairman, Town and Regional Planning Commission.

Durban,
1st February, 1971.

Introduction

This report on the water resources of the coastal areas of Natal and Zululand from the Mhlanga river to the Mkuze river, but excluding the Tugela river, has been prepared to determine the possible development of the water resources of the region.

Maps required for this type of investigation are available over the major portion of catchment areas south of the Tugela river, but in Zululand the maps are not adequate to determine the storage basin characteristics on the shorter rivers.

Records of gaugings of the river flows are inadequate for the complete assessment of the water yields of the storage basins. It has, however, been possible to adapt techniques for analysing the available records so that the data obtained from these investigations may be reliable for planning purposes. These findings have been presented in the same form as published in volume 7 of the Town and Regional Planning Commission's reports.

Owing to these limitations, attention is directed more to the determination of assured draughts, where suitable storage sites are known to be available on major rivers, than to the meticulous comparison of numbers of sites which is normally carried out in the detailed planning stages of river development.

These investigations show possible development of the rivers to meet the future demands of existing users as well as the northern Natal coastal areas and the proposed extensive development of the Richards Bay/Empangeni complex.

SUMMARY OF FINDINGS

The results of these investigations are presented diagrammatically in Figs. 1 to 4 which show the catchment areas together with the potential hydrological development of each river for comparative purposes.

In addition the systems for supplying water to the major complexes of development are presented in flow diagrams for:

- A The Mvoti/Tongaat/Mdloti rivers complex supplying water to the Stanger/Tongaat/Mdloti areas.
- B The Buffalo/Mfolozi/Emseleni rivers complex supplying water to the Richards Bay/Empangeni/Mtubatuba areas.

1. DESCRIPTION OF THE RIVER SYSTEMS

The total area of the drainage systems between the Tugela and the Mgeni rivers is 1600 square miles with an average annual run-off of 640,000 acre feet. In Zululand, between the Tugela and the Pongola rivers, the area is 10,920 square miles with a run-off of 1,965,000 acre feet.

The rivers of Natal and Zululand are mostly perennial with good streamflow characteristics in the dry winter months. They are, however, situated in areas covered largely by Native Reserves where high rainfall intensity occurs resulting in high silt loads or silt movement along the rivers.

In view of the development which is being undertaken along these coastal regions, as well as the upper coal mining areas, attention

is directed to the necessity for planning development of the total catchment areas.

2. TOPOGRAPHY AND RIVER PROFILES

Natal North Coast:

An important feature of all the rivers considered within this report is that their sources are in mountain areas which do not generally rise to peaks higher than five thousand feet above sea level, whereas the other major drainage systems of Natal, such as the Mgeni river, the Tugela river and other major rivers of the south coast of Natal, all rise near the Drakensberg which has peaks over ten thousand feet above sea level.

In northern Natal all the rivers with the exception of the Mvoti river, rise in the Noodsberg and flow in a south-easterly direction along water courses up to 54 miles in length until they reach the Indian Ocean. The Mvoti river, however, has its headwaters approximately 28 miles north of Pietermaritzburg, flows in a north easterly direction and passes through mountains forming the source of other rivers at Mvoti Poort near Greytown, then in a south-easterly direction to enter the sea near Stanger, a total length of 134 miles.

Zululand:

Another notable feature of the area to the north-east of the Tugela river is that the coastal zone is extremely flat, generally less than five hundred feet above mean sea level for a distance of about thirty miles from the sea. This has resulted in the formation of a large number of fresh water lakes.

The rivers in Zululand vary in length up to approximately 220 miles and generally flow towards the Indian Ocean in a south-easterly direction in the upper reaches, but become more easterly in the lower areas nearer the sea.

Average gradients of the shorter rivers are 10 feet per mile and for the longer rivers 20 feet per mile. The river profiles are shown in Appendices 9 to 27 inclusive.

3. GEOLOGY

Two main geological systems occur in the northern Natal and Zululand regions, viz. the Table Mountain Series of the Cape System and the Karroo System.

The Table Mountain Series usually form the flat-top mountains due to the hard quartzitic rocks which resist weathering. This is predominant in eastern Natal along the high areas about ten to twenty miles from the coast. The river valleys have exposed the underlying Dwyka and Ecca Beds of the Karroo Systems and sometimes the Older Granite. These conditions prevail further inland but with a greater distribution of the Dwyka and Ecca Series, each occurring on the surface along a band in the north east-south west direction.

The area to the north east of the Tugela river has been extensively faulted for a distance of about fifty miles from the coast, which has resulted in the haphazard exposure on the surface of the Older Granite, the Table Mountain Series and the Karroo System. Further inland the Dwyka and Ecca Series of the Karroo System are predominant and no serious or extensive faulting has occurred.

Intrusions of dolerite in the form of dykes and sills are common in the Karroo System. It is not easy to recognise on the surface the formation from which dolerite has been derived as the weathering of the rocks does not usually show a definite pattern.

The general geological formation which outcrops along the rivers is shown on the river profiles.

This information has been obtained from Geological Maps compiled by the Drawing Office of Geological Survey, Pretoria.

4. RAINFALL

Isohyetal maps have been prepared for areas both north and south of the Tugela river from long term annual rainfall records.

FIG. 1
POTENTIAL DEVELOPMENT OF COASTAL RIVERS OF
NORTHERN NATAL AND ZULULAND

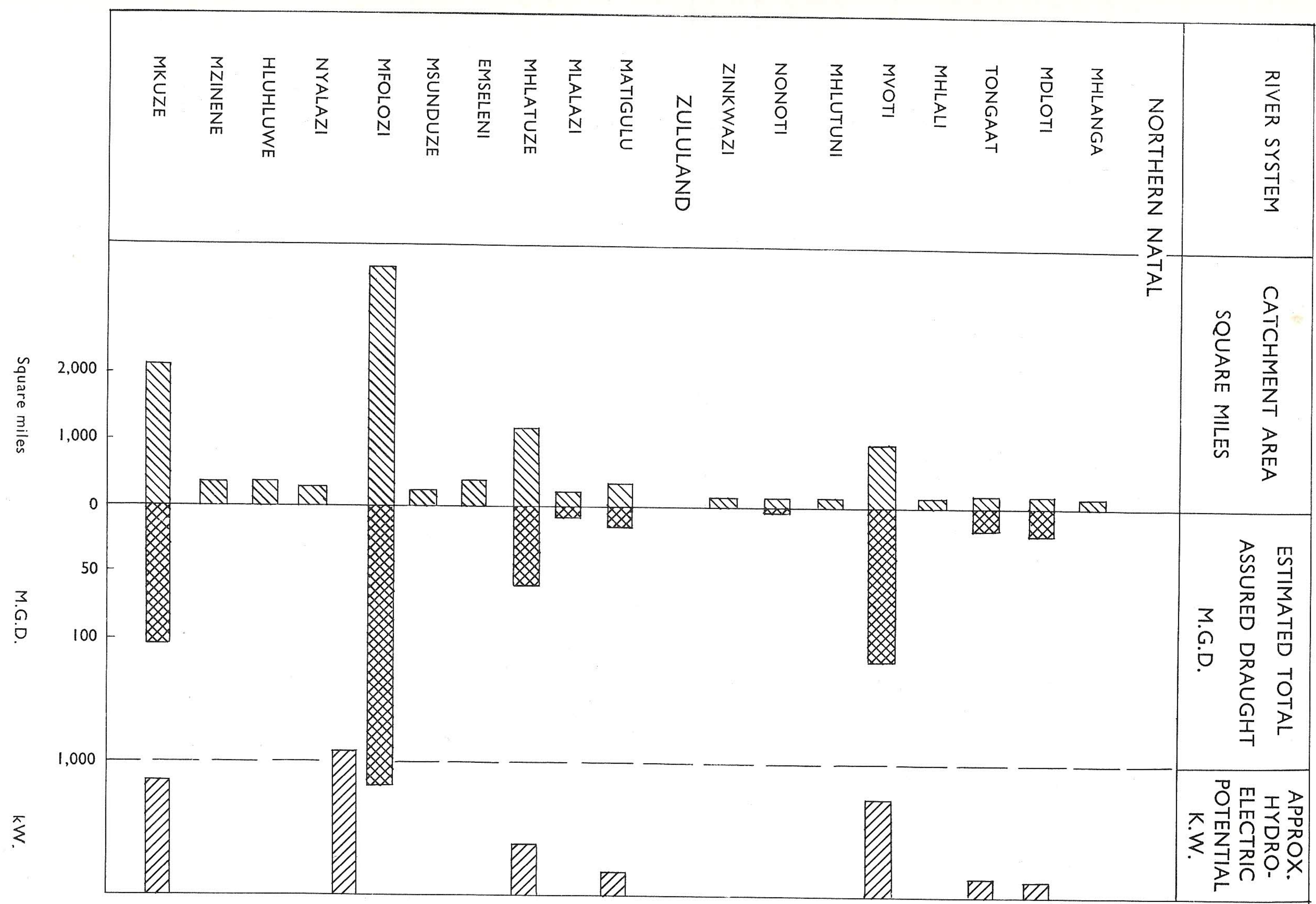
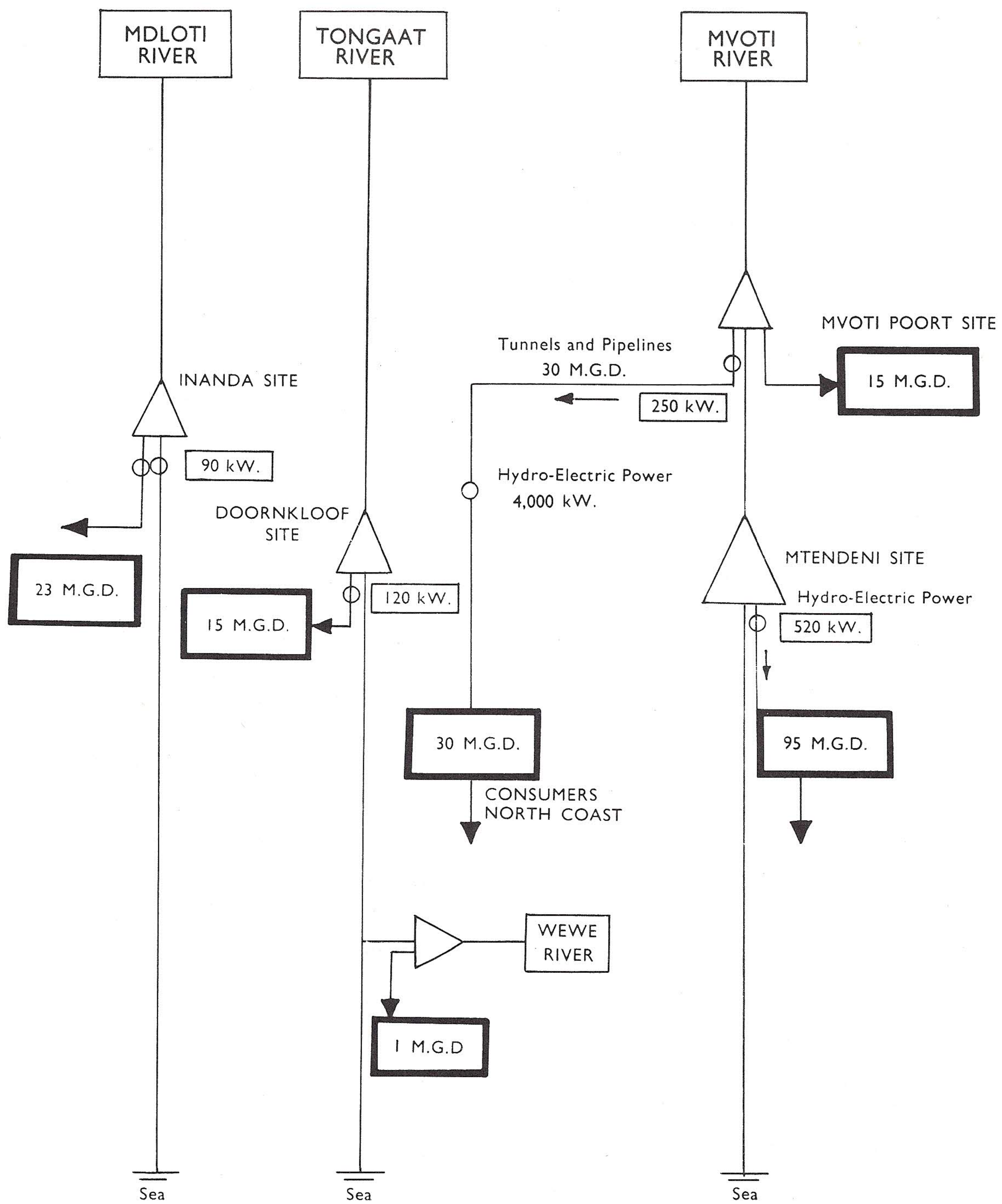


FIG. 2

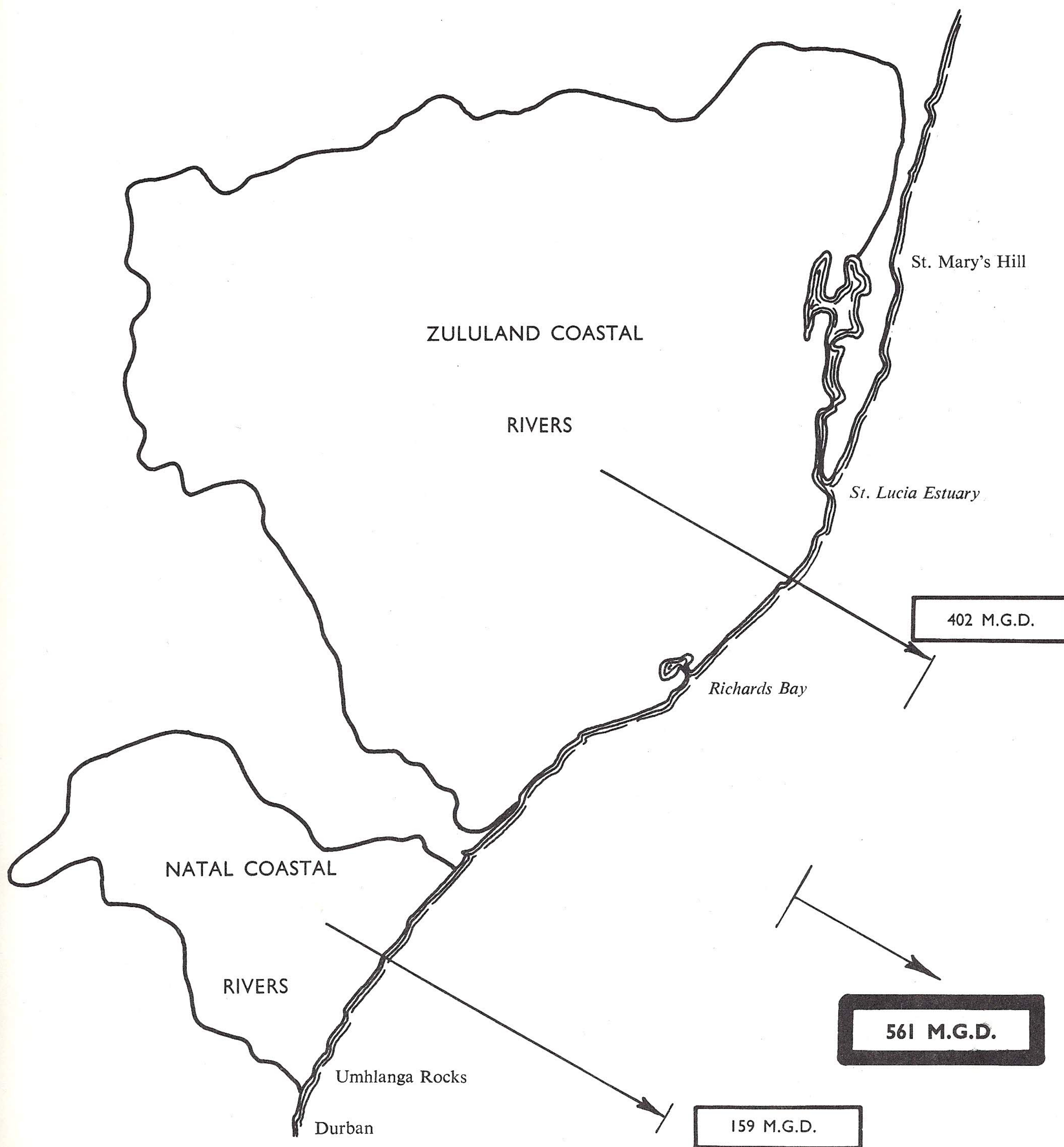
OPTIMUM DEVELOPMENT OF WATER RESOURCES OF
MVOTI, TONGAAT, MDLOTI RIVERS



TOTAL CUMULATIVE YIELD 156 M.G.D.
TOTAL HYDRO-ELECTRIC POTENTIAL 1,000 K.W.

FIG. 4
CUMULATIVE ASSURED DRAUGHT

Scale: 1,500,000



The average rainfall varies from 30 inches to 60 inches in northern Zululand while on the north coast the variation is between 30 inches and 50 inches.

Although this rainfall pattern indicates catchments where highest run-off may occur, it also shows clearly the areas where irrigation requirements are probably the greatest.

All the river catchments considered in this report are within Rainfall District 14B, as given by the Weather Bureau, except for the upper reaches of the White Mfolozi catchment in the vicinity of Vryheid, which is in District 22B.

A plot of the departure of annual rainfall from the long term average rainfall for districts 14B and 22B is presented in Fig. 5 to show the pattern of rainfall in these areas.

These two rainfall districts do not show a distinct correlation pattern over the period from 1905 to 1958 and are in fact out of phase for each of the areas shaded on the diagram. It will be seen that only in the year 1931 did both districts fall below 80 per cent of the mean at the same time.

There is a lack of rainfall data over the inland areas in the Bantu Reserves, due to the non-existence of rainfall stations, and isohyets here should therefore be treated with due caution.

5. EVAPORATION

Evaporation losses on the North Coast and in Zululand vary from an average of 45 inches to 60 inches per annum. These losses were estimated at various sites after consideration of available monthly records and the net evaporation determined from local rainfall records. Due regard was paid to variations occurring in different months of the year.

These net evaporation losses were considered in relation to the area of water in the storage basin throughout the process of storage/draught analyses.

Department of Water Affairs Professional Paper No. 19 "Evaporation in the Union of

South Africa" by P. K. Goosen, was used for the basic distribution of evaporation.

6. SILT

Conditions which mainly affect silt loads in rivers are the river gradients, the extent and types of vegetation covering the catchment, the geological system, land tenure, and farming practices.

Most of these conditions are unfavourable in the Bantu Reserves from which a major portion of the silt is derived.

No surveys of silt loads in these rivers have been undertaken and it has been necessary to estimate the loss of storage space due to siltation from other references. Professional Paper No. 16 by L. A. Mackenzie and "Suspended Silt Loads in the Tugela River" by E. A. Middleton and W. D. Oliff, have been used for this purpose.

An allowance has been made for retention of 90 per cent of the average silt load over 50 years at a silt content varying from 0.2 per cent to 0.6 per cent by volume (depending upon the catchment under consideration) which has been determined from the above references.

This is included in the dead storage shown on the sustained draught curves for each site.

Typical silt movement in these areas, as estimated by Dr. D. C. Midgley, is shown in Appendices 5 and 6 on which the limits of Bantu Reserves are also indicated.

7. QUALITY OF WATER

Surface Water:

The quality of water in rivers is affected by effluents from industries and minerals in the rocks and soils of the catchment.

The development of the coal fields in northern Natal, which has resulted in contamination of the Black Mfolozi river by sulphates, is a good example.

Many industries have problems in meeting the requirements of the Water Act and the

authorities concerned are taking measures to record the quality of river water and to reduce pollution.

As a result, water quality is generally poor for a distance of about twenty miles from the coast. Further inland the quality varies from fairly good in Zululand to poor in Northern Natal with the only pollution of the headwaters of the larger rivers being evident in the Black Mfolozi and Mkuze rivers.

As these areas develop, any pollution of the fresh water lakes will require careful control as these lakes are used for water supplies.

Underground Water:

As far as the quality of ground water is concerned, the following conditions apply:

- (i) Near the coast the waters are highly saline to slightly saline.
- (ii) To a distance of 50 miles from the sea the waters are mainly Class B waters, viz. mineralized chlorides, having total solids from 750-2500 p.p.m.
- (iii) Further inland the waters are Class C, viz. slightly saline.
- (iv) Near the headwaters of these rivers the temporary hard carbonate waters (Class D) prevail.

8. RUN-OFF

In order to determine run-off from the various catchments, records for each suitable gauging station were considered in relation to the duration curve. These were adjusted on rainfall data to obtain the long term mean annual run-off for the catchment above each gauging station. These results were used to determine the mean annual run-off for each storage site under consideration.

On rivers where flow records were inadequate or not available, run-off was determined by correlation with adjacent catchments.

Unit run-off varies throughout the regions under consideration, from above 500 acre feet per square mile for the coastal area near Durban to below 220 acre feet per square mile for the inland areas of northern Zululand. For determination of run-off from the various catchments, Dr. Midgley's Isomar Map has been used as a guide. In the smaller catchments, however, it has not been possible to determine the run-off with any reasonable degree of accuracy.

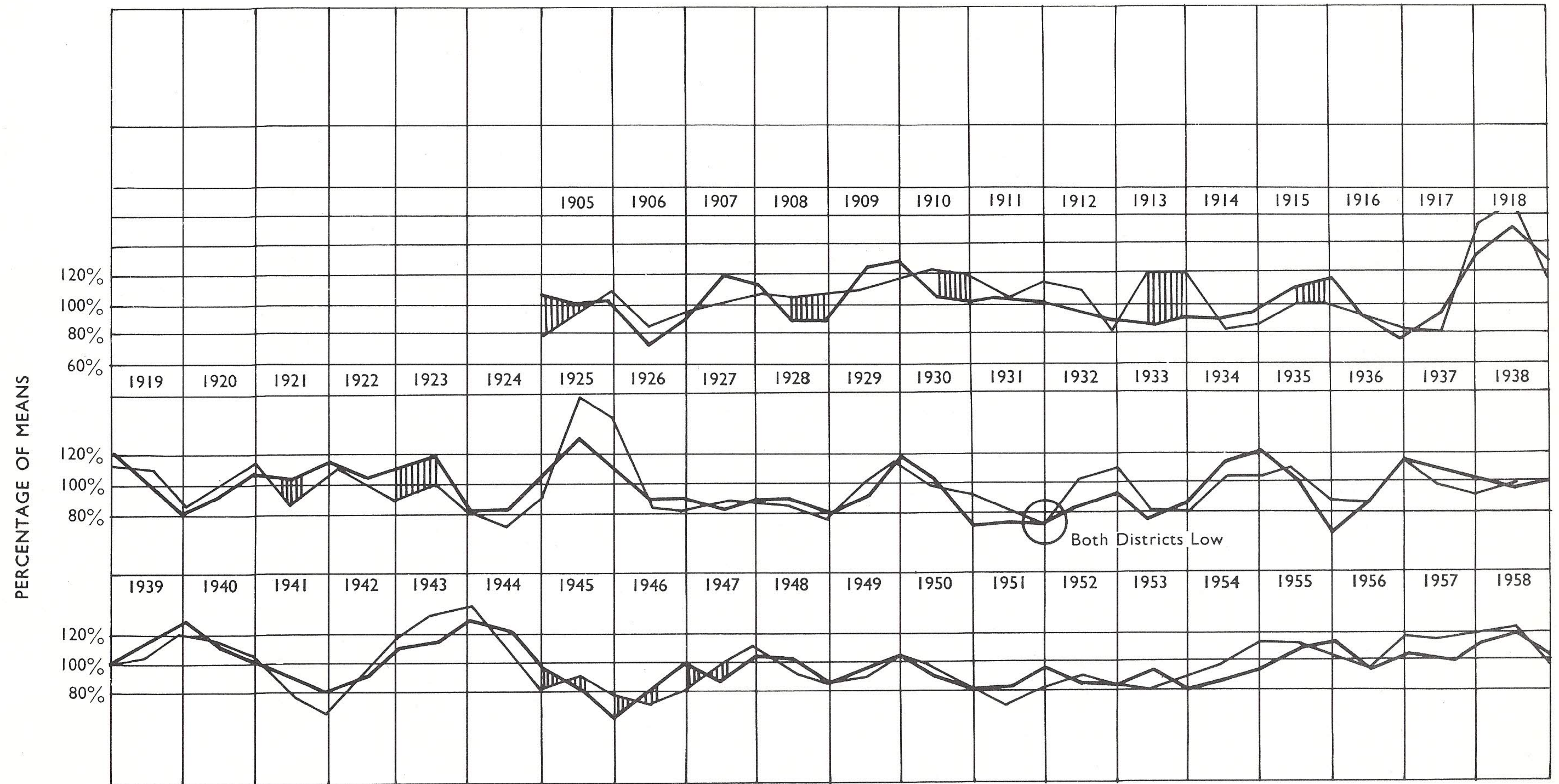
The mean annual run-off of all rivers being considered in this report are shown in Table 2 as the cumulative run-off from source to sea.

Details of the gauging stations available and the mean annual run-off are shown in Table 1 and Appendices 7 and 8.

TABLE 1
Gauging Stations and Run-off

River	Hydro Station No.	Catchment Area square miles	Mean annual Run-off acre feet	Unit Run-off acre feet per square miles	Average Flows		Lowest Recorded Flow cusecs
					Cusecs	M.G.D.	
Mdloti	U ₃ M ₀₂	135	62,000	460	87	46	9.9
Tongaat	U ₃ M ₀₁	96	55,000	570	77	41	5
Mvoti	U ₄ M ₀₂	122	51,000	420	72	38	5.6
Mvoti	U ₄ M ₀₅	949		No long term Records			40 (approx.)
Matigulu	W ₁ M ₁₀	169		No long term Records			0
Mhlatuze	W ₁ M ₀₁	489	121,000	248	170	90	17
White Mfolozi	W ₂ M ₀₃	1976		Not reliable			0
White Mfolozi	W ₂ M ₀₅	1515		No long term Records			0.27
Black Mfolozi	W ₂ M ₀₂	1339		Not reliable			0
Mkuze	W ₃ M ₀₁	553	125,000	226	176	93	0.22
Buffalo	V ₃ M ₀₁	3062		Not reliable			0

FIG. 5
RAINFALL RECORDS FOR DISTRICTS 14B & 22B



Note: Comparisons of 12 monthly rainfall as percentage of means.

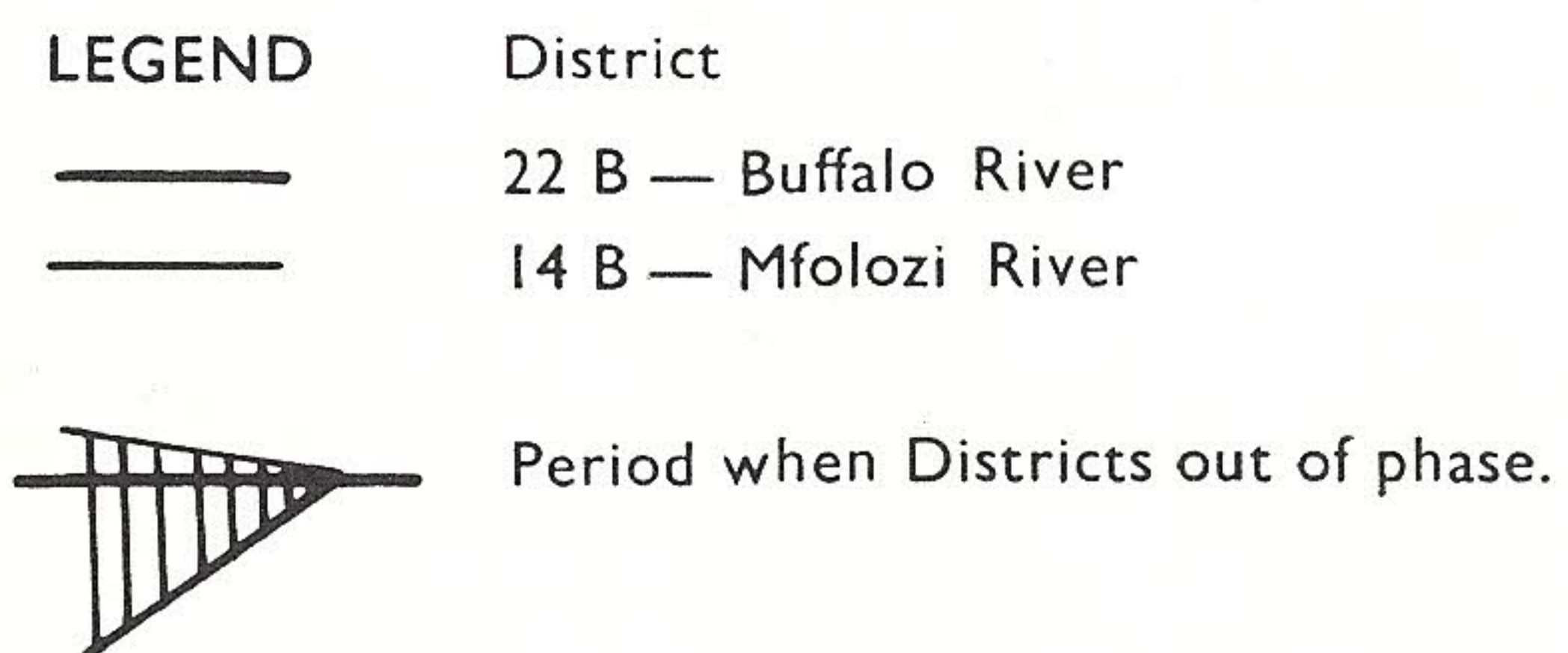


TABLE 2
Cumulative Run-off from Source to Sea

NATAL NORTH COAST RIVERS					
River	Point on River	Catchment Area square miles		M.A.R. acre feet	
		A	B	A	B
Mhlanga	Sea	48	48	16,000	16,000
Mdloti	Inanda	104	104	46,000	46,000
	Sea	88	192	39,000	85,000
Tonga	Doornkloof (including Mona R.)	80	80	46,000	46,000
	Maidstone	21	102	8,400	54,400
	Wewe River	26	128	10,400	64,800
	Sea	26	154	10,400	75,200
Mhlali	Sea	99	99	40,500	40,500
Mvoti	Mvoti Poort	290	290	110,000	110,000
	Mtendeni	585	875	215,000	325,000
	Sea	110	985	51,000	376,000
Mhlutuni	Sea	20	20	8,000	8,000
Nonoti	Darnall	51	51	22,000	22,000
	Sea	17	68	5,900	27,900
Zinkwazi	Sea	29	29	11,600	11,600
Total Mean Annual Run-off (acre feet)					640,200

Note: "A"—Incremental areas, and incremental M.A.R.
"B"—Cumulative areas, and Cumulative M.A.R.

ZULULAND RIVERS

River	Point on River	Catchment Area square miles		M.A.R. acre feet	
		A	B	A	B
Matigulu	Matigulu	169	169	44,000	44,000
	Sea	159	328	63,500	107,500
Mlalazi	Eshowe	7	7	4,050	4,050
	Obanjeni	109	116	27,650	31,700
	Sea	46	162	18,400	50,100
Mhlutuze	Normanhurst	512	512	121,000	121,000
	Nduna Site	210	722	44,000	165,000
	Mfule Confluence	187	909	37,400	202,400
	Nseleni	320	1229	86,300	288,700
	Richards Bay	184	1413	64,400	353,100
Emseleni	Nseleni	210	210	47,800	47,800
	Mhlutuze	110	320	38,500	86,300
Msunduze	St. Lucia Estuary	208	208	72,900	72,900
Mfolozi (White)	Mooiplaats (Vryheid)	116	116	37,900	37,900
	Onrust	412	528	110,200	148,100
	Diversion to Nseleni	1402	1930	331,000	479,100
	At confluence with Black				
	Mfolozi River	107	2037	16,000	495,100

TABLE 2—continued

River	Point on River	Catchment Area square miles		M.A.R. acre feet	
		A	B	A	B
Mfolozi (Black)	Mpakaneni At confluence with White Mfolozi River	630	630	139,500	139,500
		750	1380	140,500	280,000
Mfolozi (lower)	Lower Dam Sea	130	3547	25,000	280,000
		140	3687	60,000	Z775,100
Nyalazi	Lake St. Lucia	272	272	68,000	800,100
Hluhluwe	Game Reserve Lake St. Lucia	282	282	62,500	860,100
		75	357	11,300	68,000
Mzinene	Lake St. Lucia	312	312	12,500	62,500
Mkuze	Mooiplaats	436	436	99,400	73,800
	Gauging Station	116	552	25,700	99,400
	Welcome	334	886	50,000	125,100
	Confluence of Msunduze	430	1316	17,300	175,100
	Msunduze	448	1764	13,600	192,400
	Lake St. Lucia	377	2141	75,400	206,000
Total Mean Annual Run-off (acre feet)					281,400
					1,965,700

Note: "A"—Incremental areas, and incremental M.A.R.
 "B"—Cumulative areas, and Cumulative M.A.R.

9. SUSTAINED DRAUGHT

Where long term records were available stream flows at each gauging station were studied and run-off characteristics for each river were then determined for the dry periods.

Assured run-offs were calculated on the basis of 1 in 100 year drought frequency.

These were analysed to determine the storage/draught characteristics for the particular storage basin under consideration with suitable allowance being made for evaporation losses.

Loss of storage by silt was considered for each of the sites and this is shown as dead storage on the storage-draught curves in the Appendices.

The smaller coastal rivers of northern Natal and Zululand do not have stream flows which would provide an economical assured water supply for development and as such have not been considered further.

The larger rivers have been analysed for the best storage sites at a major catchment area or major storage basin on the river. In determining inflow into the dam allowance has been made for upstream usage. Where development is essential for water supply to a town in the upper reaches of the river, the net run-off from the catchment has been used to determine the assured yield of the lower storage site. The lower storage sites have also been analysed with gross run-off without upstream development for comparison purposes.

Results of the above analyses are recorded on the sustained draught curves for each site as A100, which represents the assured draught on a basis of 1 in 100 year drought frequency. The curve A10 similarly represents a 1 in 10 year drought frequency. These are given with the description of sites in the following subsections.

The water demands of the areas are relatively unknown. However, in order to suggest

possible methods of development of these resources, allowance has been made for urban and industrial usage so that the water available for irrigation purposes, which could stand a shortfall once every ten years on the average, could be determined.

Maps showing contours along the rivers are not adequate for an investigation of all the sites available. The sites used in this report are possible storage basins which could provide major regulation of the flows of rivers. Detailed surveys would be necessary to determine more accurately the storage characteristics of the sites.

Allowances for river bed losses must be made where storage is used for regulation of the river flow.

The flow down the White Mfolozi river shown in Appendix 2 has been reduced to allow for this.

In view of constant changes in water usage, care must be exercised in the interpretation of the results of these analyses. This will become more important with progressive development within the catchments.

They should be used for preliminary purposes only and a detailed study of each case should be undertaken when more reliable information is available in connection with streamflows, storage basins, etc.

FIGURE 8

Example:

Sustained draught for domestic and industrial use (A. 100)	8 M.G.D.
Storage required	16,000 acre ft

This storage will alternatively provide 15 m.g.d. for irrigation purposes (A. 10).

Sustained Draught Storage Sites

on

Natal North Coast Rivers

See paragraph 9 for interpretation of the charts and maps

9.1 Mhlanga River

The cost of providing an assured draught on the Mhlanga river would be high as the flow is extremely low for most months of the year and a good storage basin is not available.

Water is pumped from the Mdloti and the Mgeni rivers for the irrigation of sugar cane in the catchment. Development in the catchment will be dependent upon water supplies from larger rivers outside this catchment.

Figure 6 shows the contour map of this catchment.

9.2 Mdloti River—Inanda Site

The site chosen is situated in the gorge to the north of Inanda, where the river passes through the Table Mountain Series. Two sites have been investigated by the Department of Water Affairs and it is understood that certain foundation drilling has been undertaken in the past. This dam is situated in a Bantu Reserve with the storage basin in a reach of the river having an average fall of 34.5 feet per mile. The flanks of possible sites for this storage basin have slopes of about 1 in 4.

A 1 M.A.R. dam would be 160 feet high and provide a draught of 6 M.G.D. for domestic and industrial use and about 25 cusecs

for irrigation purposes. The potential hydro electric power available would be 90 kW.

The present users of the water from the river are the townships of Verulam and La Mercy, the woodboard factory and irrigation along the river. During low flow periods the water supply to lower users is not sufficient for their needs, and this has been aggravated in recent years by increased irrigation in the upper reaches.

The construction of a suitable dam is receiving the attention of the Department of Water Affairs.

Figure 7 shows the catchment area and the storage characteristics are shown in Fig. 8.

9.3 Tongaat River—Doornkloof Site

The profile of the Tongaat river shows clearly the steep gradient towards the sea with a fall of about 50 feet per mile over the major length of the river.

The best site for storage is situated on the Tongaat river two miles upstream of the junction of the Mona river. It would be possible to divert the flow from the Mona river into this storage basin through a tunnel about 1500 feet long. In the analysis of this site diverted flows of up to 100 cusecs from

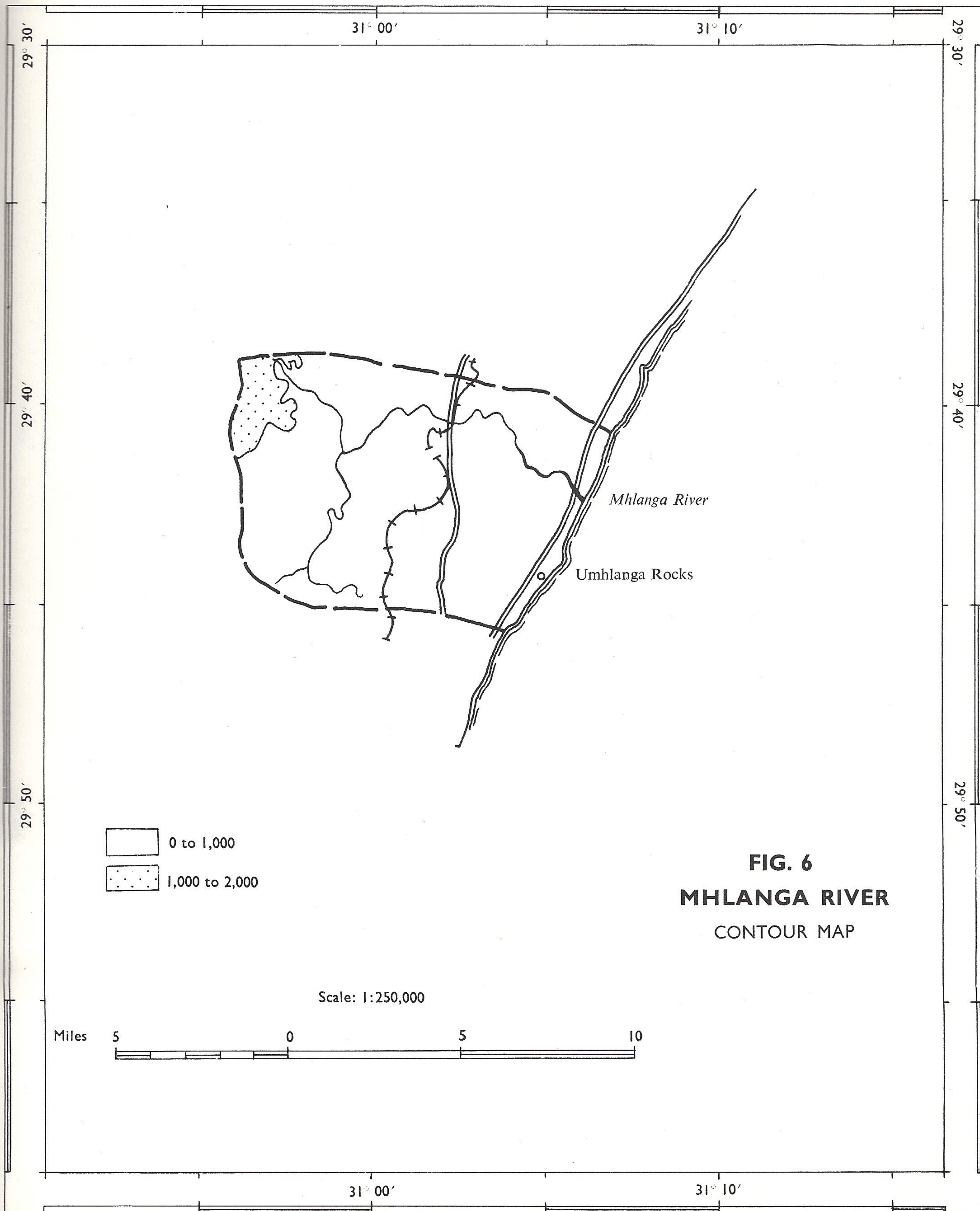
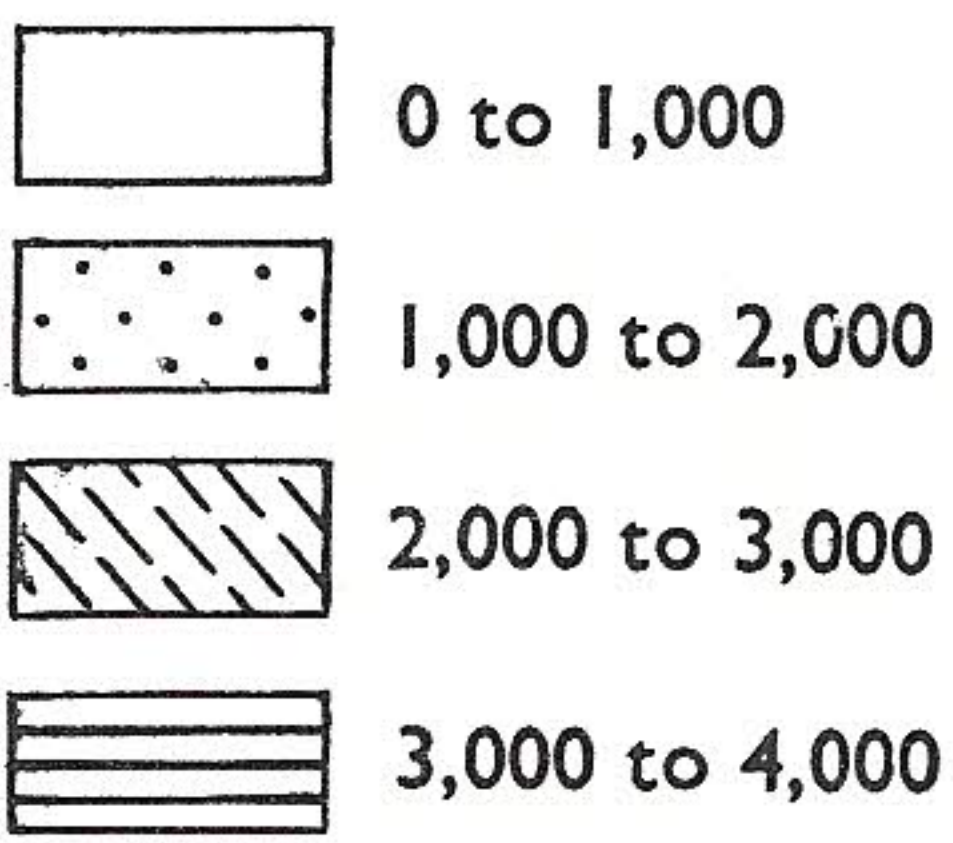
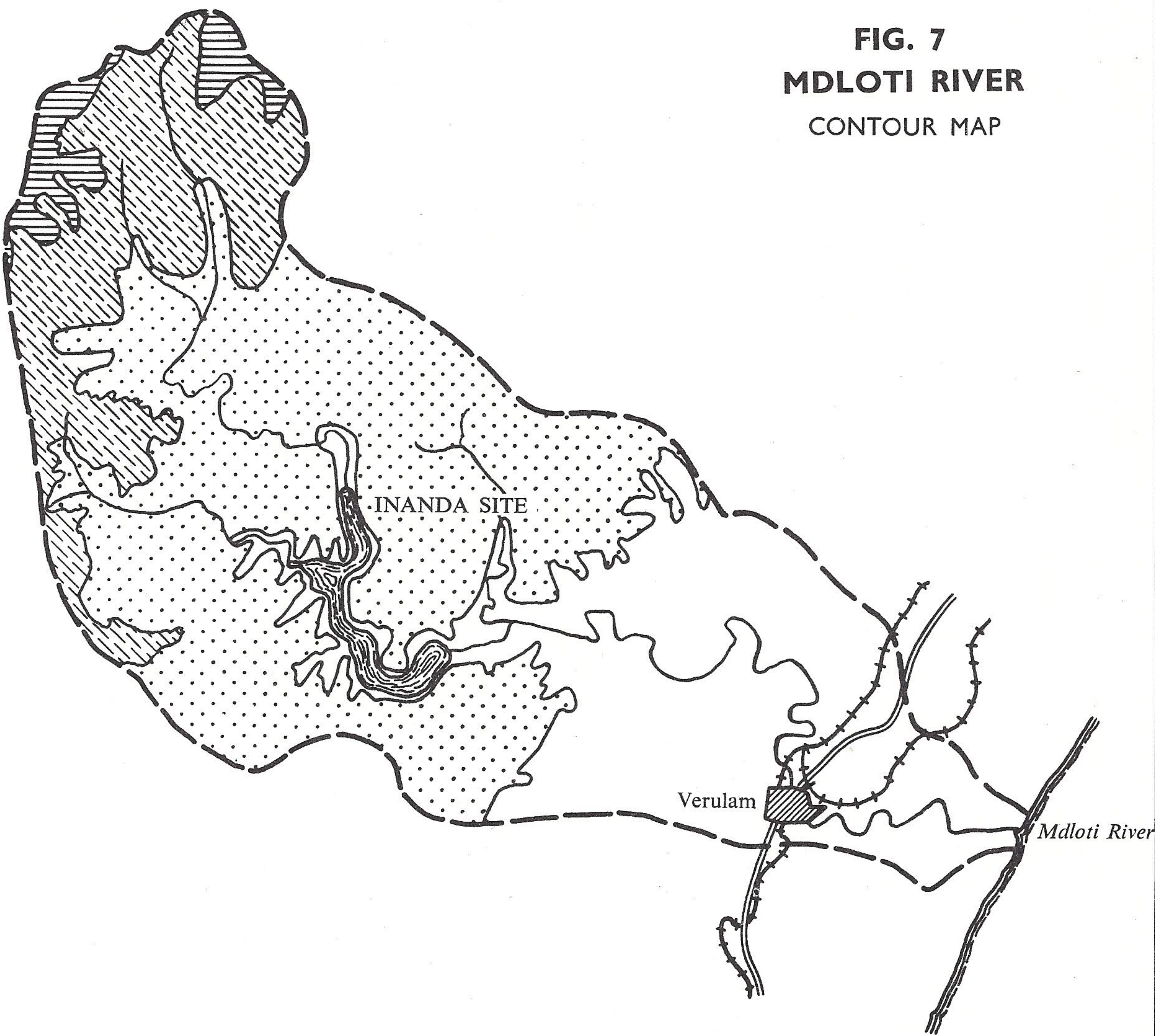


FIG. 6
MHLANGA RIVER
CONTOUR MAP

FIG. 7
MDLOTI RIVER
CONTOUR MAP



Scale: 1:250,000

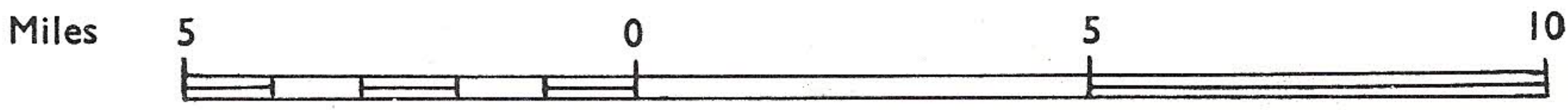
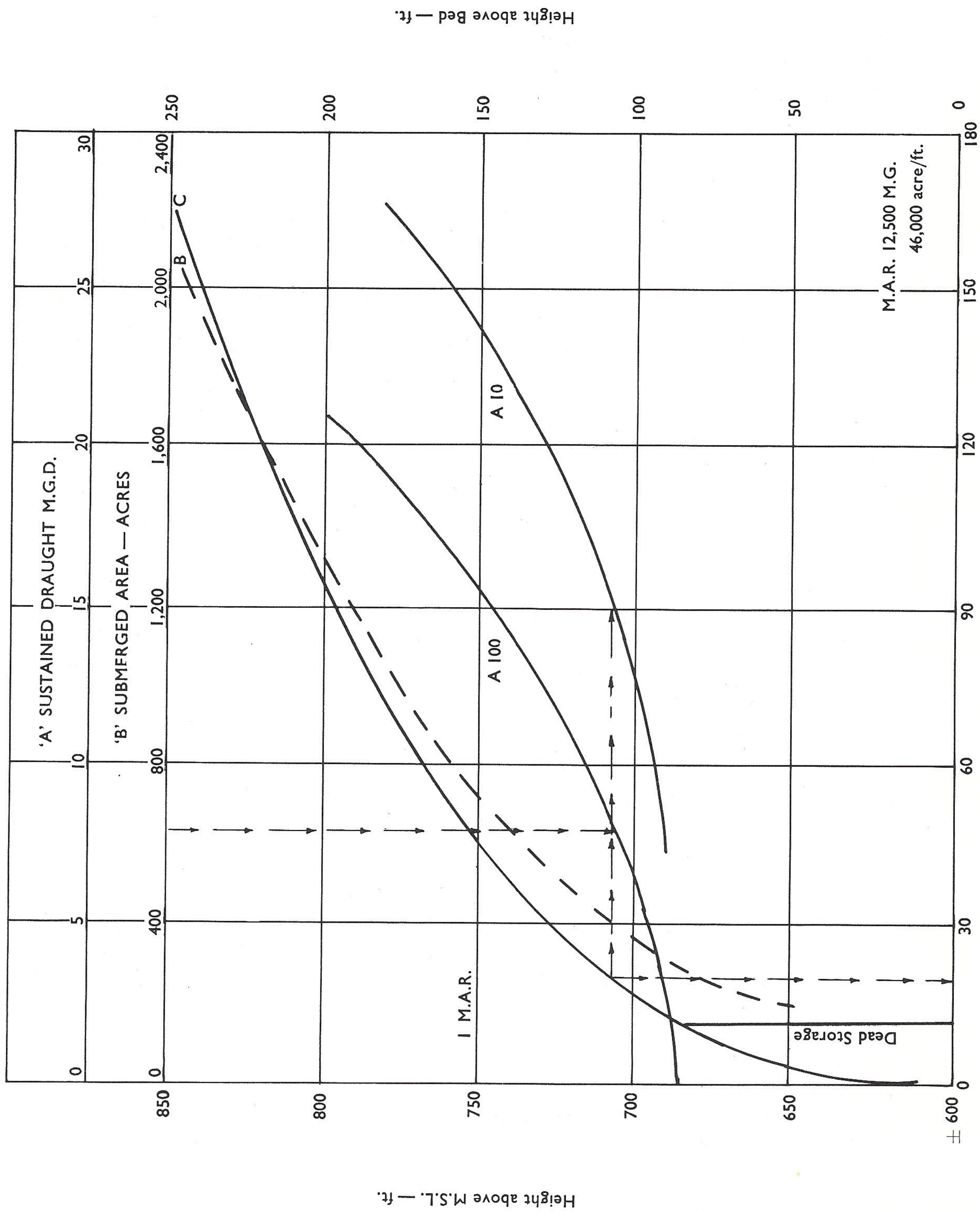


FIG. 8
MDLOTI RIVER
INANDA SITE



'C' STORAGE CAPACITY — ACRE/FT. × 10³

the Mona river into the storage basin have been considered.

Table Mountain Sandstone is exposed as a steep rock face on the right flank with a soil covered slope up the left flank.

The advantage of this site is the enlarged catchment area by the diversion of the Mona river and the relatively lower loss of storage from silt.

To obtain a storage basin of $\frac{1}{2}$ M.A.R. it will be necessary to raise the water level to 175 feet above the river bed. This is not a good storage site as can be seen by comparison with other sites in Fig. 41.

The cost of providing water storage on the Tongaat river will be high and will require careful investigation to ensure an economically sound scheme.

Two dams have been constructed by the Tongaat Sugar Company on the Wewe river, one dependent on 25 square miles of catchment of this tributary and the other to provide off-stream storage for surplus water from the flow in the Tongaat river.

The domestic water supply for the township of Tongaat, as well as for industries and the irrigation of sugar cane is provided from these dams.

The assured draught from a dam at the Doornkloof site, having a capacity of $\frac{1}{2}$ M.A.R., could be about 5 M.G.D. for domestic and industrial use and 26 cusecs for irrigation use.

Potential development of hydro-electric power would be about 125 kW.

The present water usage from the river is approximately 15 M.G.D. which has to be reduced during very dry periods.

Fig. 9 shows the contour map of the catchment and Fig. 10 the storage characteristics.

9.4 Mhlali River

The streamflows in the Mhlali river are erratic and any storage would have to be rela-

tively large for an assured draught. A very good storage basin could not be found for this purpose as the river has a very steep average gradient of 90 feet per mile over most of its length. Storage on this river would be most efficiently used for irrigation purposes. No detailed analysis of flows was undertaken.

The catchment area is shown on Fig. 11.

9.5 Mvoti River

Two major storage sites have been examined on this river, one in the upper catchment at Mvoti Poort in the vicinity of Mispah to the south of Greytown and the other thirteen miles from Stanger at Mtendeni in a Bantu Reserve.

9.5.1. Mvoti Poort Site:

The storage basin immediately above the Poort is wide with the site in a narrow gorge. The rock at the higher levels is sandstone probably underlain by shale which is evident in the basin upstream of the site. The sides of the valley are steep and are some six hundred feet high, with the lower slopes at a grade of almost 1 in 4.

The gradient of the river bed above this site is thirty feet per mile and steepens considerably below the site.

A notable feature of the river upstream of the national road from Greytown to Pietermaritzburg is the Mvoti Vlei where the river has a fall of only 7.4 feet per mile. This will serve as a silt trap above the site and the vlei will not be affected by development at the Poort.

The draught from a dam having 1 M.A.R. storage will be 45 M.G.D.

The potential development of hydro-electric power would be about 250 kW.

9.5.2 Mtendeni Site:

The site is situated below the junction of the Mushave river where the contours widen to form a basin. The right flank rises steeply but

the left flank is flat. The crest length would be 1700 feet for a dam 100 feet high. The river bed gradient is 16 feet per mile. The silt load in the river will be high at this site, most of which would be contributed from the catchment area below Mvoti Poort.

The assured draught from a dam having a capacity of 1 M.A.R. will be 120 M.G.D. with hydro-electric power potential of 520 kW.

The assured draught for the Mvoti Poort site has been shown on Fig. 14 together with that of the Mtendeni site for comparison purposes.

Water from the site at Mvoti Poort could be used upstream of the site to supply Greytown as well as for regulating flow for use downstream.

The river passes through steep valleys between Mvoti Poort and Mtendeni and losses would be high if development of the upper site is used for regulation of stream flow to the lower area.

Probable irrigation requirements on the river below the Mtendeni site are of the order of 100 cusecs and the development of this site would provide about 50 M.G.D. for urban and industrial use in addition to the irrigation usage.

The catchment area is shown on Fig. 12 and storage characteristics on Figs. 13 and 14.

At present the water supply to Greytown is obtained from a small dam in the upper reaches of the river at Lake Merthley above the town.

A hydro-electric power station having a capacity of 1,000 kW has been installed below Glendale and water is extracted from the river for supply to Stanger.

Other usage from the river is mainly for irrigation purposes.

9.6 Mhlutuni River

This river has a total length of only 6 miles with steep gradients in the upper reaches. The water is polluted and river flows are very unreliable from a very small catchment. No analysis has been carried out for this river.

The catchment is shown on Fig. 15.

9.7 Nonoti River—Darnall Site

This site is situated about a mile upstream of the Darnall sugar mill where the river gradient is less than 20 feet per mile. The sides of the valley are in the form of a flat U with the right bank of the river derived from Dolerite and Basalt and the left bank from Eccra Shales. It would be possible to locate the spillway over a divide into an adjacent tributary.

The assured draught from a dam having a capacity of 1 M.A.R. would be 4 M.G.D. which could be used for the township as well as the irrigation of about 1000 acres of sugar cane depending on upstream usage in the catchment. A wall about 120 feet high would be required at this site. The development of hydro-electric power would be low and has not been considered.

Fig. 16 shows the catchment and Fig. 17 the storage characteristics of this river.

9.8 Zinkwazi River

The total catchment area of this river shown on Fig. 18 is only 29 square miles with the upper section at gradients steeper than 75 feet per mile. Any development would be by private enterprise probably for irrigation purposes.

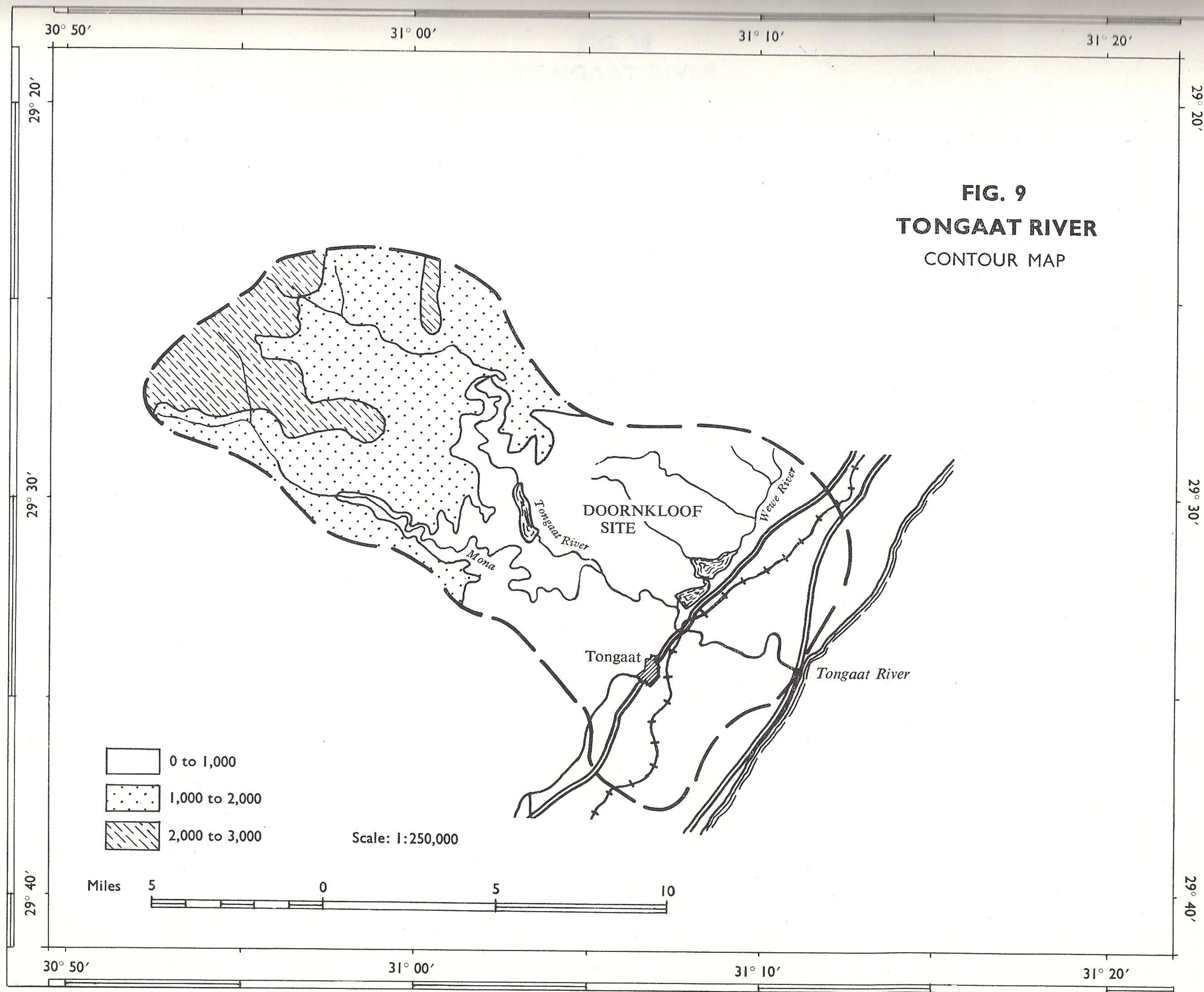
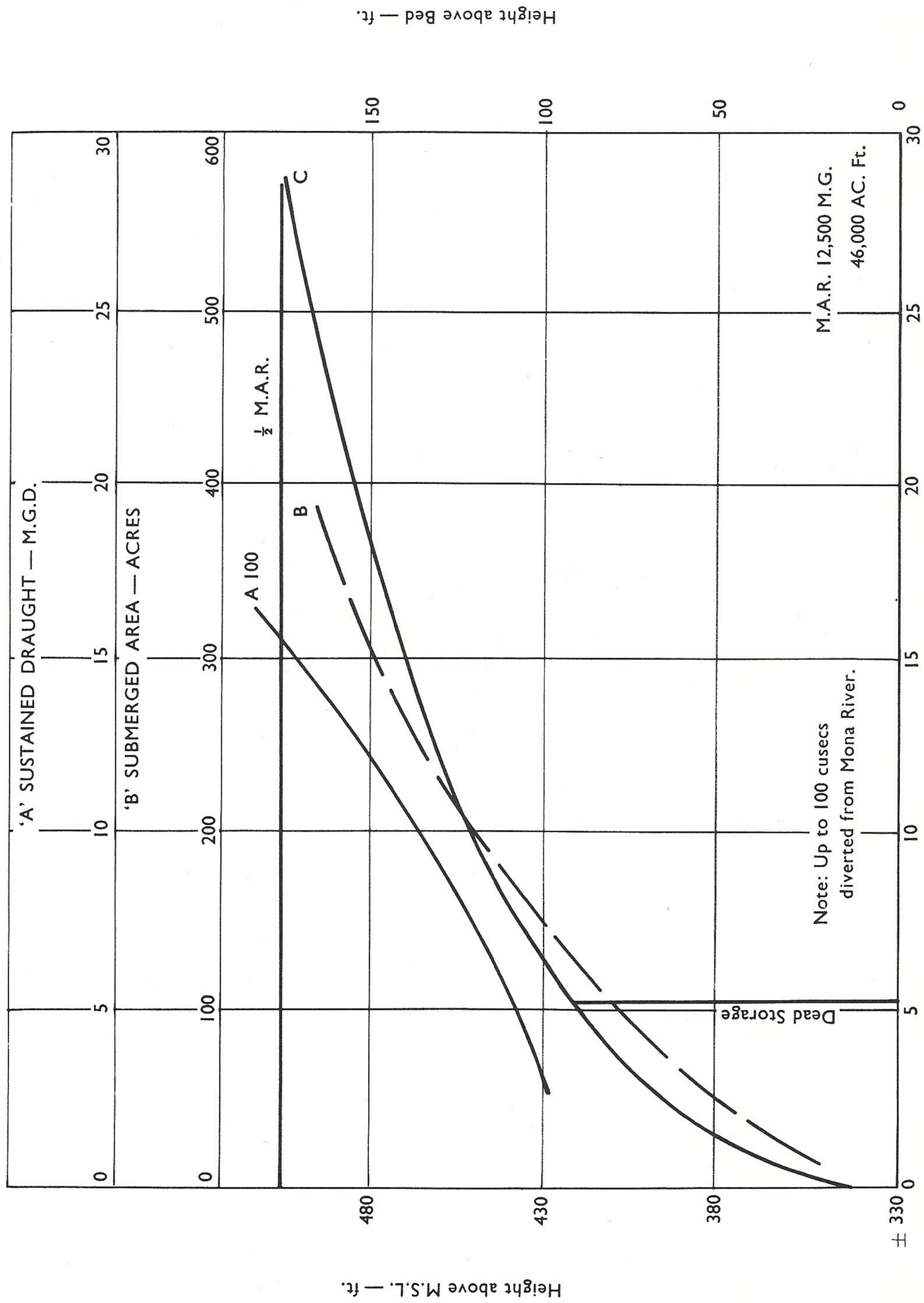
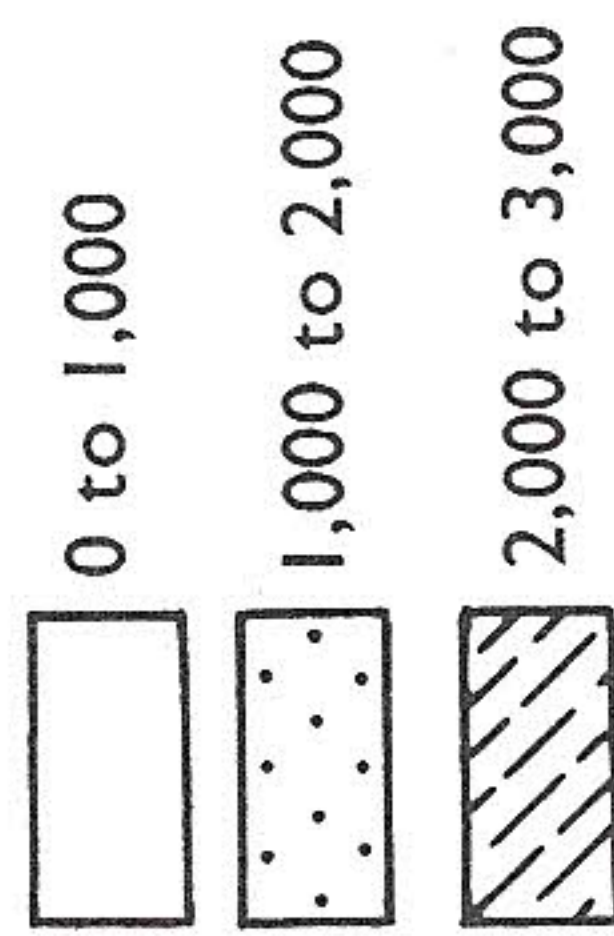
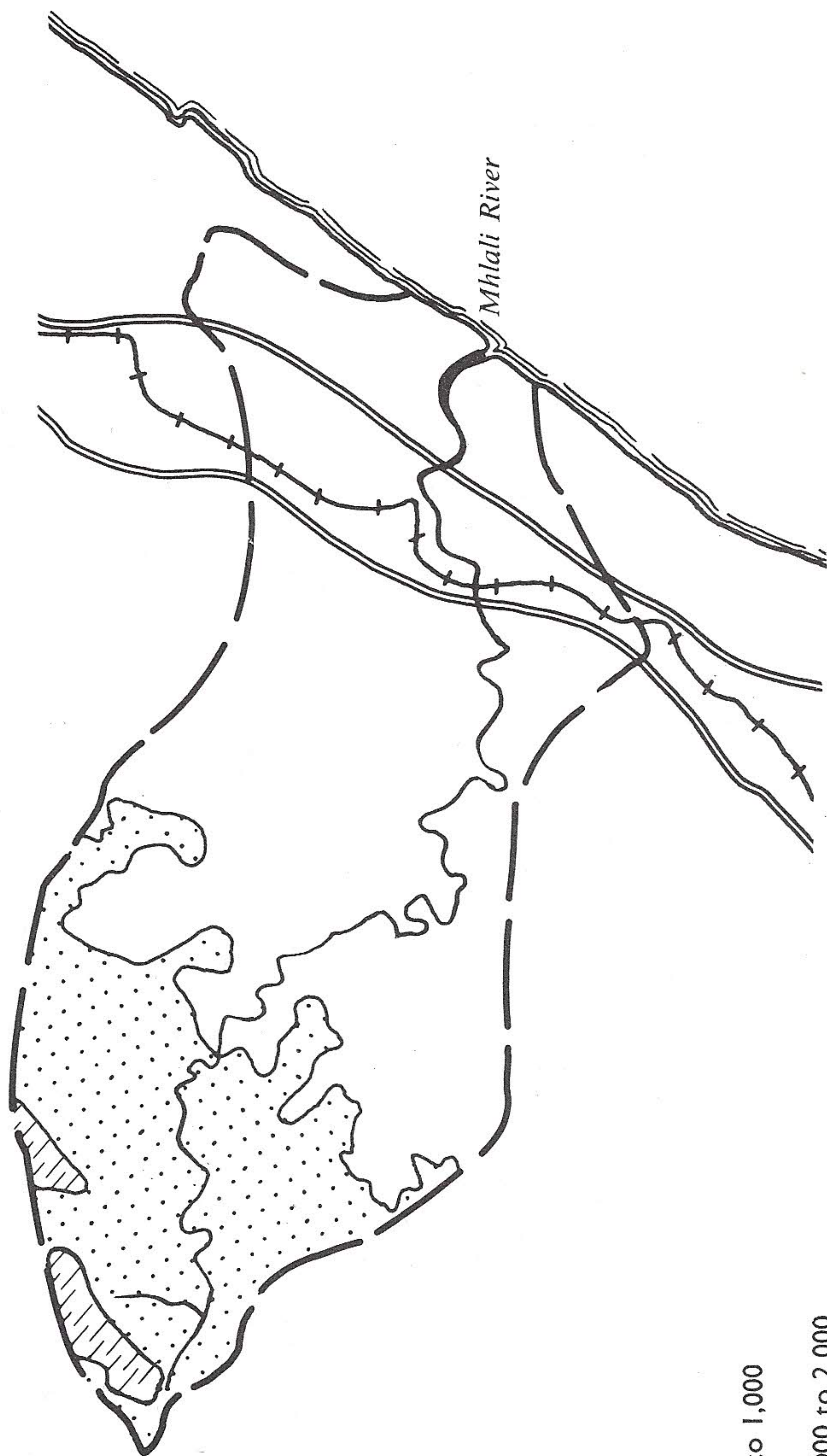


FIG. 10
TONGAAT RIVER
 DOORKLOOF SITE



'C' STORAGE CAPACITY — ACRE/FT. $\times 10^3$

FIG. 11
MHLALI RIVER
CONTOUR MAP



Scale: 1:250,000

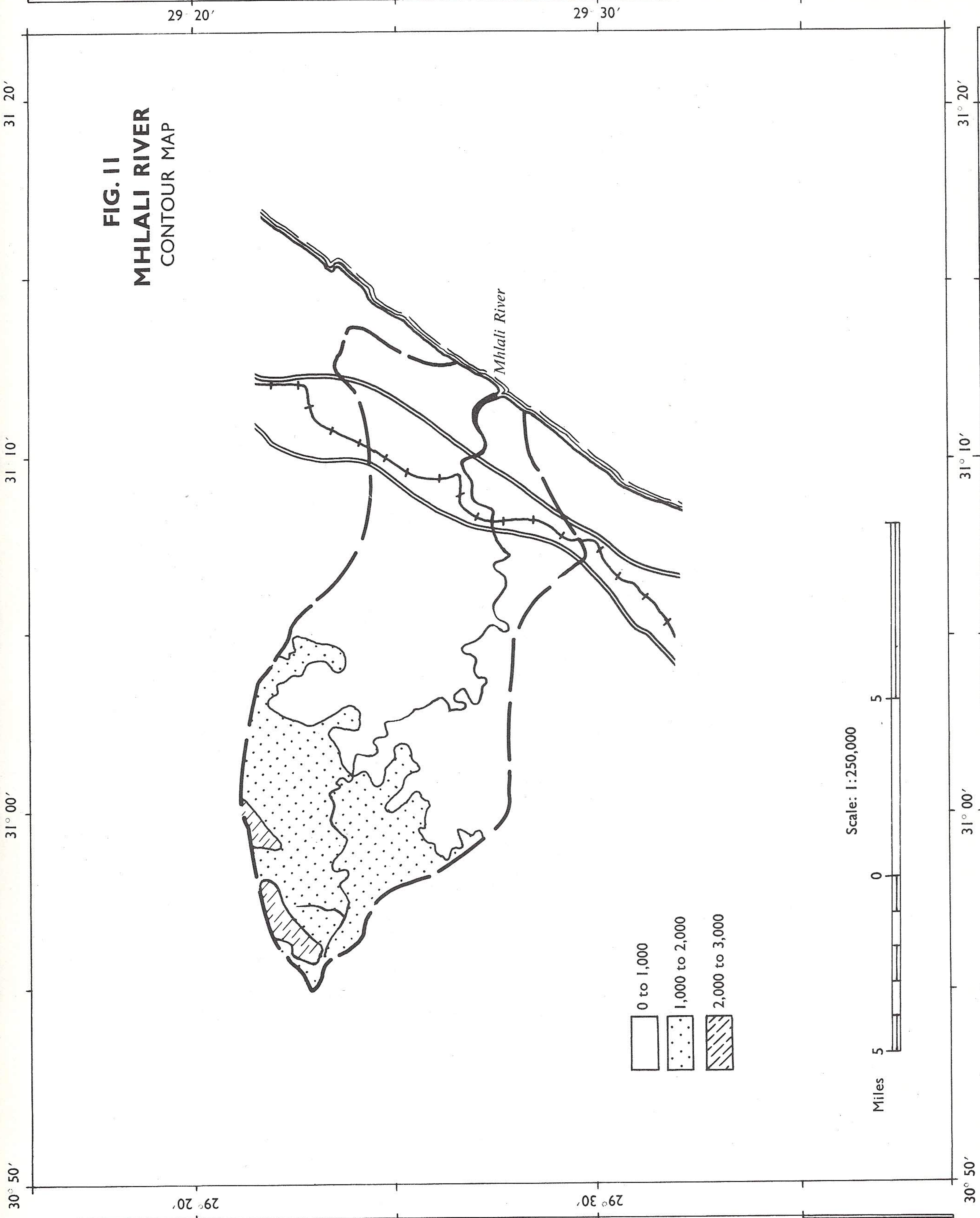


FIG. 12
MVOTI RIVER
CONTOUR MAP

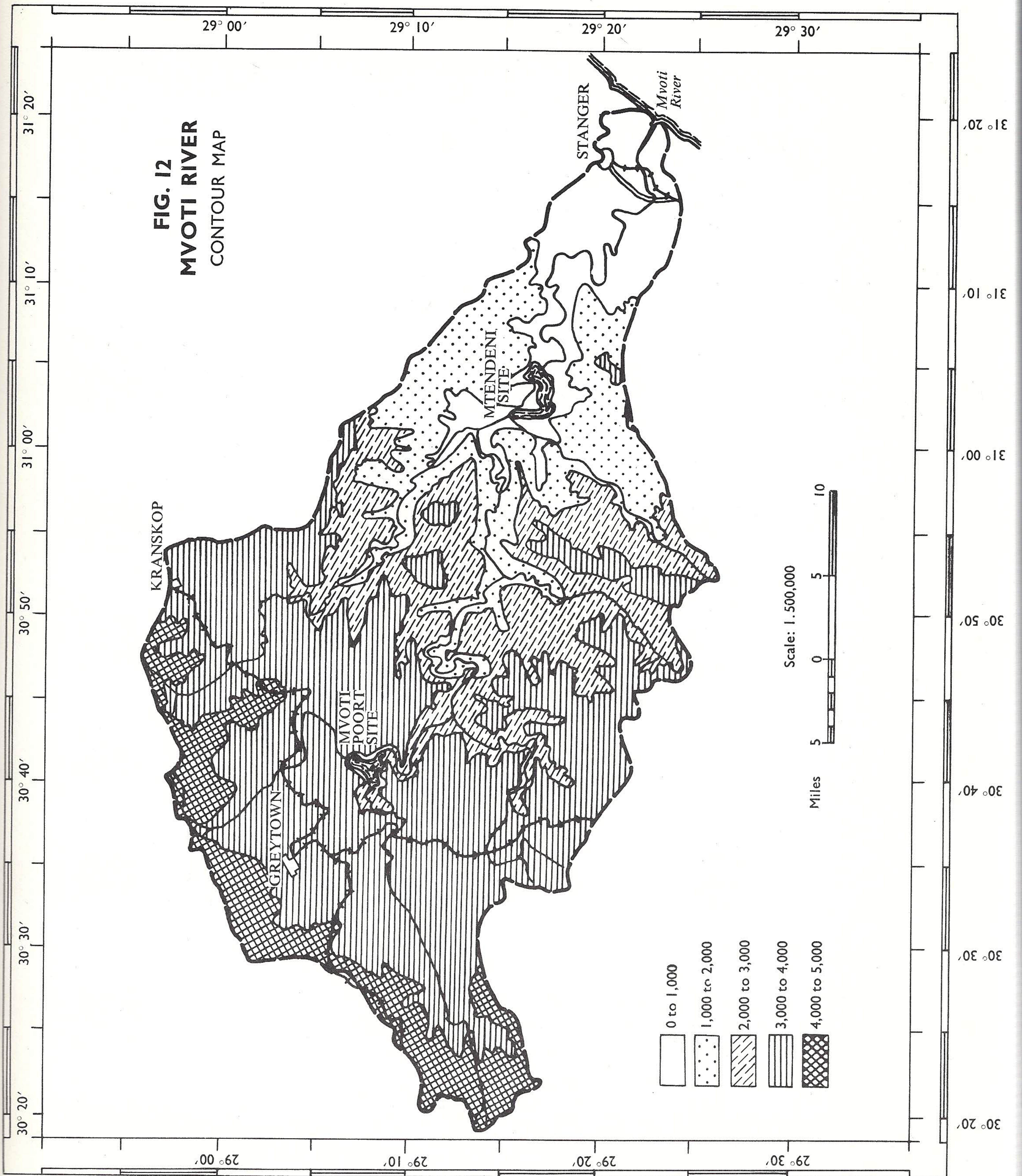


FIG.13
MVOTI RIVER
MVOTI POORT SITE

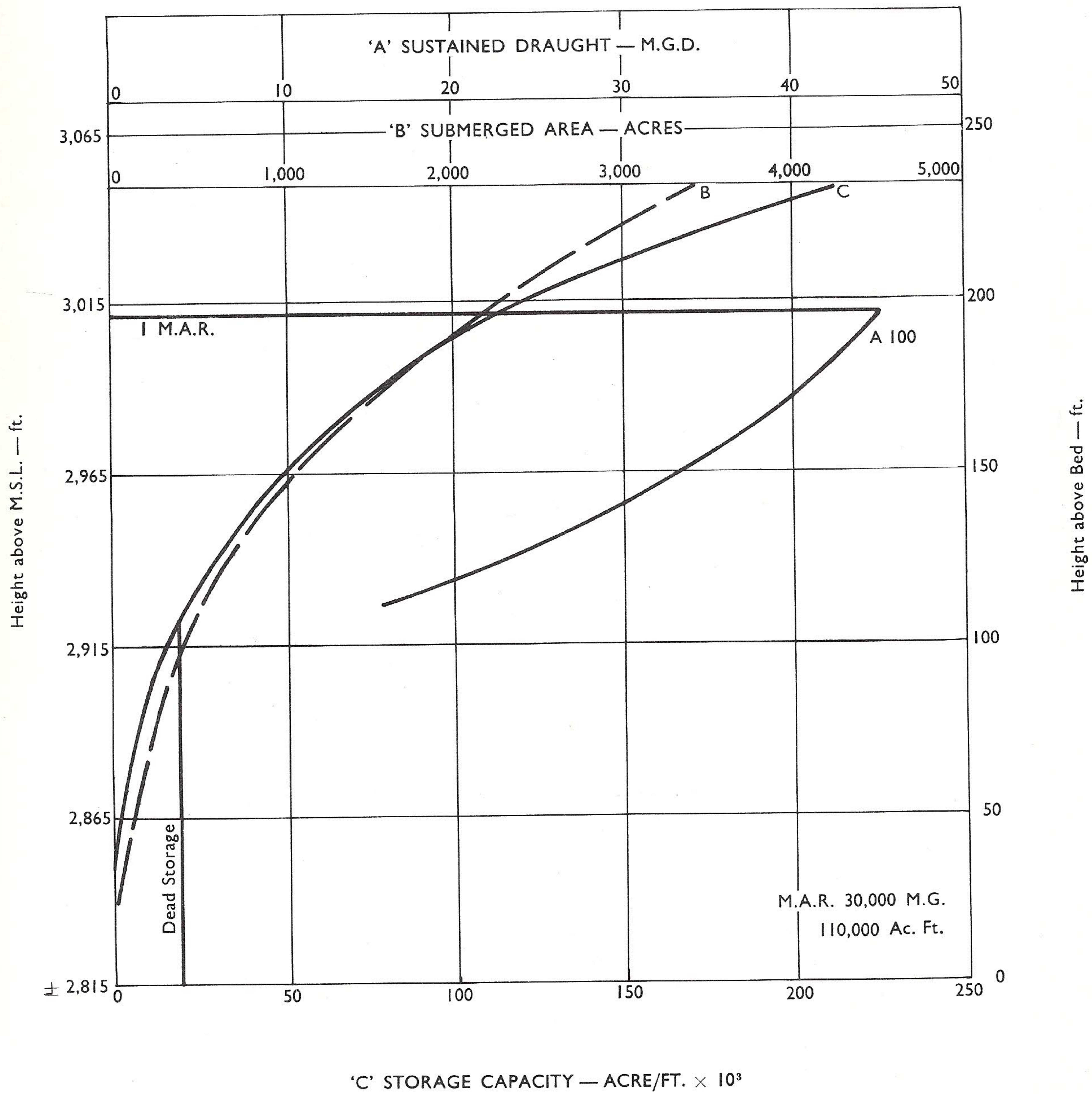
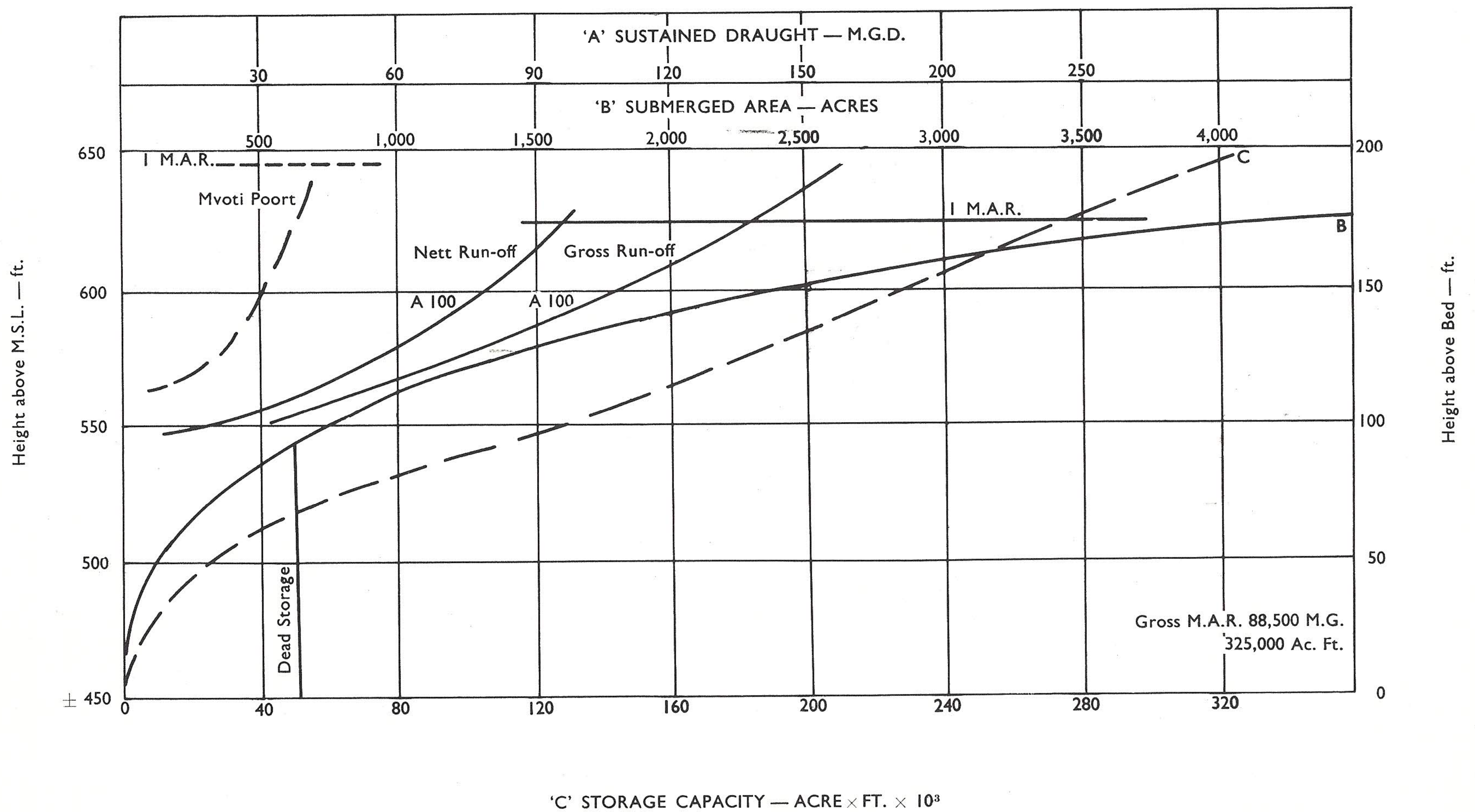


FIG. 14
MVOTI RIVER
 MTENDENI SITE



Note: Mvoti Poort site plotted Draught vs. Height.

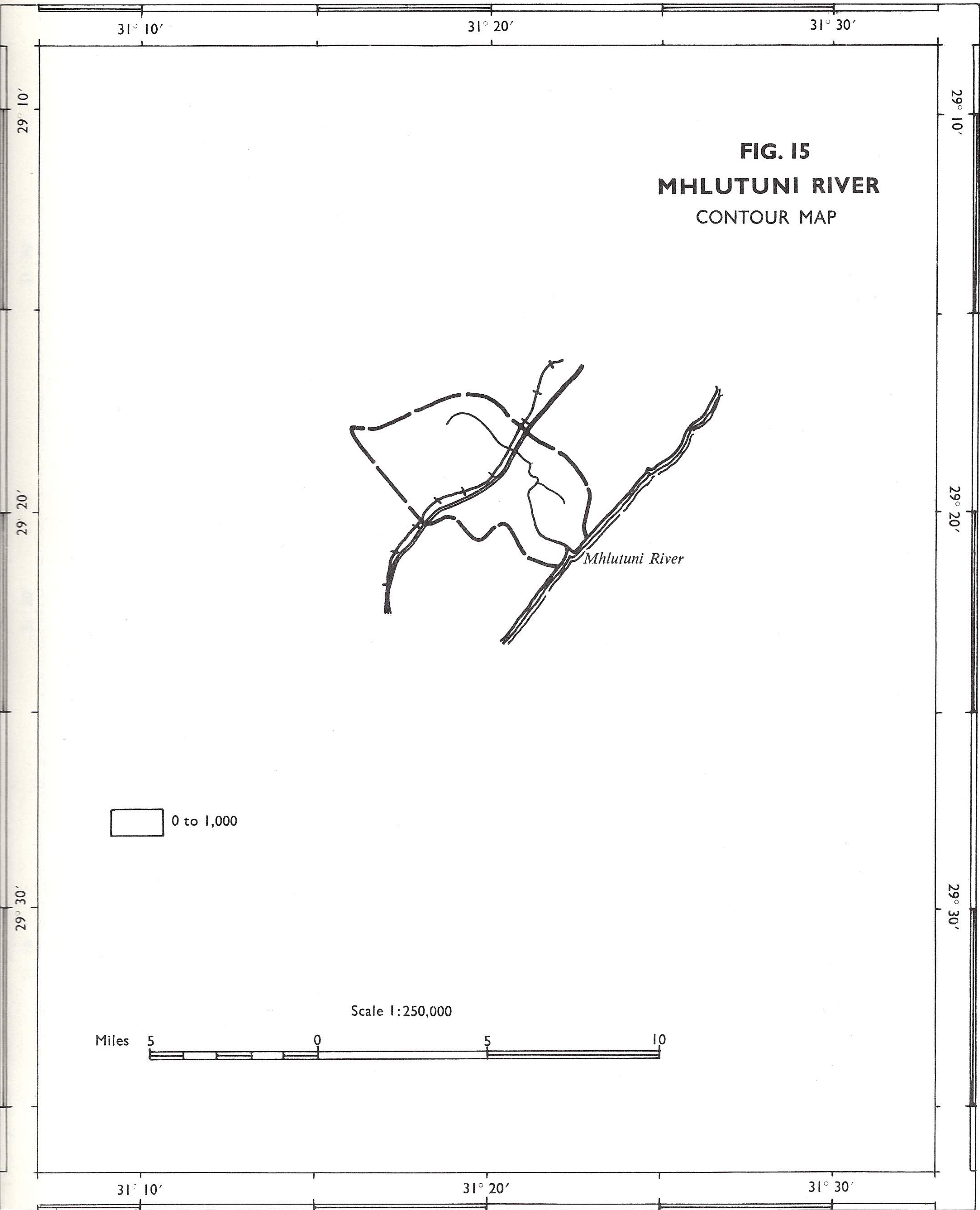
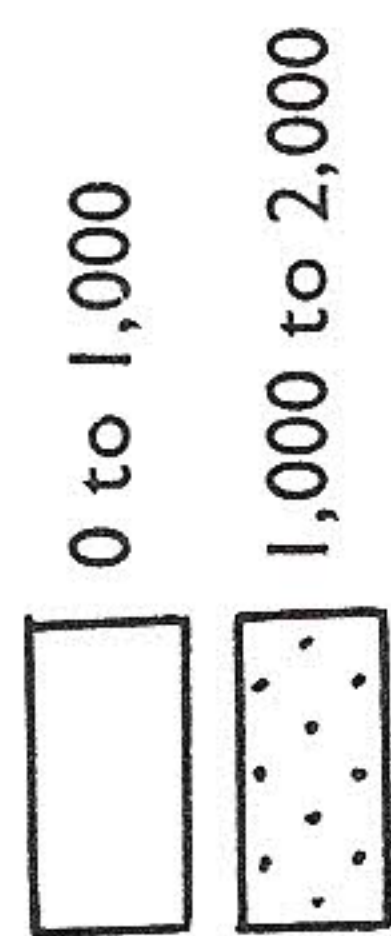
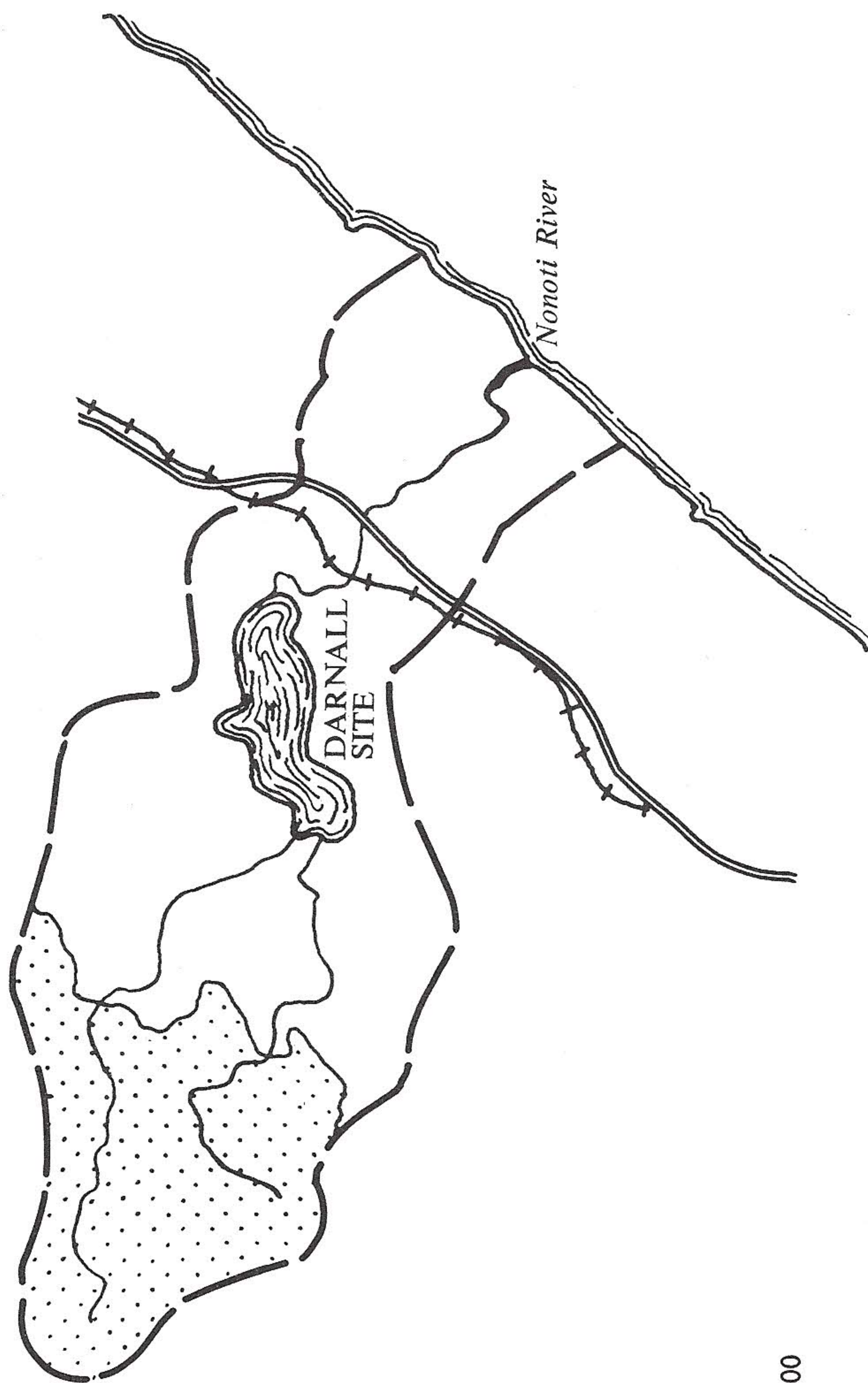


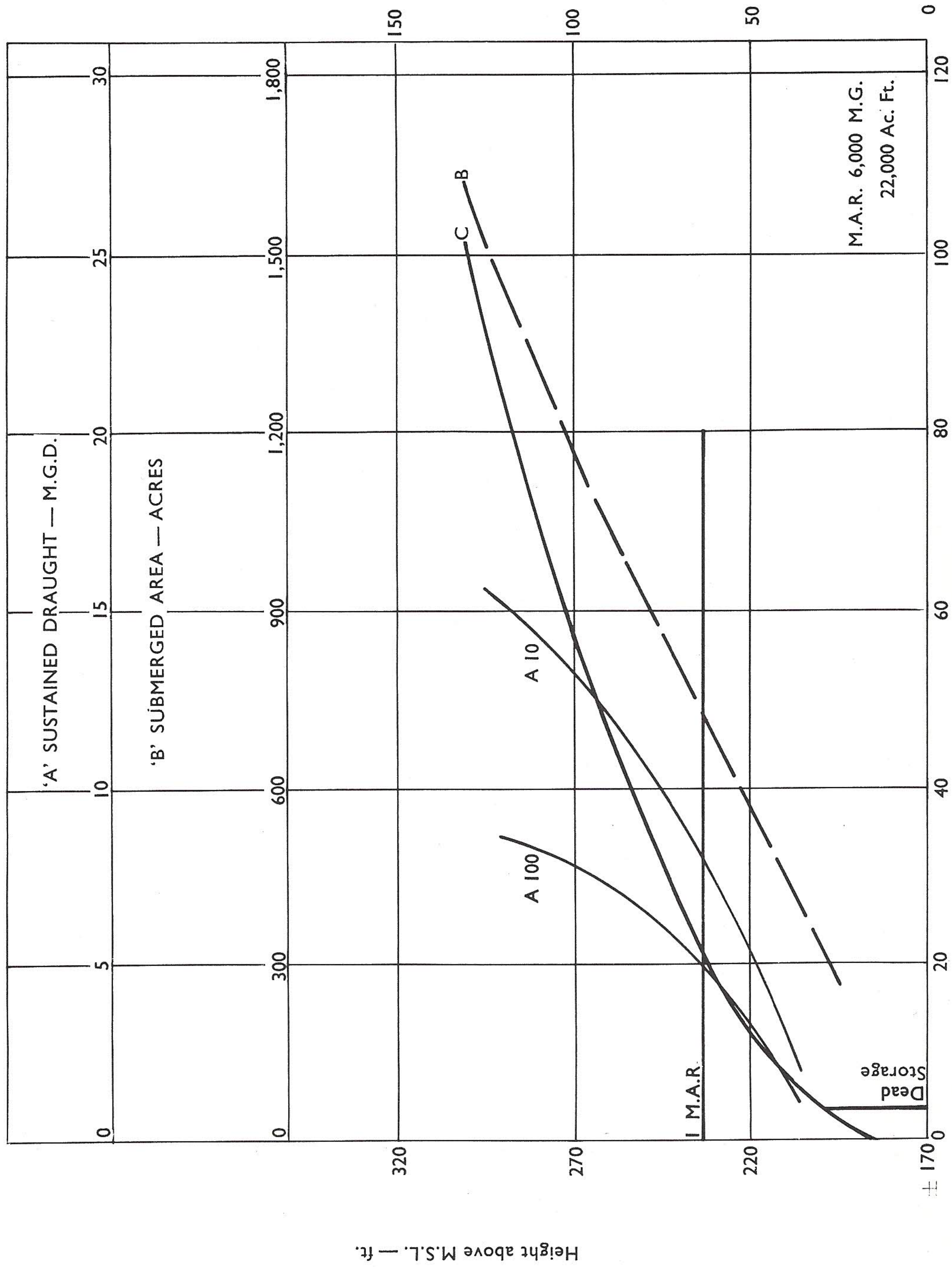
FIG. 16
NONOTI RIVER
CONTOUR MAP



Scale 1:250,000

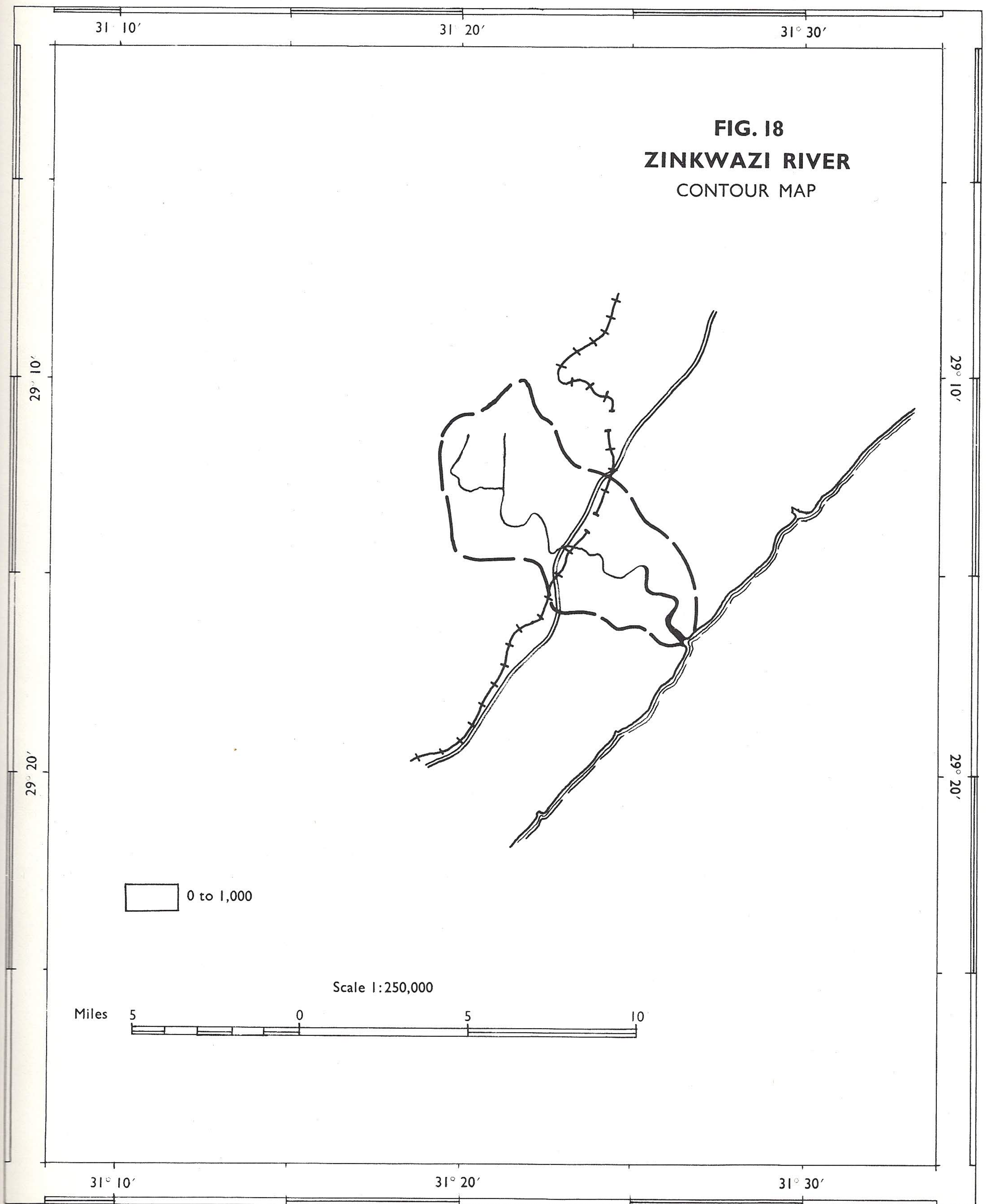


FIG. 17
NONOTI RIVER
 DARNALL SITE



'C' STORAGE CAPACITY — ACRE/FT. $\times 10^3$

FIG. 18
ZINKWAZI RIVER
CONTOUR MAP



Sustained Draught Storage Sites on Zululand Rivers

See paragraph 9 for interpretation of the charts and maps

9.9 Matigulu River—Matigulu Site

This site is located in Bantu Reserve No. 21 where the average gradient of the river is 25 feet per mile. The valley sides are not steep and are composed of quartzitic rocks of the Table Mountain Series.

A notable geological feature is the fault which occurs in this vicinity. Although the site is in the Table Mountain Series the storage basin would be in the older granite which normally underlies it. Water would be stored in two tributaries as well as the main stream bed. The crest of a dam 150 feet high would be about 1000 feet long.

The foundation would require full investigation as the valley slope indicates weathering of the rock.

A dam having a capacity of 1 M.A.R. would yield an assured draught of 18 M.G.D. There is little urban use for this water and if 6 M.G.D. is reserved for such purposes then about 6,000 acres of sugar cane could be irrigated in the immediate vicinity of this site.

Potential hydro-electric power at this site would be about 150 kW.

The catchment is shown on Fig. 19 and the storage characteristics on Fig. 20.

9.10 Mlalazi River

9.10.1 Eshowe Dam

At present the water supply to Eshowe is drawn from a dam on the river in Eshowe. The catchment of this dam is approximately 7 square miles with a mean annual run-off of over 4,000 acre feet. This supply will probably be inadequate for Eshowe in the near future, due to the limitations of the catchment which can only supply an assured draught of about 0.75 M.G.D.

9.10.2 Obanjeni Dam Site

This site is situated in the lower reaches of the river at a distance of 18 miles from the source, where the gradient of the river is 20 feet per mile in the storage basin. The centre line of a storage dam would be on the Eccia Series consisting of Sandstone and shale with a geological fault crossing the river at an angle upstream of the proposed wall.

In the analysis of this storage site only the run-off below the existing dam was considered.

The storage basin would be formed in the Bata river, a wide flat tributary which joins the main river at the site.

A dam having a capacity of 1 M.A.R. will give an assured draught of 5 M.G.D. depending on upstream usage.

Water could be supplied to Mtunzini from this site when the water demands of this township exceed the present supply, as well as being used for the irrigation of sugar cane in the immediate vicinity of the site itself.

Fig. 21 shows the contour map of the river and the storage characteristics are shown on Fig. 22.

The potential hydro-electric power has not been considered as it would be low. In addition the water used from this dam would have to be pumped up to storage reservoirs.

9.11 Mhlatuze River

9.11.1 *Normanhurst Site*

This site is situated immediately downstream of the existing diversion weir for the Nkweleni irrigation scheme. The site is at the junction of the Dwyka series and the Table Mountain series but is located on Dwyka Tillite.

The gradient of the river is 19 feet per mile. A suitable supply of sand would be available for the construction of the dam from the silt deposited behind the existing weir. The valley is a flat V-shape with a vertical rock face on the left flank at river level indicating good foundations.

This site was chosen in preference to two other sites further upstream due to the larger catchment area available although storage basin characteristics may not be quite as good as those at the alternative sites.

Foundation investigations are at present being carried out by the Department of Water Affairs for a suitable site in this vicinity.

Storage of 1 M.A.R. at this site will yield an assured draught of 47 M.G.D. for a drought frequency of once in 100 years.

If 5 M.G.D. is reserved for urban use, such as water supply to Eshowe and other townships in the valley, then a dam having a capacity of $\frac{1}{2}$ M.A.R. will be able to supply 85 cusecs for irrigation purposes.

Power from hydro-electric development would be about 320 kW.

A diversion weir on the Mhlatuze river at present supplies water by means of canals for irrigation of 14,000 acres of citrus and sugar cane in the valley under the Nkweleni irrigation scheme.

The contour map of the river is shown on Fig. 23 and storage characteristics on Fig. 24.

9.11 Mhlatuze River

9.11.2 *Nduna Site*

There is a storage site seven miles upstream of the existing diversion weir on the Mfule river and below the junction of the Nhlozane river. This site is situated in the Table Mountain Sandstone series, the valley having a V-shape with slopes of about 1 in 5 to 1 in 4. The river bed gradient is about 25 feet per mile.

A dam having a capacity of 1 M.A.R. would be about 140 feet high and would yield an assured draught of 18 M.G.D. for urban and industrial use or about 45 cusecs for irrigation purposes.

Hydro-electric power generated at this site could be about 100 kW.

Storage characteristics are shown on Fig. 25.

The existing diversion weir and canal supply irrigation water to the valley below and into the lower Mhlatuze valley.

Further down the valley below the national road the Felixton sugar mill and the Ngoye paper mill are established. Both industries use water from the river and have been seriously affected by low flows during drought periods.

A scheme has been proposed for the supply of water to the Ngwelelene Bantu township from the Mhlatuze river.

An assured water supply to this valley has become necessary due to increased water usage over recent years, which has had serious effects on lower users.

The above two dams in the Mhlatuze

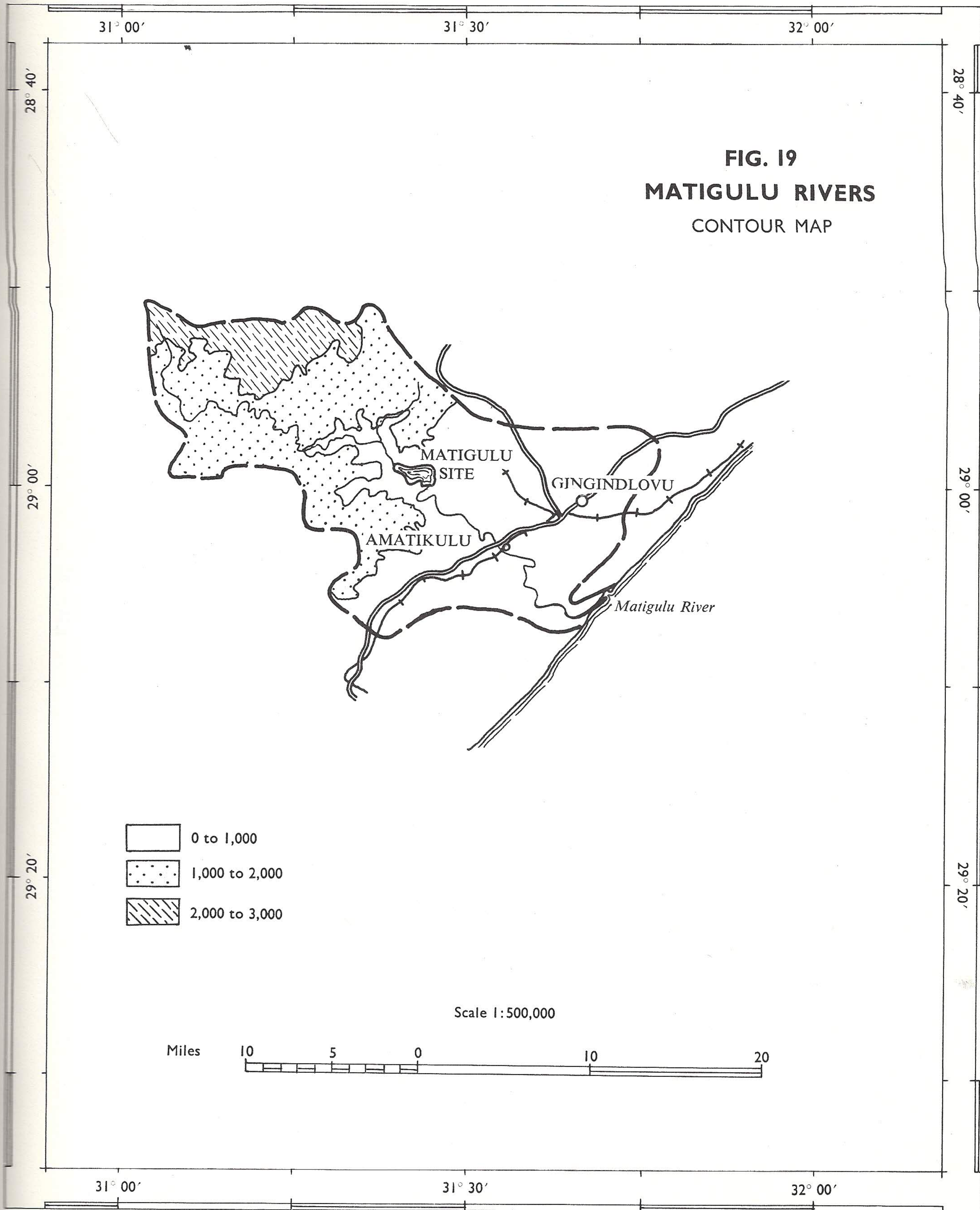
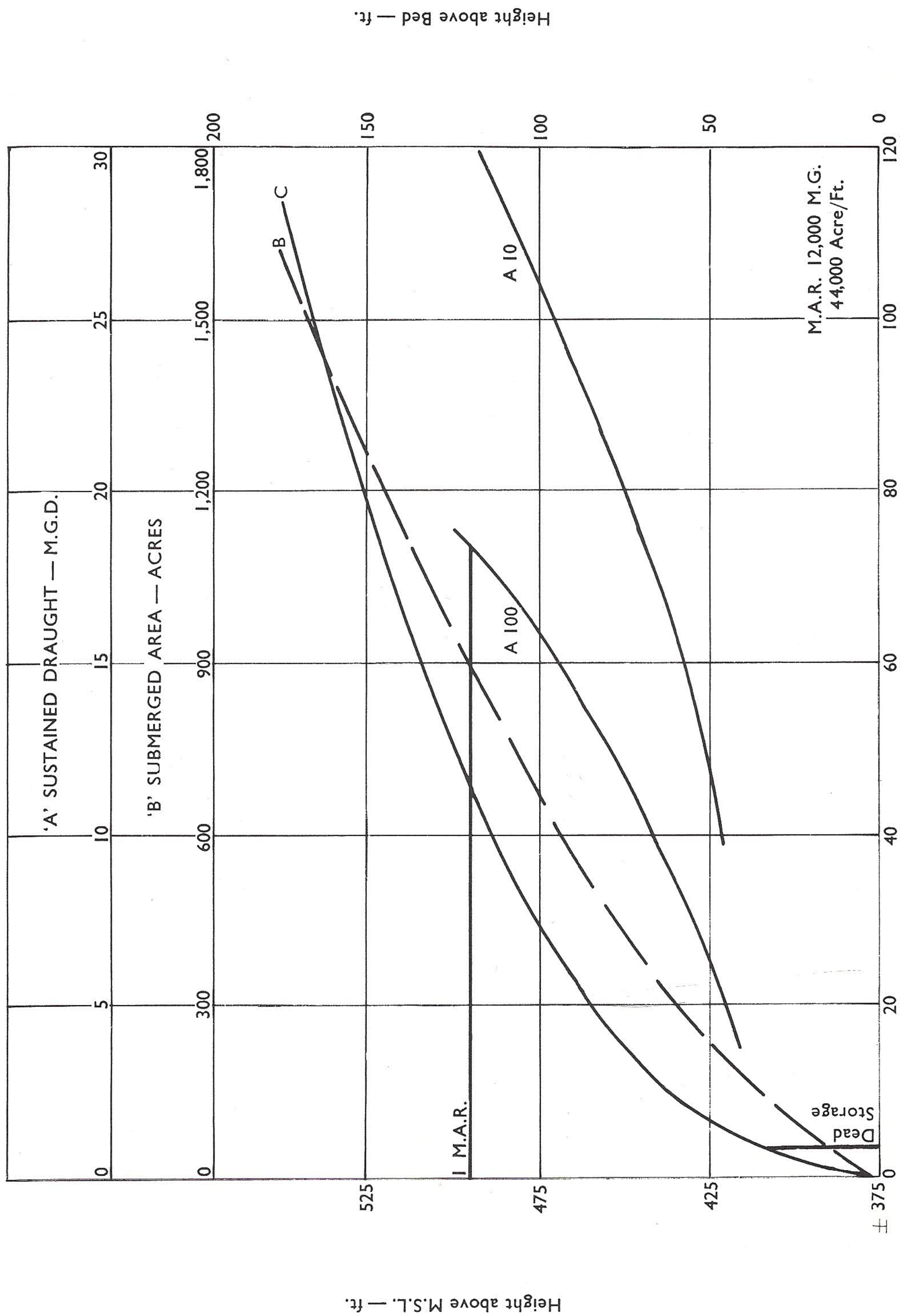
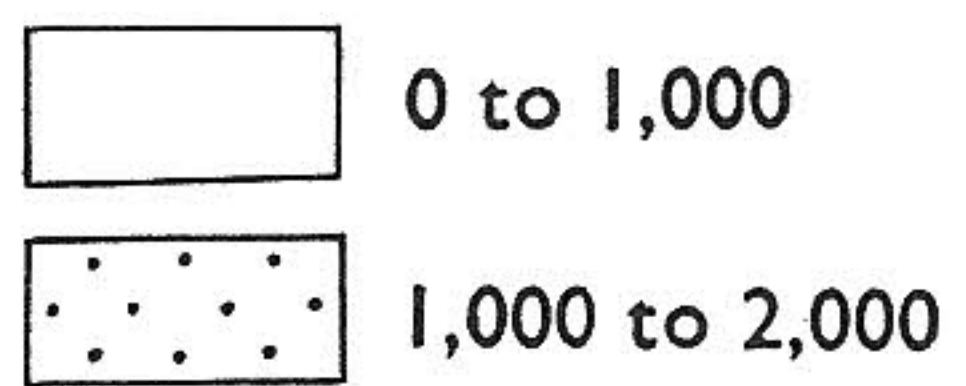
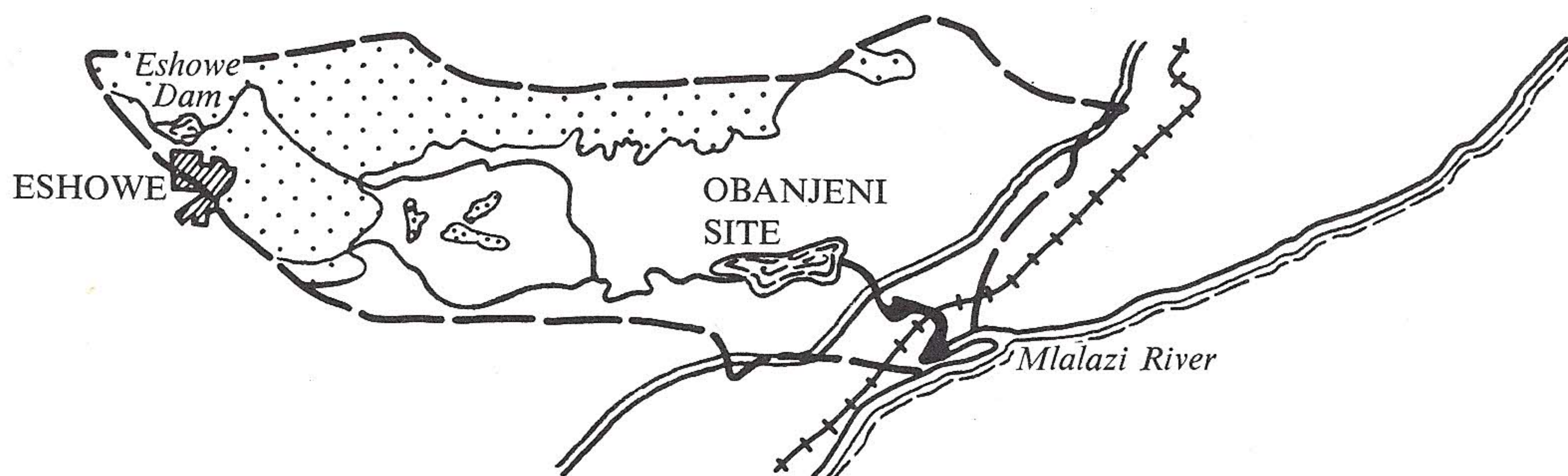


FIG. 20
MATIGULU RIVER
 MATIGULU SITE



'C' STORAGE CAPACITY — ACRE/FT. $\times 10^3$

FIG. 21
MLALAZI RIVER
CONTOUR MAP



Scale 1:500,000

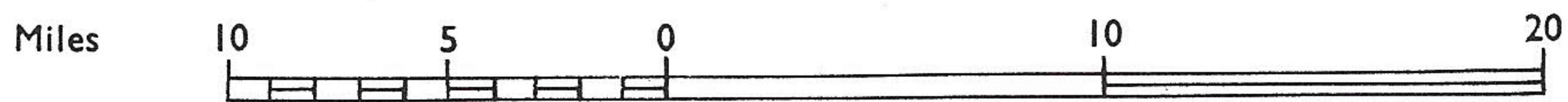
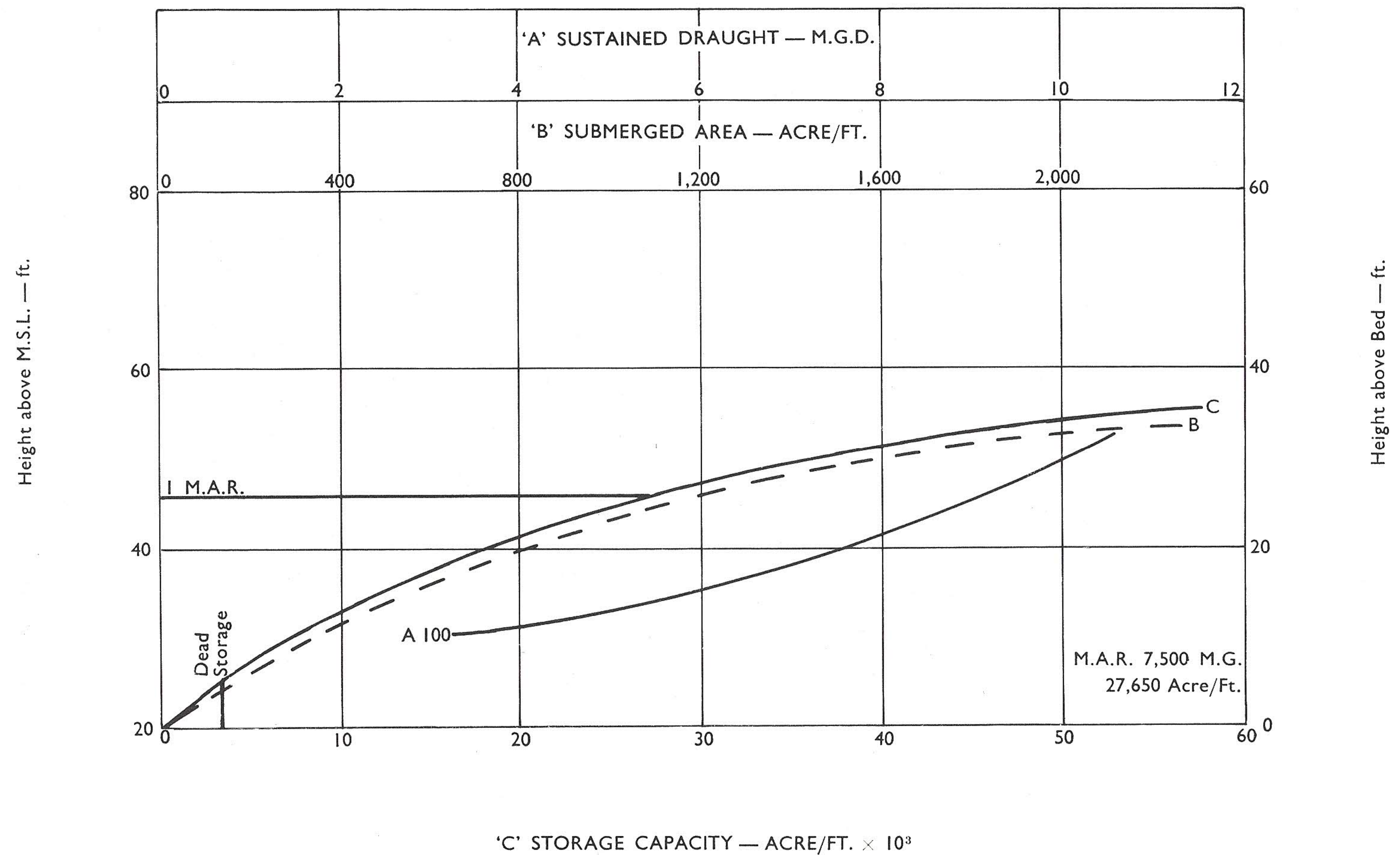
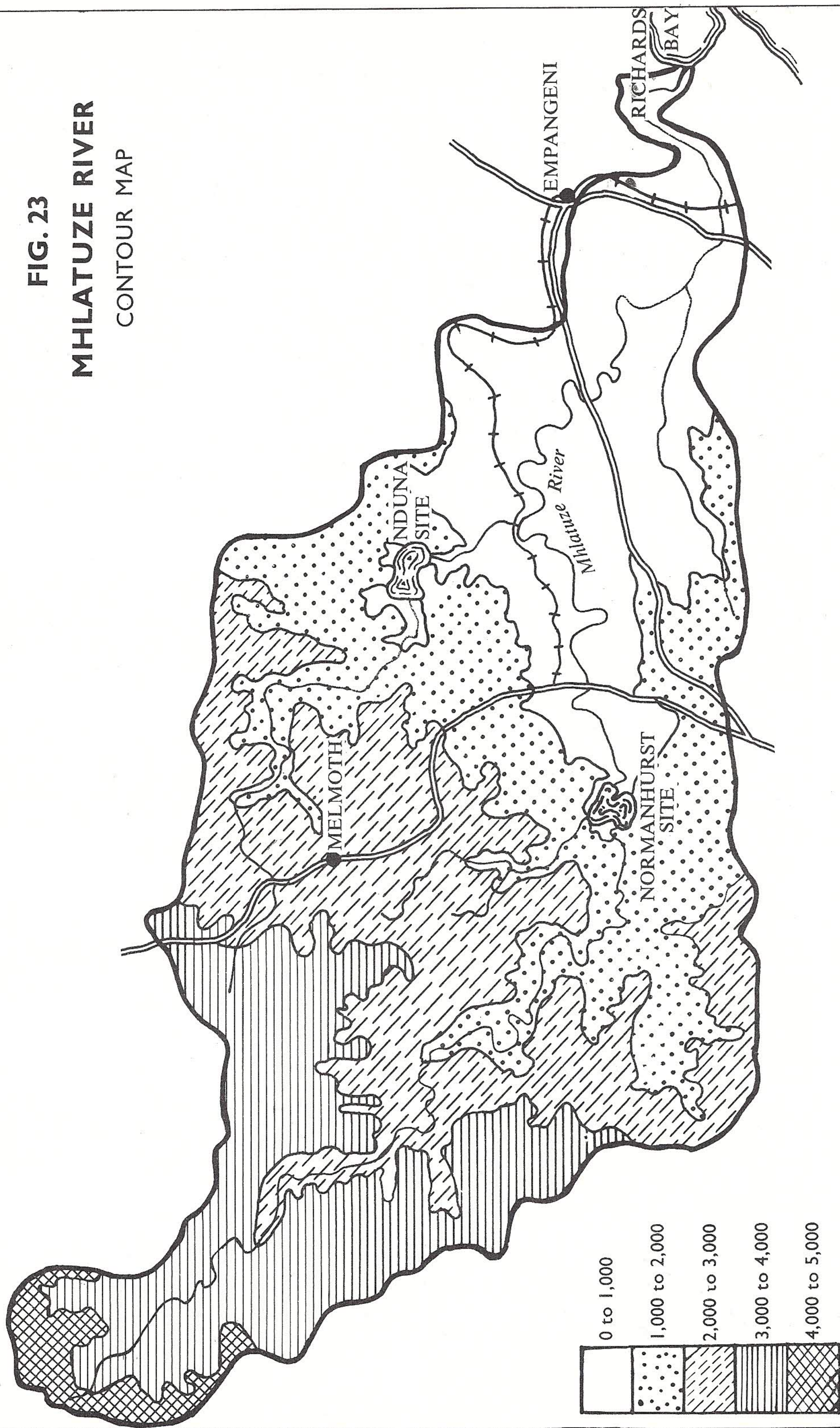


FIG. 22
MLALAZI RIVER
 OBANJENI SITE



Note: Allowance for additional upstream usage should be made.

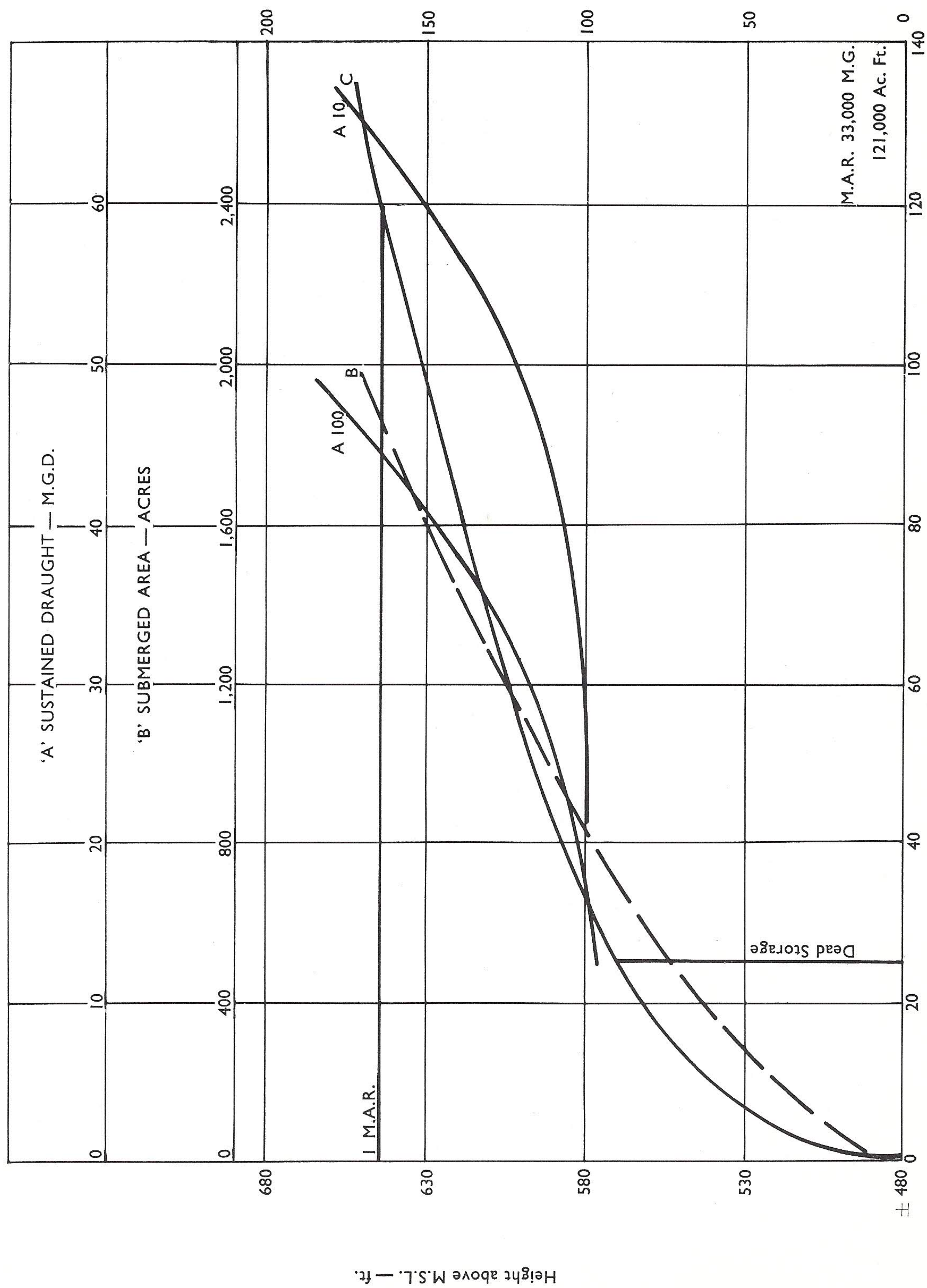
FIG. 23
MHLATUZE RIVER
 CONTOUR MAP



Scale 1:500,000

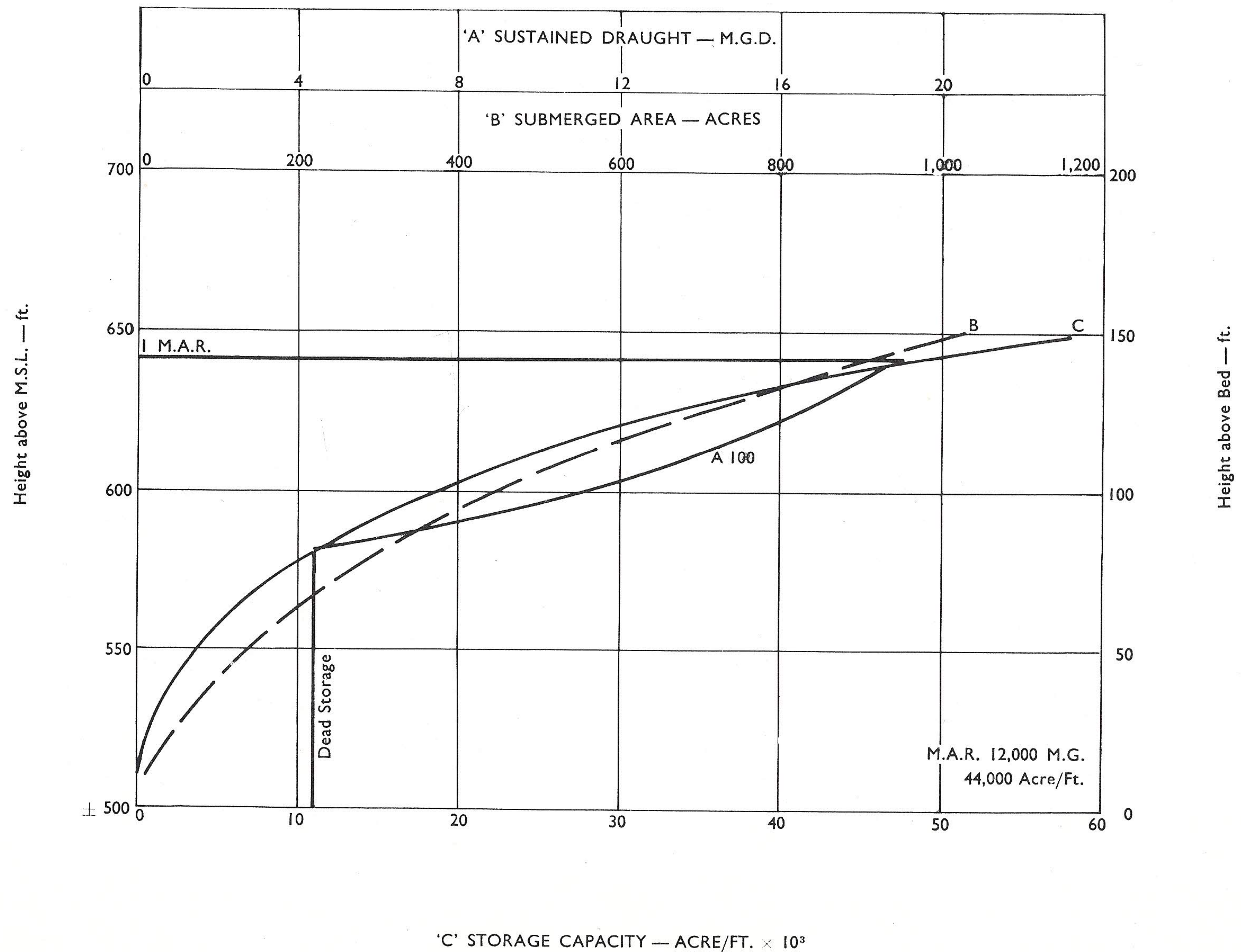


FIG. 24
MHLATUZE RIVER
NORMANHURST SITE



'C' STORAGE CAPACITY — ACRE/FT. $\times 10^3$

FIG. 25
MHLATUZE RIVER
NDUNA SITE



catchment could ensure a supply of water for the irrigation of about 20,000 acres but this would probably still be lower than the irrigation requirements of the valley.

9.12 Emseleni River—Nseleni Site

A large storage basin is situated on the western boundary of Bantu reserve No. 5 approximately eight miles north of Empangeni. A dolerite dyke crosses the river downstream of the site.

The proposed site is situated in the Basalt of the Stormberg series.

The river gradient is 11 feet per mile and the storage basin is wide with a geological fault crossing the basin upstream of the proposed storage.

A dam 150 feet above river level will be about 1800 feet long with valley slopes of 1 in 6 on the sides.

The natural catchment above this site is only 210 square miles with only a small proportion of the catchment above 1,000 feet.

It is proposed to use this site to store water diverted from the White Mfolozi river as part of the Buffalo/Mfolozi/Emseleni rivers complex and is dealt with fully in paragraph 9.14.3.

The contour map of this river is shown on Fig. 26.

9.13 Msunduze River

Above the main road the river has a small catchment with a gradient greater than 20 feet per mile. Below the road the river flows through Lake Teza and a flat swamp area into the St. Lucia Estuary. There is no demand for water along the banks of this river.

Fig. 27 shows the catchment area.

9.14 Mfolozi River

The Mfolozi river is the major river system in Zululand consisting of the two tributaries, the White Mfolozi river and the Black Mfolozi river.

9.14.1 *Klipfontein Site* (White Mfolozi river)

This site is situated about 3 miles below Vryheid and could be used as a possible future storage site for a water supply to Vryheid.

The grade of the river is about 13 feet per mile just upstream of the site and the storage basin would back up into Besterspruit.

Pollution could be caused by the Bantu Location, situated immediately upstream of the site. The flanks at the site are fairly flat being steeper on the right bank.

Soils from the weathered formations would probably be suitable for construction of an earth dam.

The assured draught of this dam would be approximately 5 M.G.D. which would require to be pumped for use upstream of the site. No suitable map of this small storage basin is available and it has therefore not been possible to make a more detailed study.

The contour map of the river is shown on Fig. 28.

9.14.2 *Onrust Site* (White Mfolozi river)

The location of this site is 22 miles south east of Vryheid with storage in the Sand river tributary. The grade of the river bed is about 7 feet per mile.

Side slopes of the flanks would be flat but there is a good storage basin upstream of the site which is situated in the Dwyka Series.

Storage to 1 M.A.R. will provide an assured draught of about 35 M.G.D. with the height of the dam at 80 feet and the length about 1800 ft which would include the generation of hydro-electric power estimated at 120 kW.

Storage characteristics are shown on Fig. 29.

9.14 Mfolozi River

9.14.3 *Diversion to Emseleni river of White Mfolozi river only*

If the White Mfolozi river is diverted into the Emseleni river through a tunnel having a

capacity of 150 cusecs, a sustained draught of 120 M.G.D. will be provided from a dam 200 feet high with a gross storage of 530,000 acre feet of which 110,000 acre feet is dead storage. A diversion weir would be necessary on the White Mfolozi river so that silt laden waters may be by-passed. The storage characteristics are shown on Fig. 30.

9.14.4 *Black Mfolozi river—Mpakaneni site*

This site is 63 miles from the source of the river where the bed gradient is about 14 feet per mile, just below the confluence of the Sikkwelezi tributary with valley slopes of 1 in 4.

The site is located in the Eccia Series. Foundation conditions will require careful investigation.

A dam having a capacity of 1 M.A.R. would be 160 feet high and would have an assured draught of over 50 M.G.D.

Fig. 31 shows the storage characteristics of this site.

The hydro-electric power available would be 600 kW.

9.14.5 *Mfolozi river—Patane site*

This site is about 16 miles below the confluence of the Black and the White Mfolozi rivers. River gradients in this reach are about 4 feet per mile with the right flank rising at a slope of about 1 in 8 and the left flank at 1 in 2.

The geological formation is Basalt of the Stormberg Series.

Storage of $\frac{1}{2}$ M.A.R. will give an assured supply of over 160 M.G.D. for the gross catchment or 100 M.G.D. if flows of up to 200 cusecs are diverted into the Nseleni site and no storage on the Black Mfolozi river is developed.

The storage characteristics are shown on Fig. 32.

The potential hydro-electric power which could be generated at this site would be at least 500 kW.

9.15 *Nyalazi River*

The catchment of this river is relatively small and flat, rising to 1,000 feet above sea level in one small location only. As a result, the annual run-off from this catchment is below 10,000 million gallons, and in winter has almost no flow in the upper reaches.

Fig. 33 shows the catchment area.

No suitable dam site could be found and consequently no analysis has been carried out.

9.16 *Hluhluwe River—Game Reserve Dam*

A dam has been constructed on the most suitable site on the Hluhluwe river immediately downstream of the game reserve.

The present dam has an assured supply of 14 million gallons per day for a storage capacity of 21,000 acre feet, as determined by the Department of Water Affairs in the white paper on this project.

The contour map of the river is shown on Fig. 34.

No further analysis of this site has been carried out.

9.17 *Mzinene River*

This river drains a low-lying area to the west of False Bay, as shown on Fig. 35, and flows generally in a north-easterly direction to enter the bay at the most northerly point. No sites were found on this river and no analysis was undertaken.

9.18 *Mkuze River*

9.18.1 *Mooiplaats site*

The site used in this analysis is located just below the confluence of the Manzimhlope tributary about 12 miles east of Louwsberg. In this vicinity there are a number of suitable sites and a detailed study would be required to assess the relative value of each.

Side slopes are very steep on the right flank but the left flank is flatter, being about 1 in 7.

A dam having a storage of 1 M.A.R. would

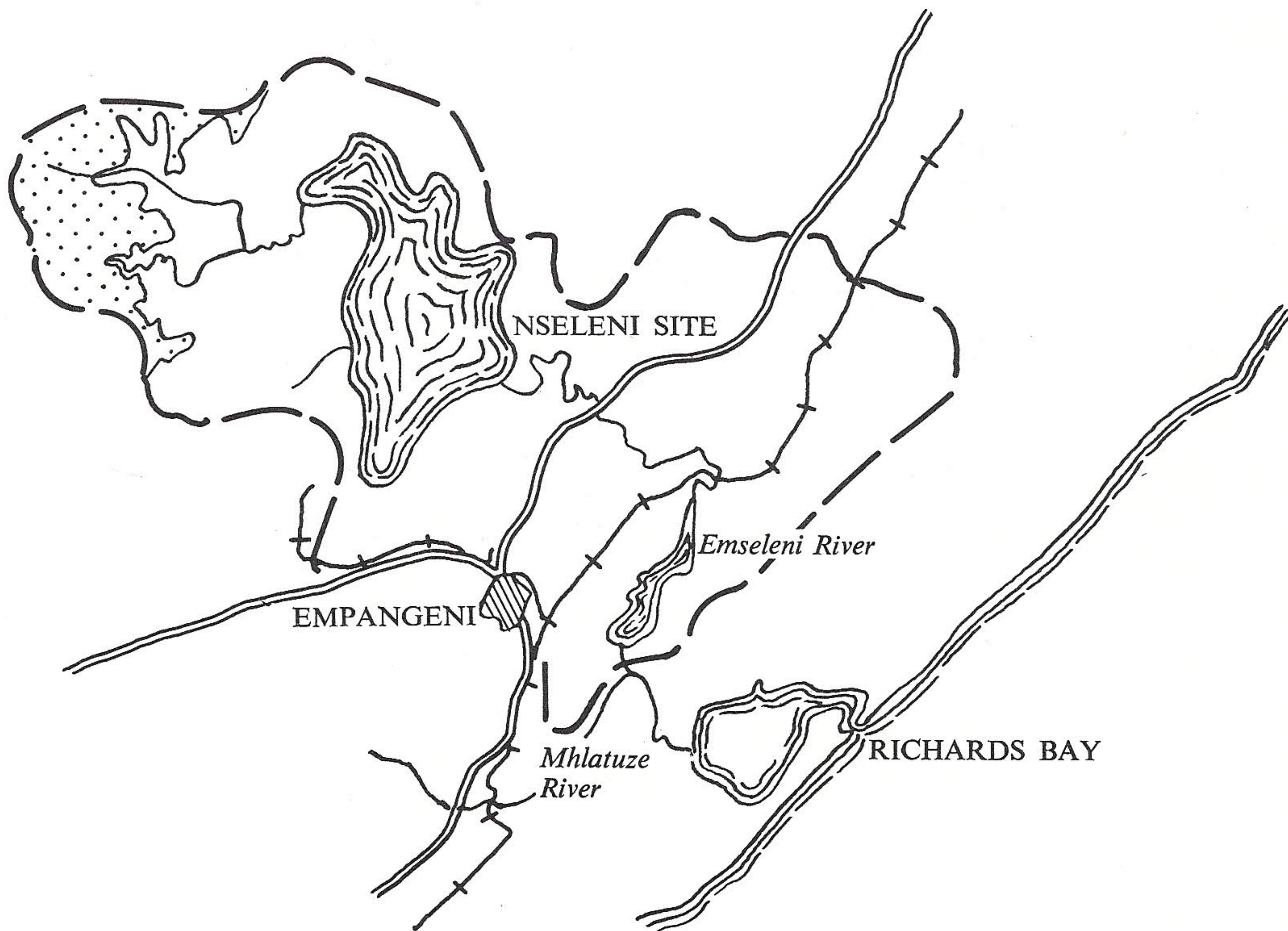
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FIG. 26

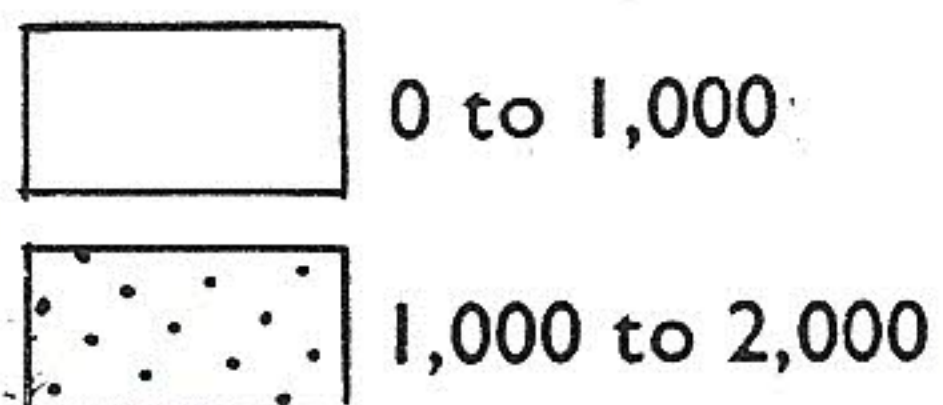
EMSELENI RIVER

CONTOUR MAP

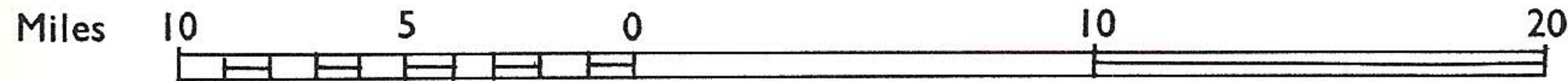


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29° 00'



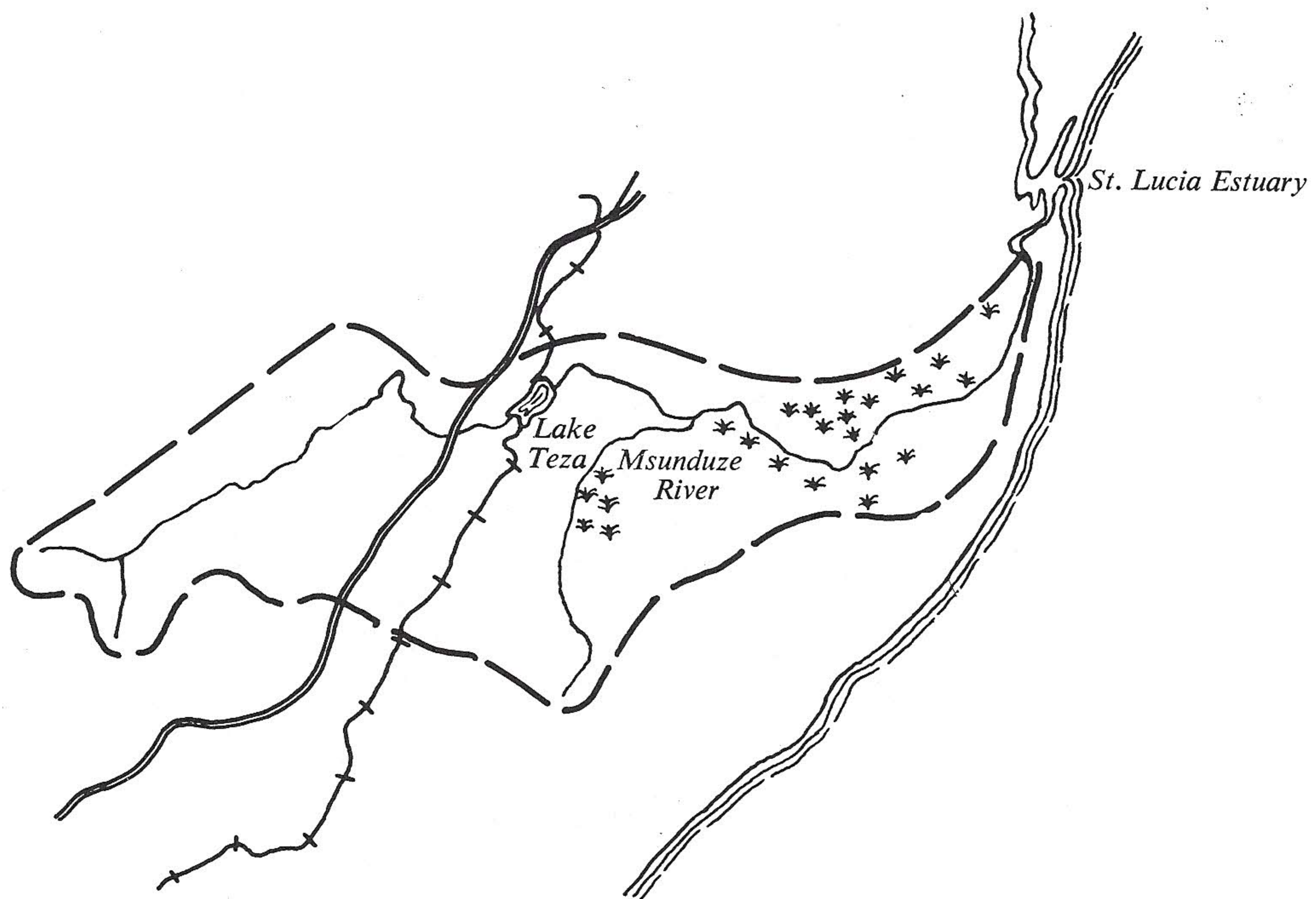
Scale 1:500,000



31° 30'

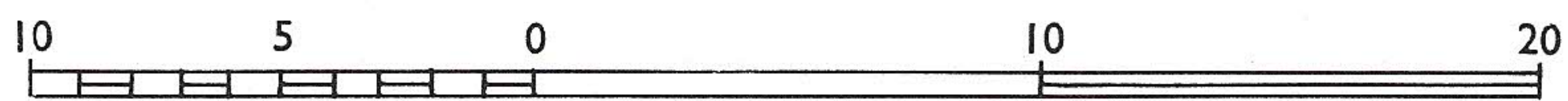
32° 00'

FIG. 27
MSUNDUZE RIVER
CONTOUR MAP



0 to 1,000

Scale 1:500,000



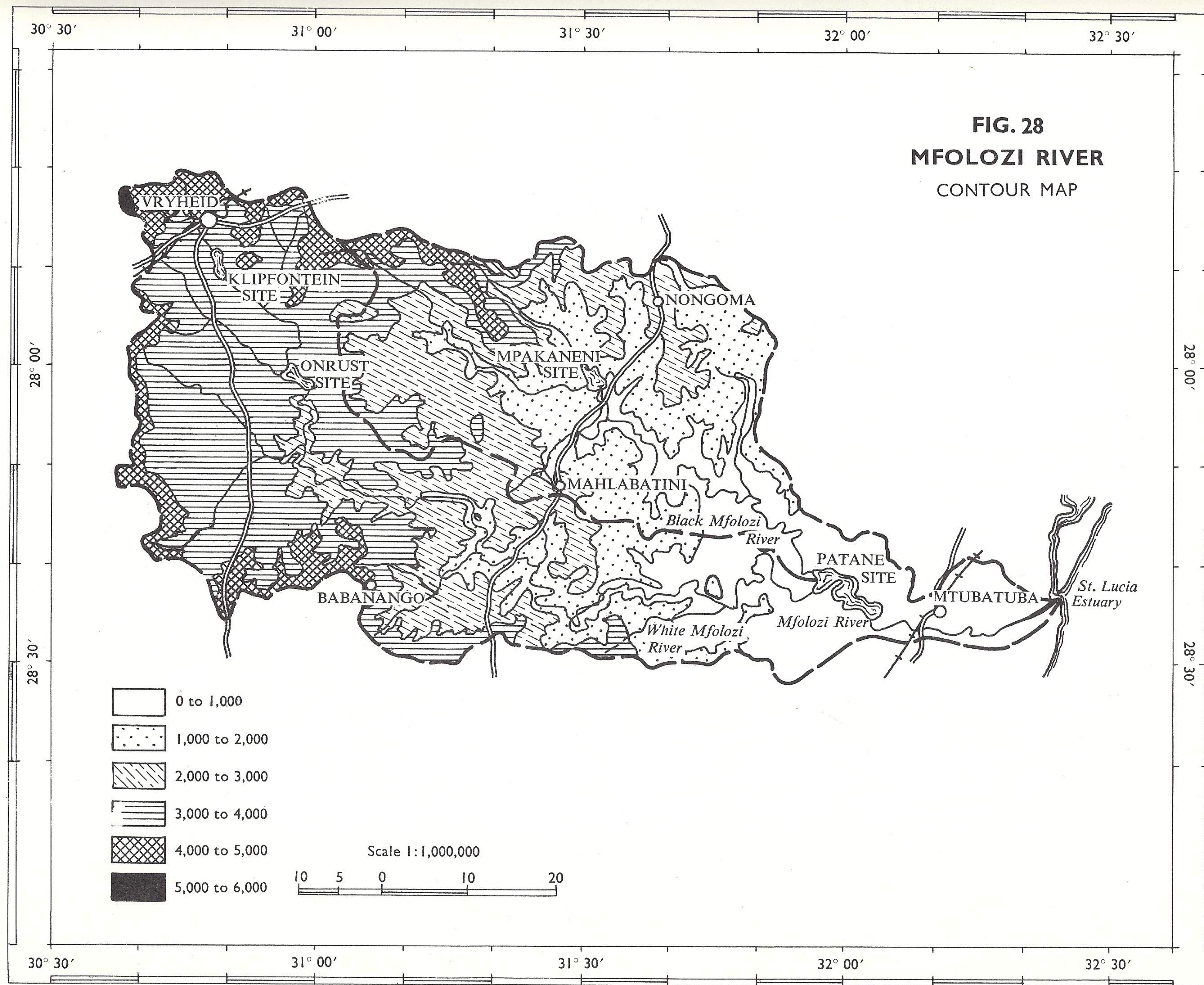


FIG. 29
WHITE MFOLOZI RIVER
ONRUST SITE

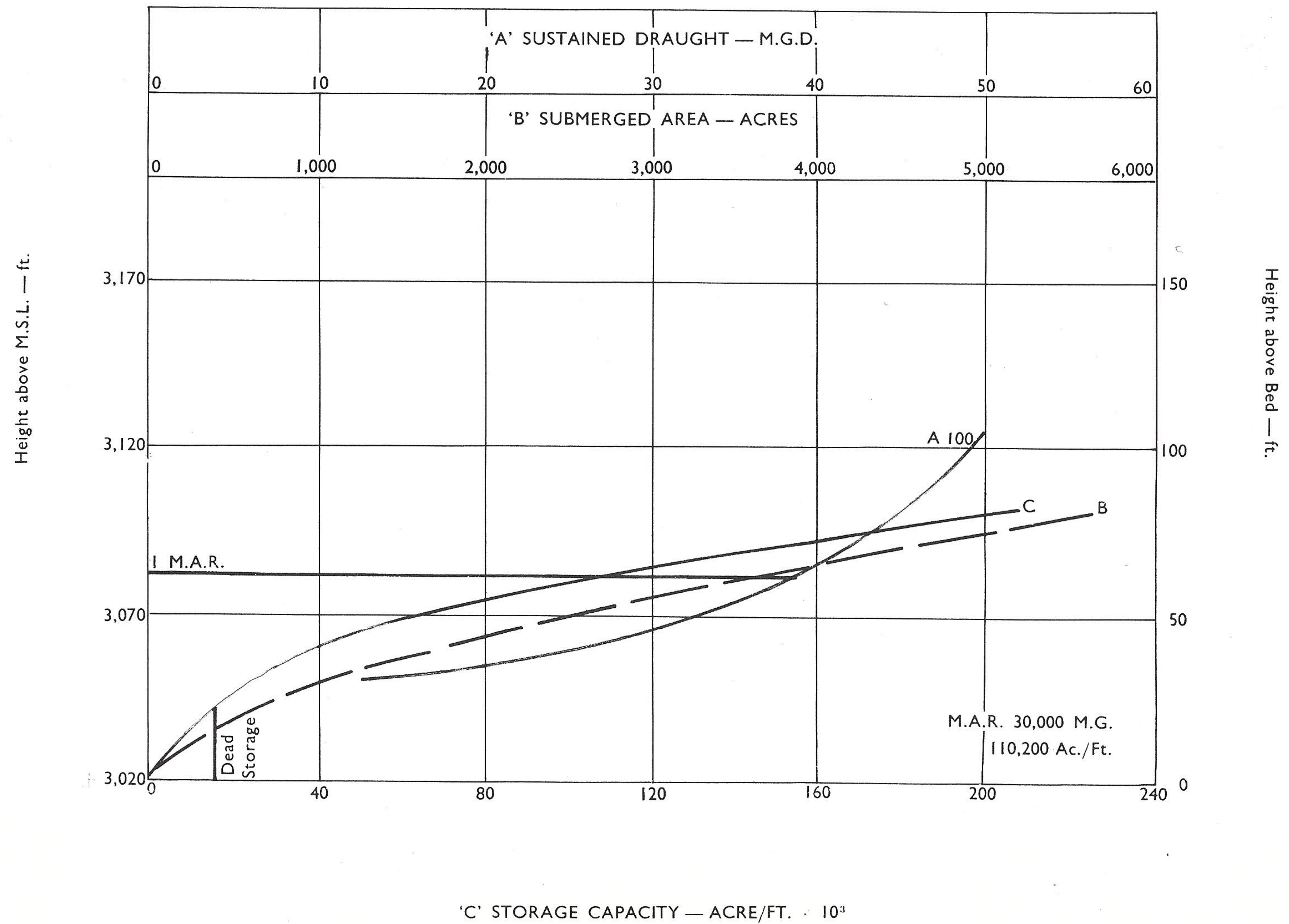
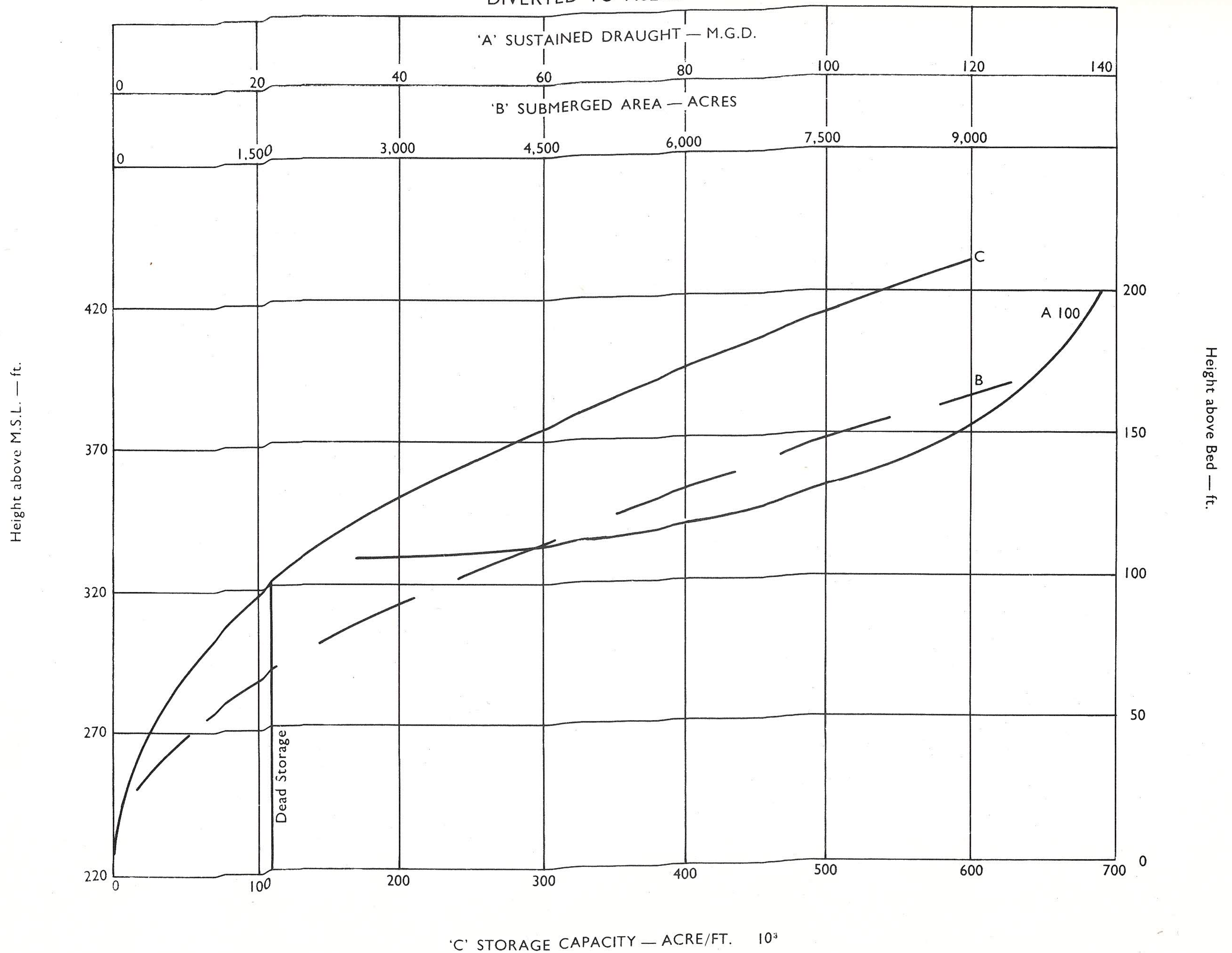


FIG. 30
WHITE MFOLOZI RIVER
 DIVERTED TO NSELENI SITE



Note: Up to 150 cusecs diverted from White Mfolozi River.

NOTE: NO LARGE STORAGE ON WHITE MFOLOZI RIVER UPSTREAM OF DIVERSION SITE HAS BEEN CONSIDERED

FIG. 31
BLACK MFOLOZI RIVER
 MPAKANENI SITE

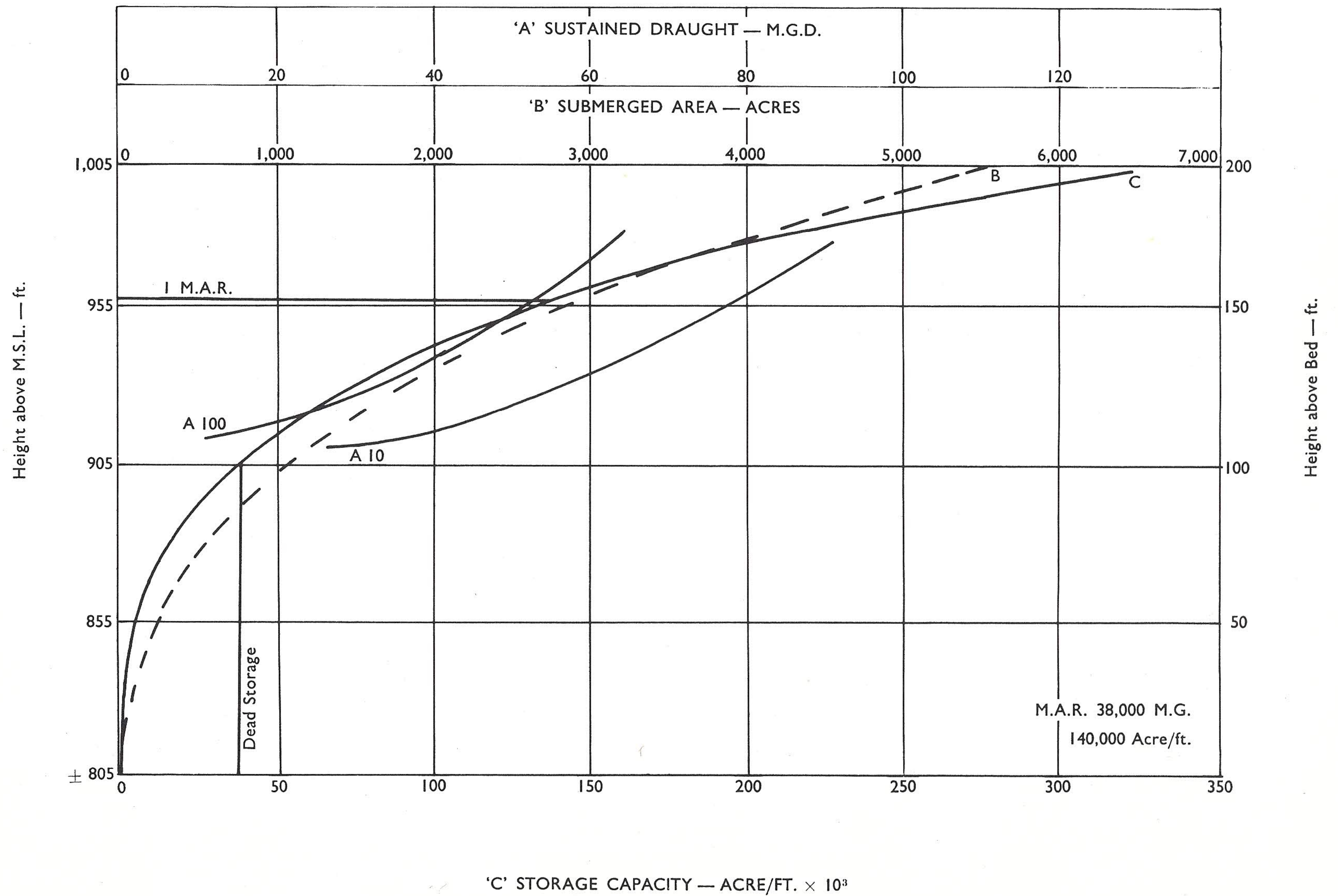
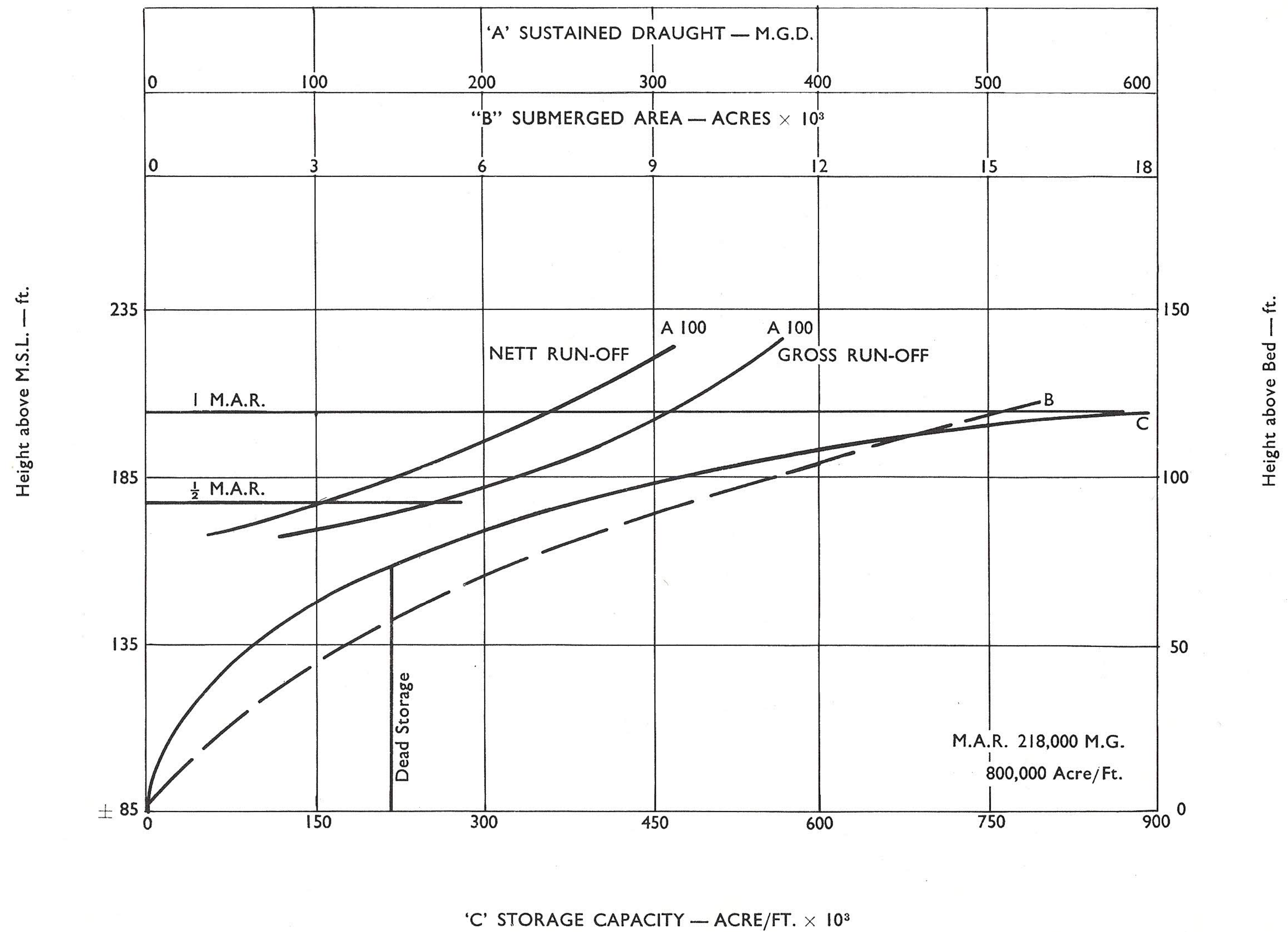
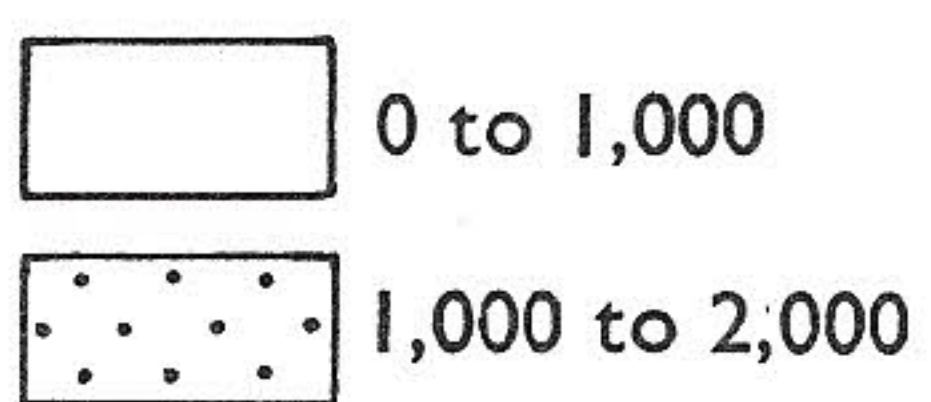
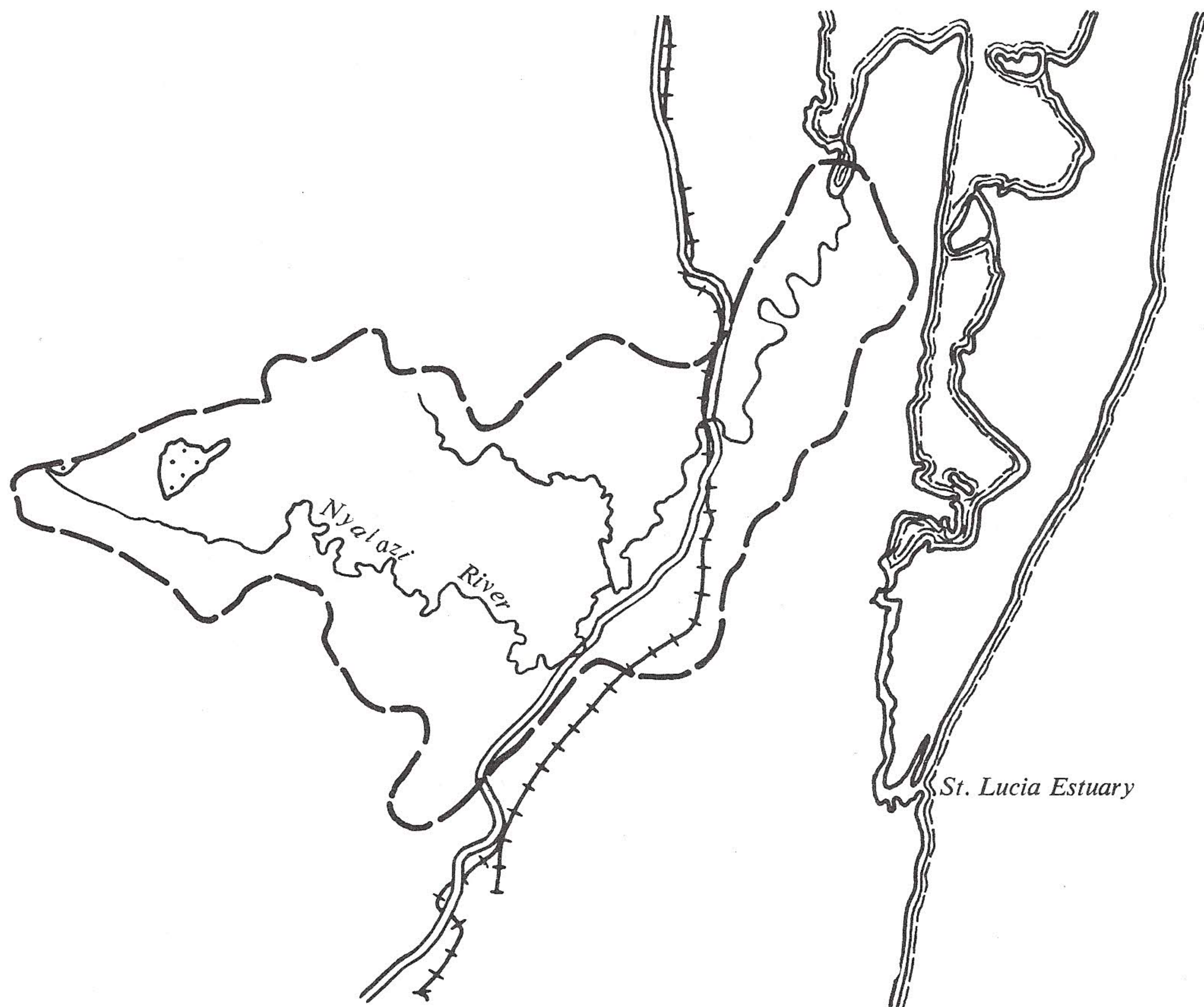


FIG. 32
MFOLOZI RIVER
PATANE SITE



NOTE: NETT RUN-OFF ALLOWS FOR DIVERSION OF WHITE MFOLOZI TO NSELENI ONLY.

FIG. 33
NYALAZI RIVER
CONTOUR MAP



Scale 1:500,000

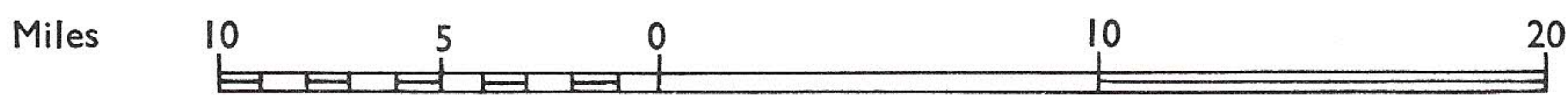
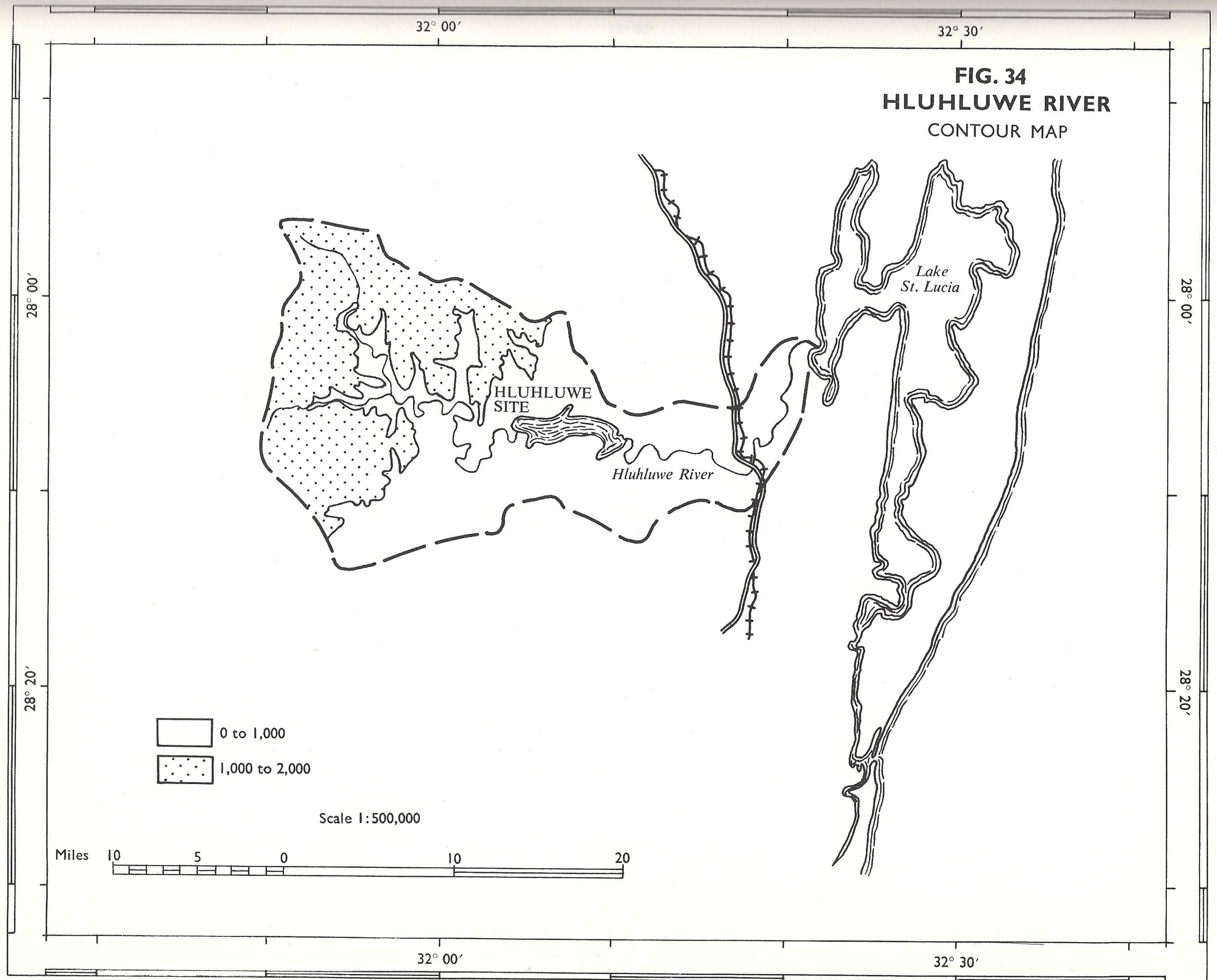


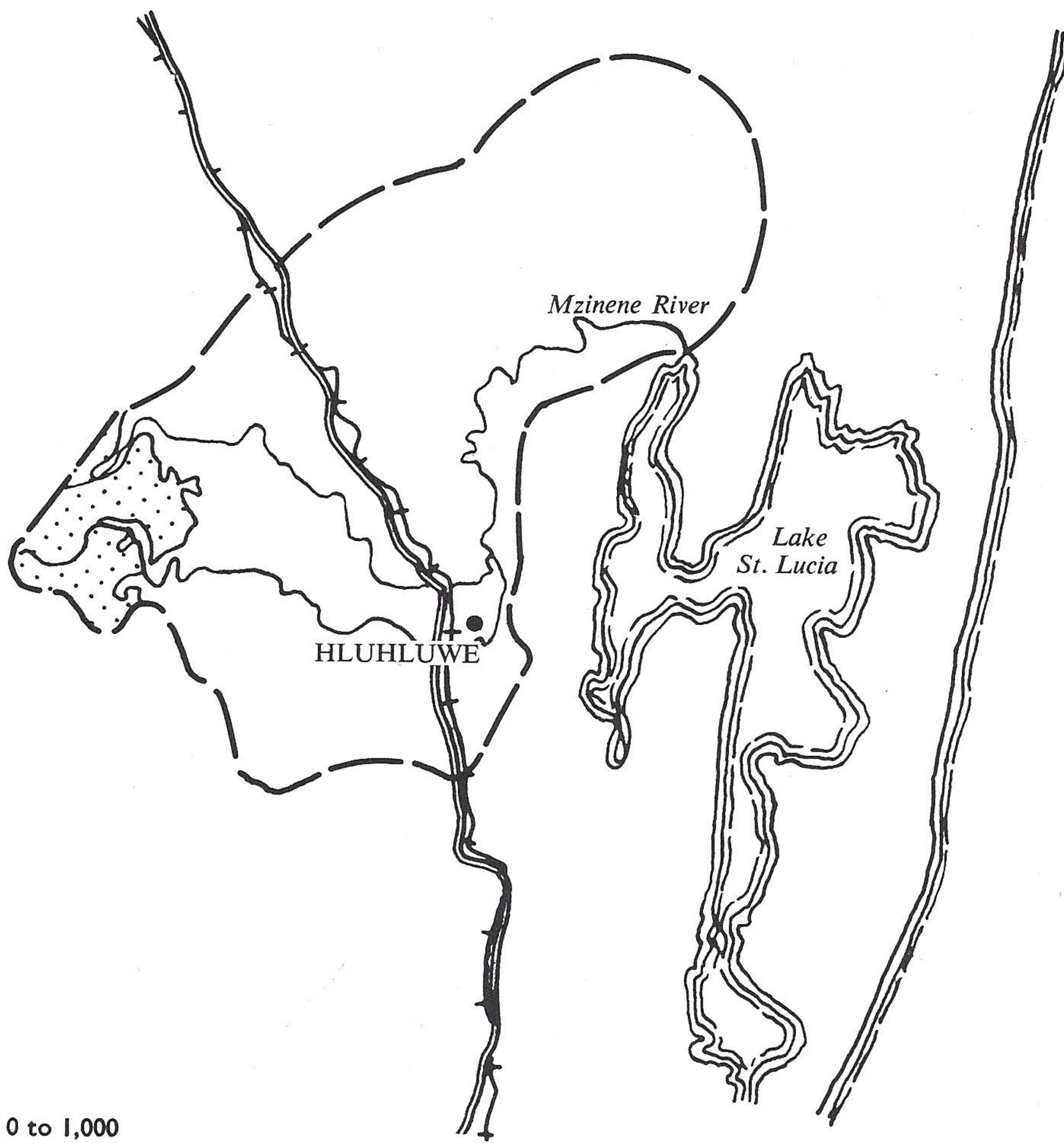
FIG. 34
HLUHLUWE RIVER
CONTOUR MAP



32° 00'

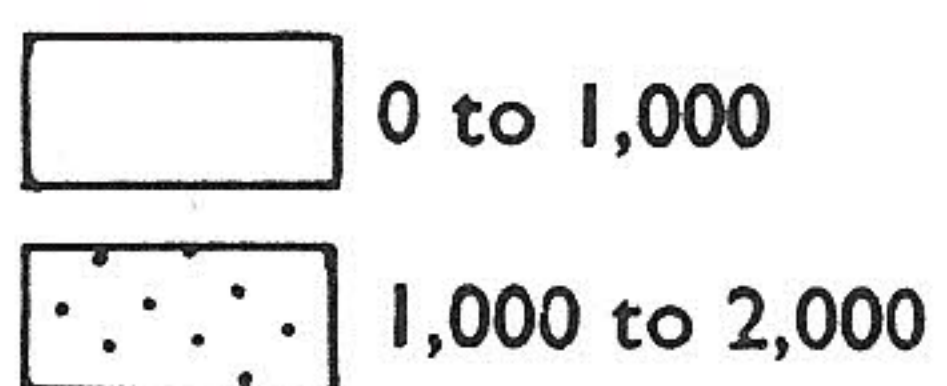
32° 30'

FIG. 35
MZINENE RIVER
CONTOUR MAP

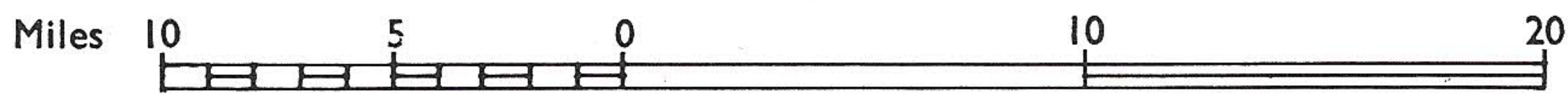


28° 00'

28° 00'



Scale 1:500,000



32° 00'

32° 30'

yield an assured draught of 45 M.G.D. but would have to be 140 feet high.

The catchment is shown on Fig. 36 and storage characteristics on Figs. 37, 38, 39 and 40.

Potential development of hydro-electric power would be about 430 kW.

9.18.2 Gauging Station site

Maps are not available for this reach of the river which winds through deep valleys with steep slopes of the Eccca Series. A storage draught analysis was carried out on a storage basin having similar characteristics to the Mooiplaats site.

For the storage of 1 M.A.R. capacity the height would be 150 feet with an assured draught of 55 M.G.D.

It would be possible to generate about 550 kW.

9.18.3 Welcome site

This site is 20 miles south east of Pongola township where the Mkuze river flows south downstream of a series of large wide bends. No maps showing suitable contours are available for the area. Storage basin characteristics have been assumed to be similar to the Mooiplaats site so the results of the analysis of this site should be used with due consideration.

A dam having a storage capacity of 1 M.A.R. would be 175 feet high with an assured draught of 80 M.G.D.

9.18.4 St. Lucia Lake—Control of Salinity

The portion of the assured nett draught which should be reserved for control of salinity as recommended by the St. Lucia Lake Commission of Enquiry would be about 50 M.G.D. or 95 cusecs for the development of Welcome site alone. If this is undertaken only one third of the assured draught would be available for other usage.

9.18.5 Pongola River—J. G. Stridjom Dam (under construction)

The southern limits of the water level in J. G. Stridjom Dam will be close to the divide between the Pongola river and the Mkuze river.

It would be possible to supply the water stored in the J. G. Stridjom Dam through a tunnel into the Mkuze river. This diversion would supply water by gravity to a large area of the flat valley in the vicinity of Mkuze with possible control on the salinity of St. Lucia lake.

9.19 Comparison of Sites

A comparison of the characteristics of sites has been prepared as follows:

9.19.1 Storage Basins

The depth/capacity relationship has been plotted on Fig. 41 for sites considered, together with the curves for dams on the Mgeni river; Midmar and Albert Falls sites which are the best sites and Upper Table Mountain site which has the poorest curve, are shown as well as Vaaldam.

These show the good characteristics of the Onrust site on the White Mfolozi river, the Nseleni site on the Emseleni river and Mtenzeni site on the Mvoti river. Spitzkop site on the Buffalo river is included as it was considered for regulation of flow to divert water into the White Mfolozi river.

The poor characteristics of the Doornkloof site on the Tongaat river, the Inanda site on the Mdloti river and the Mvoti Poort site are clearly shown.

9.19.2 Storage/Draught Characteristics

The relationship between assured draught and storage has been shown on Fig. 42 with both the draught and the storage expressed as percentages of the mean annual run-off of the river at the particular site.

It will be seen that these curves indicate that nett storage above 50 per cent M.A.R. on the

Mhlatuze and Matigulu rivers would not be economical. The other rivers all show a close correlation with each other.

The Mooiplaats site on the Mkuze river appears to be a good one and should provide good regulation of the flow.

9.19.3 Costs

In order to compare the costs of development of each site it would be necessary to undertake a cost/benefit analysis which is beyond the scope of this investigation.

In the development of these sites maximum benefit would be derived from multi-purpose projects which would include assured water supplies (to towns, industries, irrigation, etc.) flood control, hydro-electric power and recreation.

10. SYSTEM TO SUPPLY AREA FROM MDLOTI BEACH TO STANGER

Development of the coastal areas north of Durban has resulted in an increase in water demands over an area extending up to the Mhlali/Salt Rock area. Consideration has been given to the possible supply of water to this area from the only large assured supply sufficiently high to gravitate to the area, viz. Mvoti Poort site.

This would comprise the development of the Mvoti Poort site with the supply of about 30 million gallons per day to the coastal region between the Mdloti river and the Mhlali river. The water would be conveyed through a series of pipelines and tunnels to emerge on the eastern side of the Noodsberg at a high level which would ensure a gravity supply to this region.

This supply could also be diverted into the headwaters of the Mdloti river should this be desirable.

In addition the Mtendeni site could be developed to supply the area from Groutville to north of Stanger.

The potential development of hydro-electric power generation is approximately 1,000 kW.

These systems are shown on Appendix 1 with profiles on Appendices 28 and 29.

11. SYSTEM TO SUPPLY RICHARDS BAY/EMPANGENI COMPLEX

In view of the proposed major expansion in the Richards Bay/Empangeni area the investigation has considered the provision of an adequate supply of water for this area.

It has been found that with diversion of water from three separate catchment areas an assured supply of up to 260 M.G.D. could be provided for Richards Bay/Empangeni after taking cognisance of anticipated losses. In addition hydro-electric power to the extent of 20,900 kW could be made available.

11.1 Details of this proposal follow:

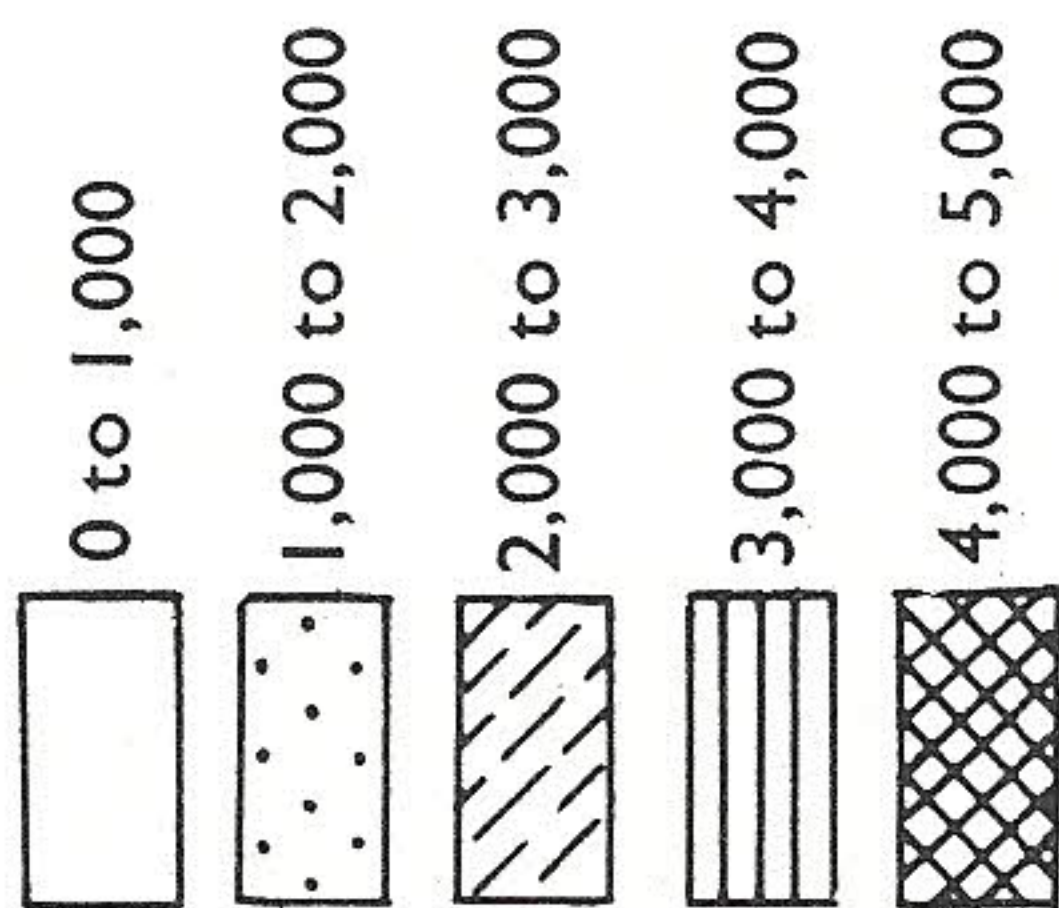
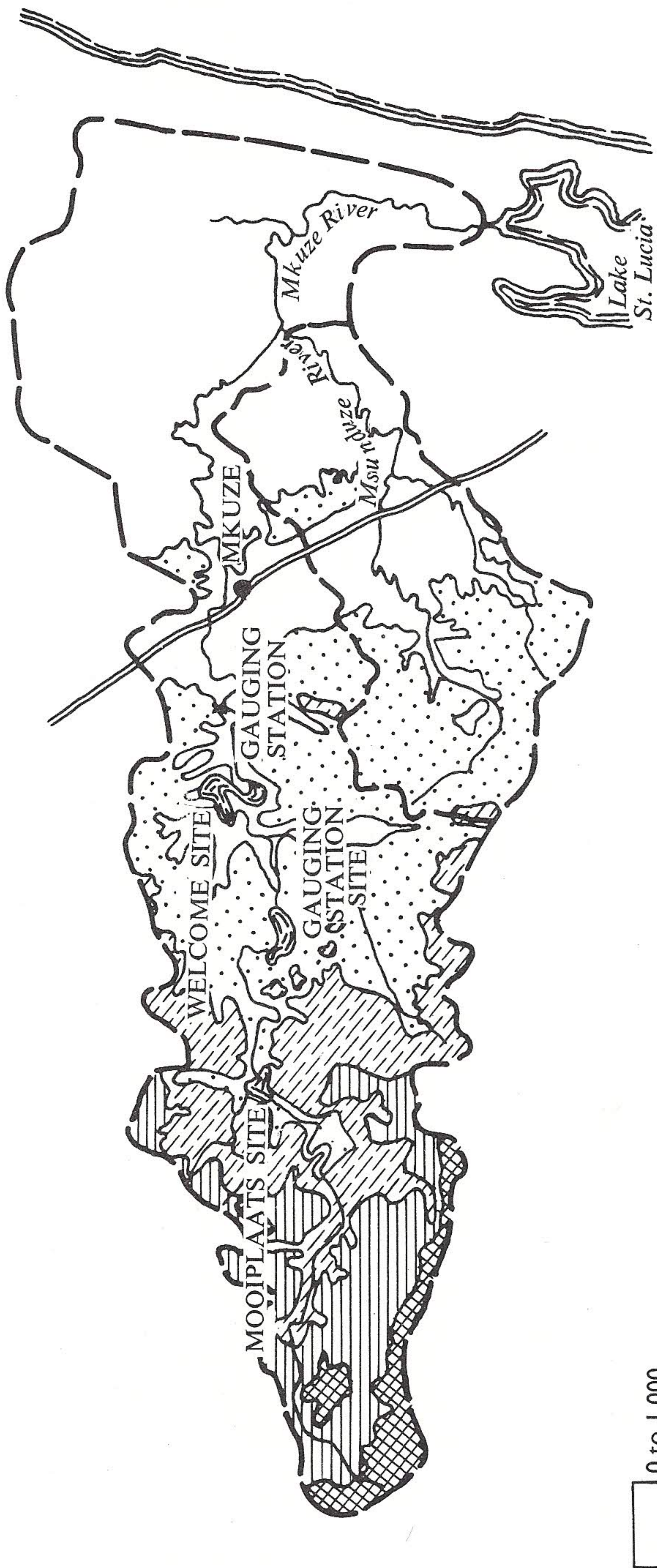
Three major river diversion sites are possible:

- (1) The Buffalo river can be diverted into the White Mfolozi river at Vant's Drift where there is a drop of about 700 feet over a distance of 35 miles to the White Mfolozi river. The tunnel length would be about 11 miles and the potential use of water from the Buffalo river below the point of diversion will be small.
- (2) The Black Mfolozi river can be diverted into the White Mfolozi river with a fall of about 60 feet through a tunnel 12 miles long.
- (3) The White Mfolozi river can be diverted to the Emseleni river through a tunnel having a fall of about 50 feet over 12 miles.

11.2 *A detailed study of this system is beyond the scope of this report but the following draughts have been calculated to indicate the potential of such a scheme:*

11.2.1 Storage on the Buffalo river could supply an estimated 150 M.G.D. for diversion into the White Mfolozi river. This would, however, be dependent upon the usage of

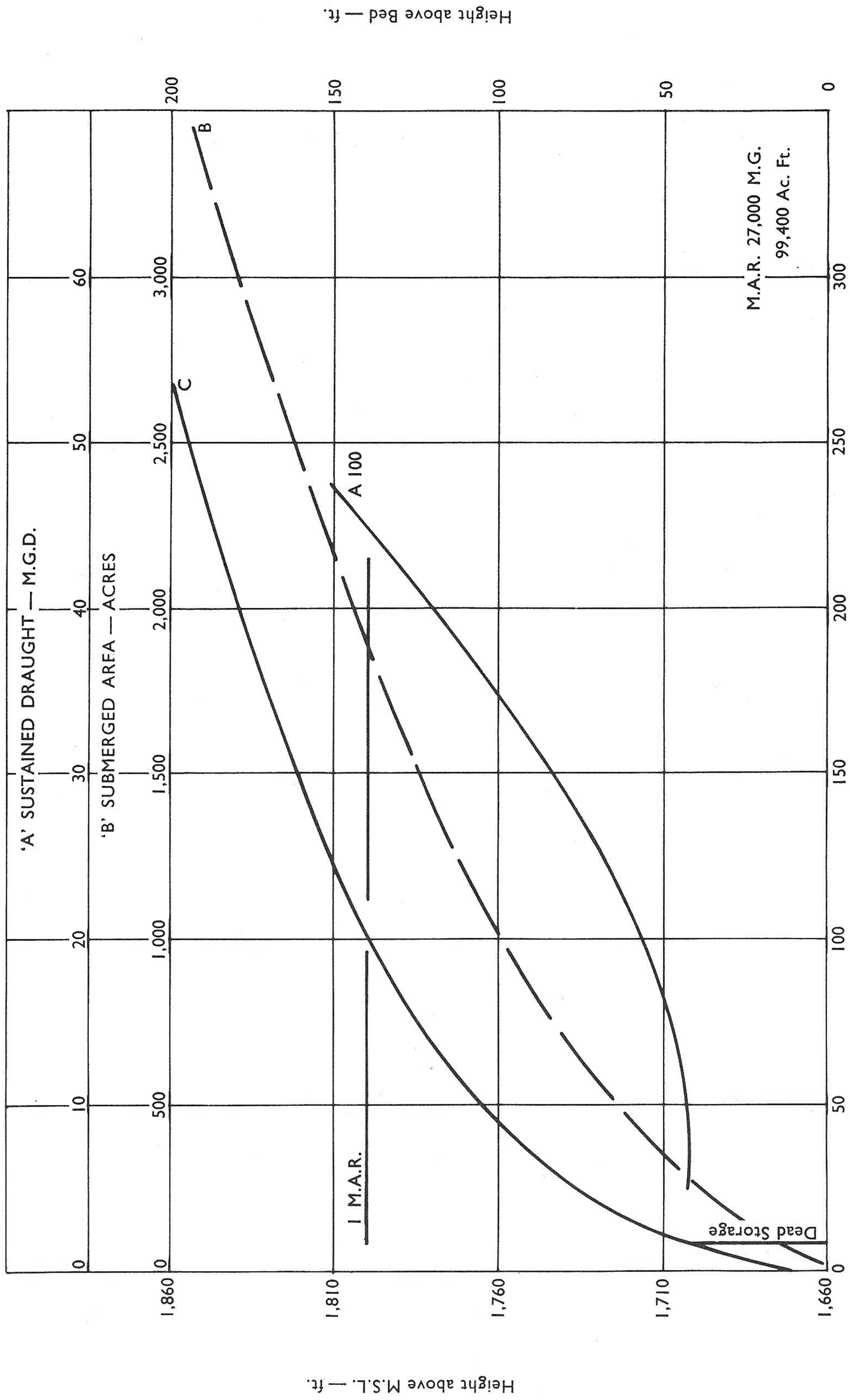
FIG. 36
MKUZE RIVER
CONTOUR MAP



Scale 1:1,000,000

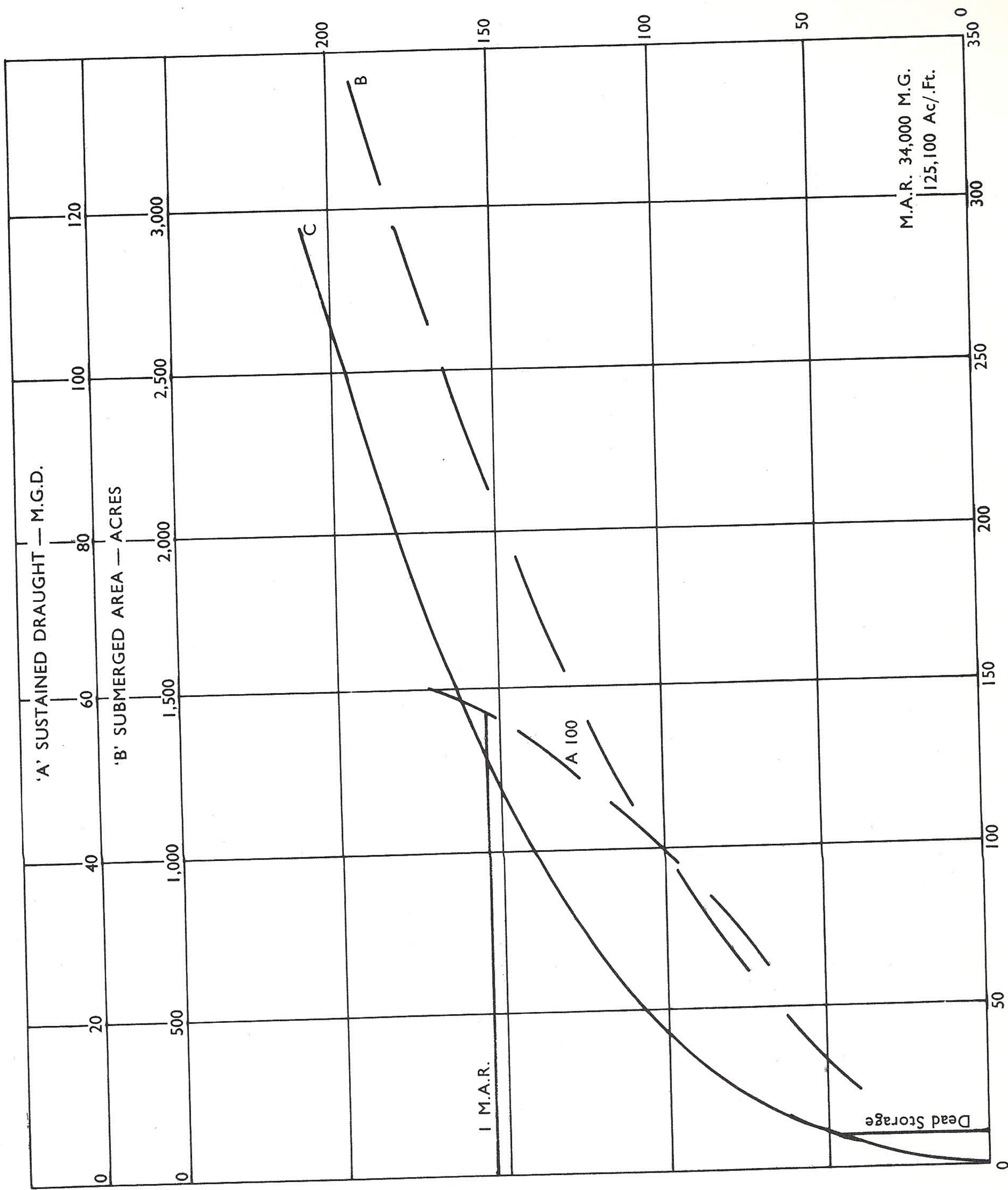


FIG. 37
MKUZE RIVER
 MOOIPLAATS SITE



'C' STORAGE CAPACITY — ACRE/FT. $\times 10^3$

FIG. 38
MKUZE RIVER
 GAUGING STATION SITE



'C' STORAGE CAPACITY — ACRE/FT. $\times 10^3$

FIG. 39
MKUZE RIVER
WELCOME SITE

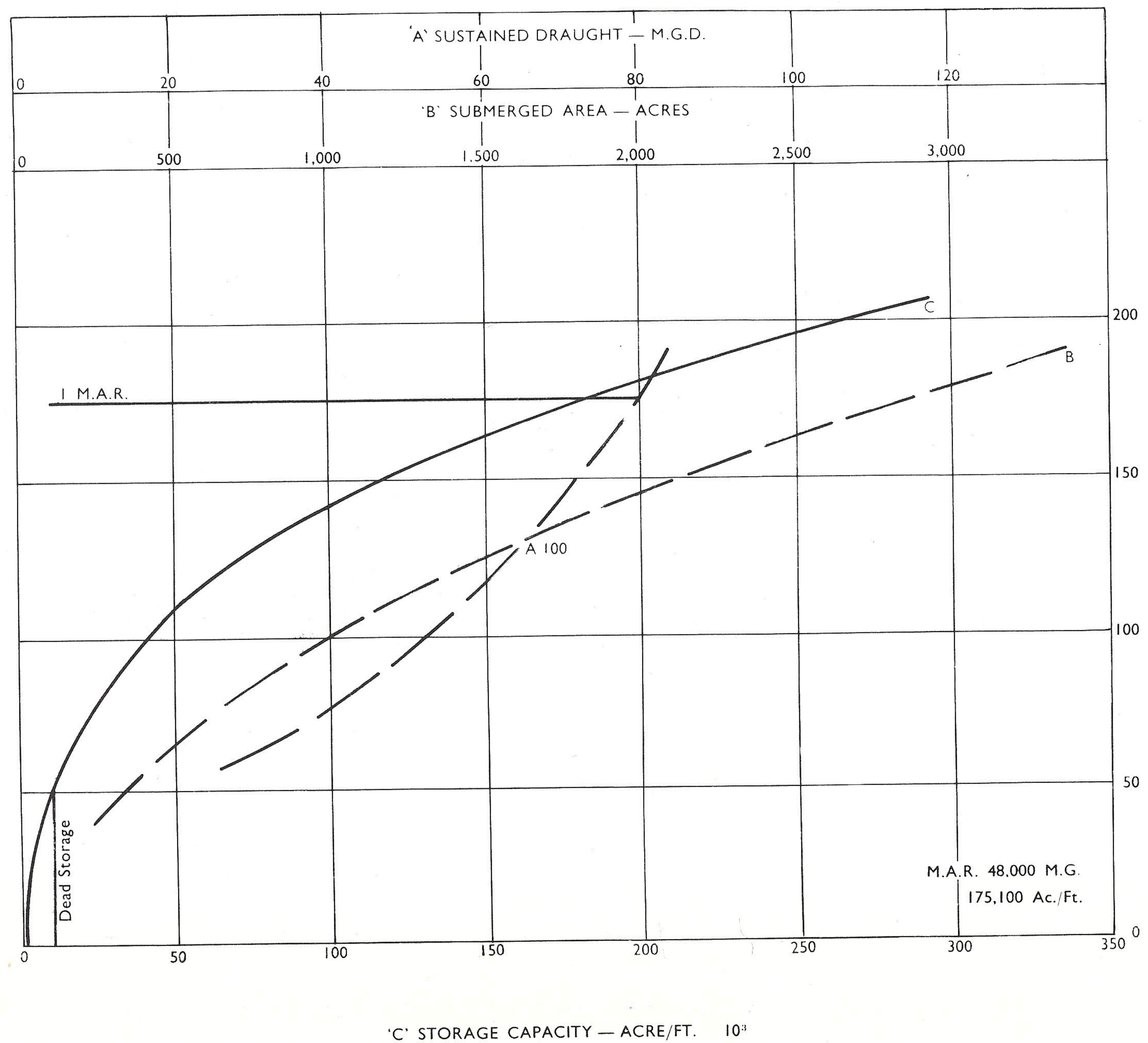


FIG. 40
MKUZE RIVER

COMPARISONS OF MOOIPLAATS GAUGE AND WELCOME SITES

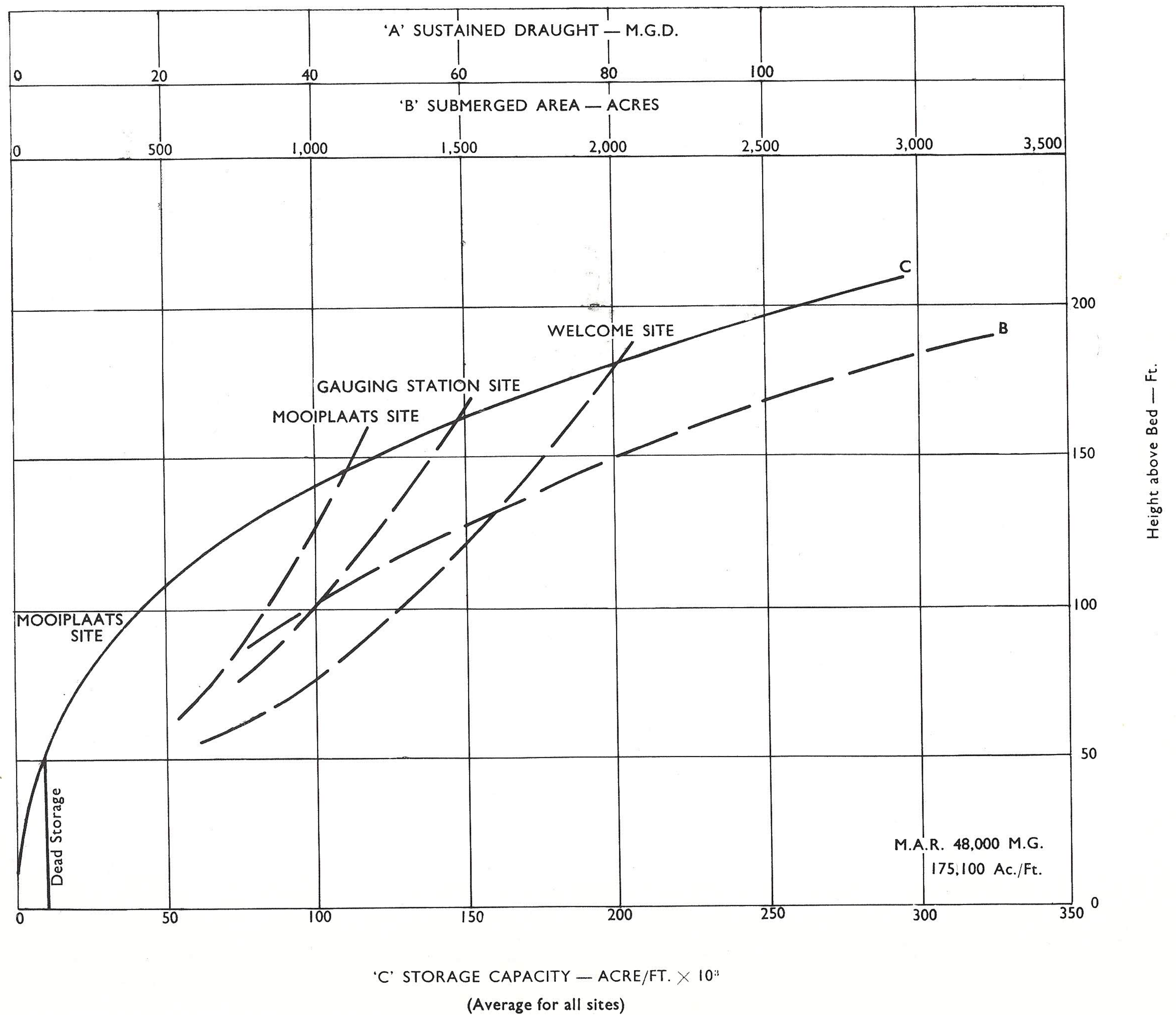
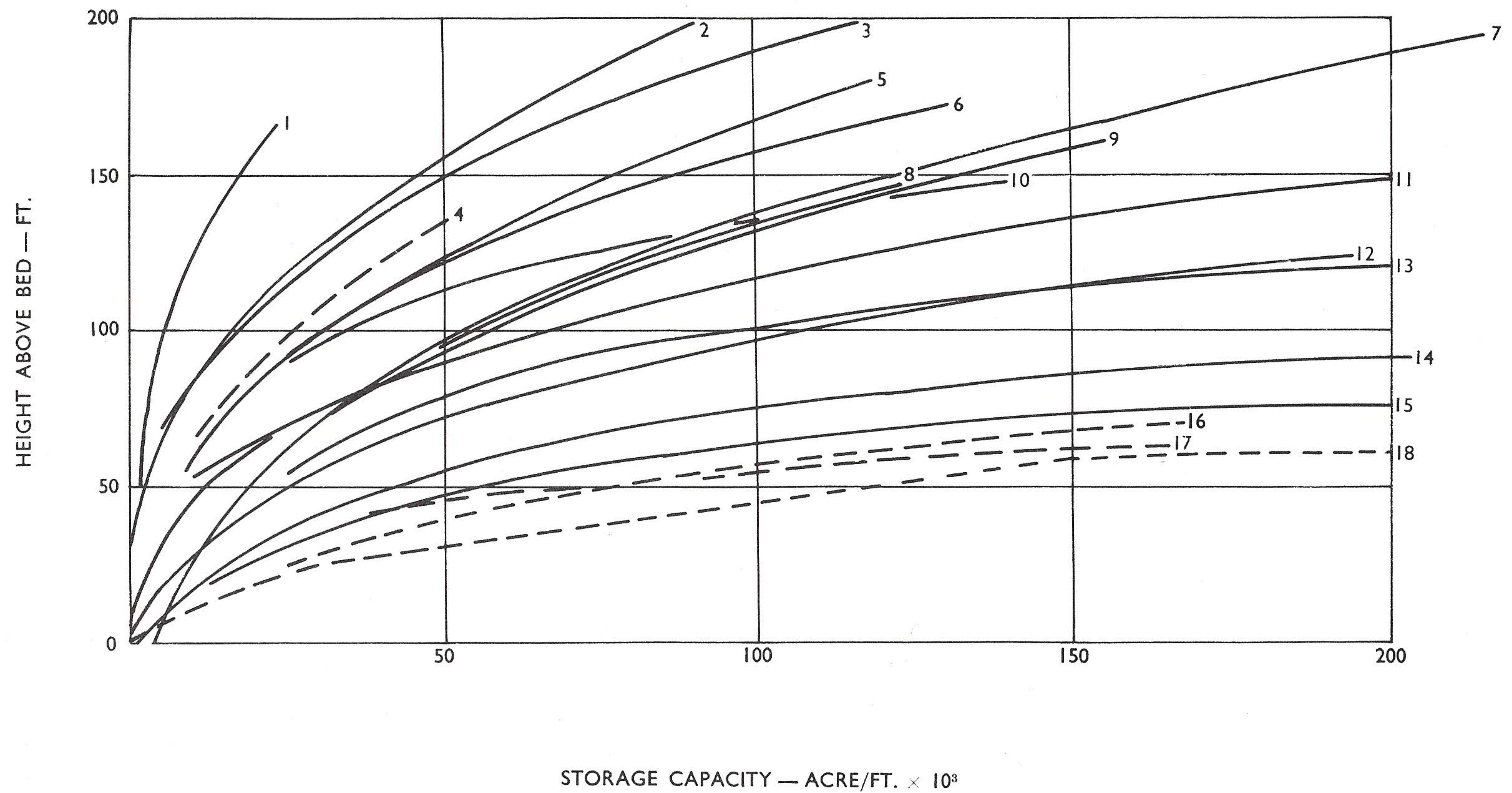


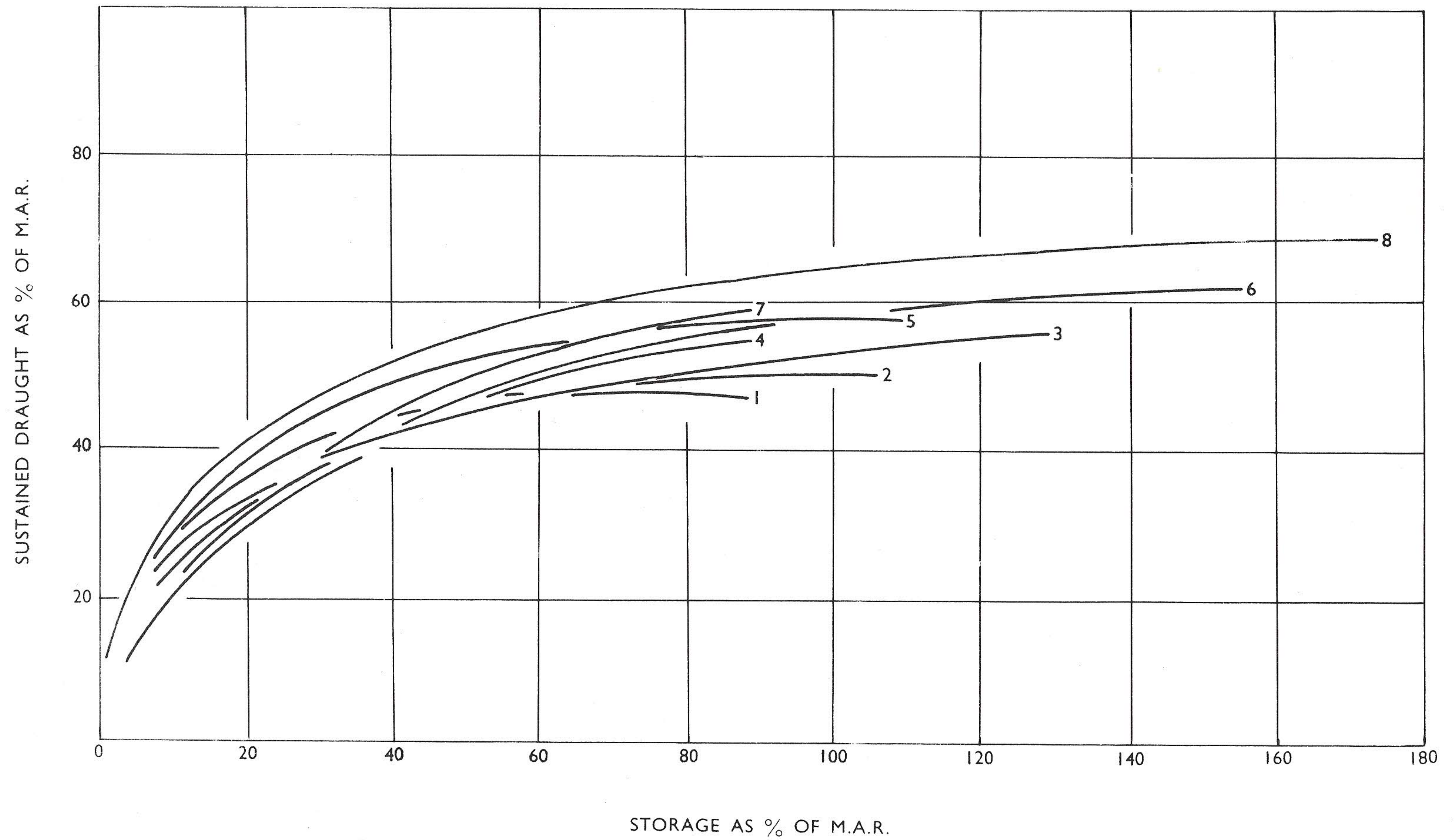
FIG. 41
COMPARISON OF STORAGE BASINS



LEGEND

- | | | |
|------------------------------------|----------------------------------|-------------------------------------|
| 1 Doornkloof—Tonga River | 7 Mooiplaats—Mkuze River | 13 Game Reserve—White Mfolozi River |
| 2 Inanda—Mdloti River | 8 Darnall—Nonoti River | 14 Spitzkop—Buffalo River |
| 3 Mvotipoort—Mvoti River | 9 Patane—Mfolozi River | 15 Onrust—White Mfolozi River |
| 4 Upper Table Mountain—Mgeni River | 10 Mpakaneni—Black Mfolozi River | 16 Midmar—Mgeni River |
| 5 Matigulu—Matigulu River | 11 Mtendeni—Mvoti River | 17 Vaaldam |
| 6 Normanhurst—Mhlatuze River | 12 Nseleni—Emseleni River | 18 Albert Falls—Mgeni River |

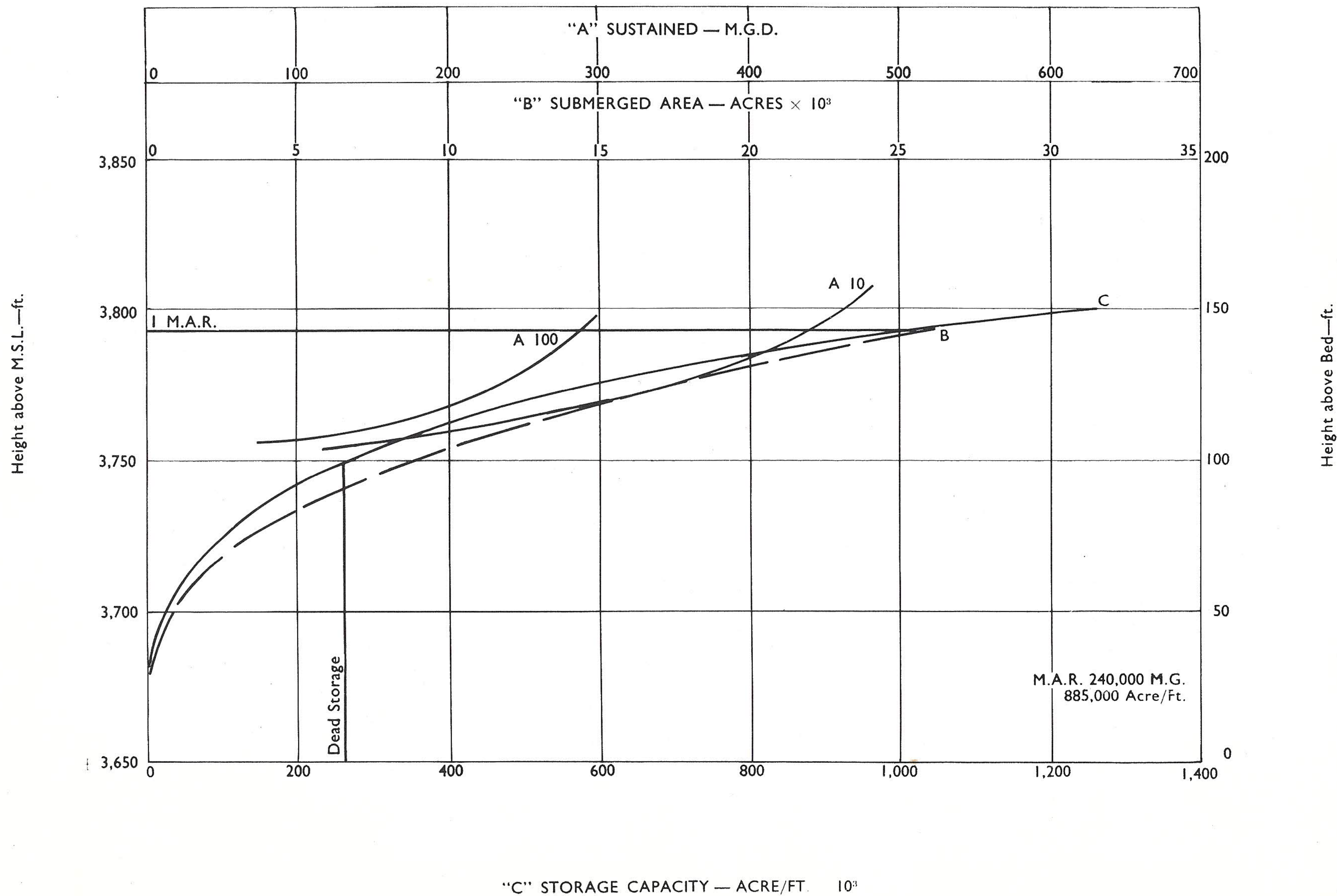
FIG. 42
STORAGE DRAUGHT CURVES FOR MAJOR RIVERS OF
NATAL NORTH COAST AND ZULULAND



LEGEND

- | | |
|---------------------------|------------------------------|
| 1 Mhlatuze at Normanhurst | 5 Mkuze at Welcome |
| 2 Matigulu at Matigulu | 6 Black Mfolozi at Mpakaneni |
| 3 Mdloti at Inanda | 7 Mvoti at Mtendeni |
| 4 Tongaat at Doornkloof | 8 Mkuze at Mooiplaats |

FIG. 43
BUFFALO RIVER
 SPITZKOP SITE



water in the Buffalo river both upstream and downstream of the diversion site.

11.2.2 The diversion of the White Mfolozi river into the Emseleni river through a tunnel having a capacity of 350 cusecs will provide a sustained draught of 85 M.G.D. from a dam 200 feet high with a gross storage of 530,000 acre feet (of which 110,000 acre feet is dead storage) allowing for upstream development which would provide an additional draught of 40 M.G.D.

11.2.3 The ultimate possible development of this complex if all the water is required to be diverted to the Nseleni site is shown in Appendix 2. The profile for this development is shown in Appendix 30. The advantages of this type of development are:

- (i) The inter-connection of catchments in different rainfall districts as shown in Fig. 5.
- (ii) At diversion sites into tunnels it would be possible to prevent the heavy silt loads from entering the storage dam on the Emseleni river.
- (iii) A large supply of water would be conducted most economically by gravity to supply areas where future water demands are estimated to be high. It will be

possible to supply all levels up to 350 feet above sea level by gravity as shown on Appendix 3.

- (iv) It would be possible to develop hydro-electric power stations operating on regulated and diverted streamflows along the route from Empangeni to Vryheid. These would generate about 21,000 kW.
- (v) Flood control of major rivers in the area.
- (vi) Recreational use of the water stored in the dams.
- (vii) Spillway capacity from a dam on the Emseleni river would be considerably smaller than on a major river which will effect savings in costs of this structure.

These proposals require careful investigation to determine the most efficient development stages in series with other proposals for storage in the Buffalo river and in the lower reaches of the Mfolozi river.

11.2.4 In order to determine the optimum development stages, the cumulative yield from the various sources has been shown in Table 3 without the contribution from the Buffalo river. The use of the assured draught from the lowest Patane site will require investigation of future development as well as irrigation requirements.

TABLE 3
Optimum Development of Mfolozi River

River	Storage Site	M.A.R. acre feet	Available Storage 1,000 acre feet	Sustained Draught M.G.D.	Cumulative Yield M.G.D.
White Mfolozi	Klipfontein	37,900	37,000	5	5
	Onrust Less losses	110,200	150,000	35 12	
	Diverted into Nseleni Mseleni river	331,000 } 47,800 }	200,000	23 85	
				108 50	113 163
Black Mfolozi	Mpakaneni	139,500	140,000		
Lower Mfolozi	Patane	181,500	400,000	70	233

12. CONCLUSIONS

This investigation indicates the potential development of the coastal rivers of northern Natal and Zululand, with attention being directed to the development of multi-purpose schemes.

Particular consideration should be given immediately to safeguarding the sources of the rivers, so that the sponges are protected, as well as the control of erosion and silt movement in these areas.

These problems are vital to the success of the proposed schemes and adequate planning

of the total catchment areas should be undertaken.

ACKNOWLEDGEMENTS

The Town and Regional Planning Commission of Natal.

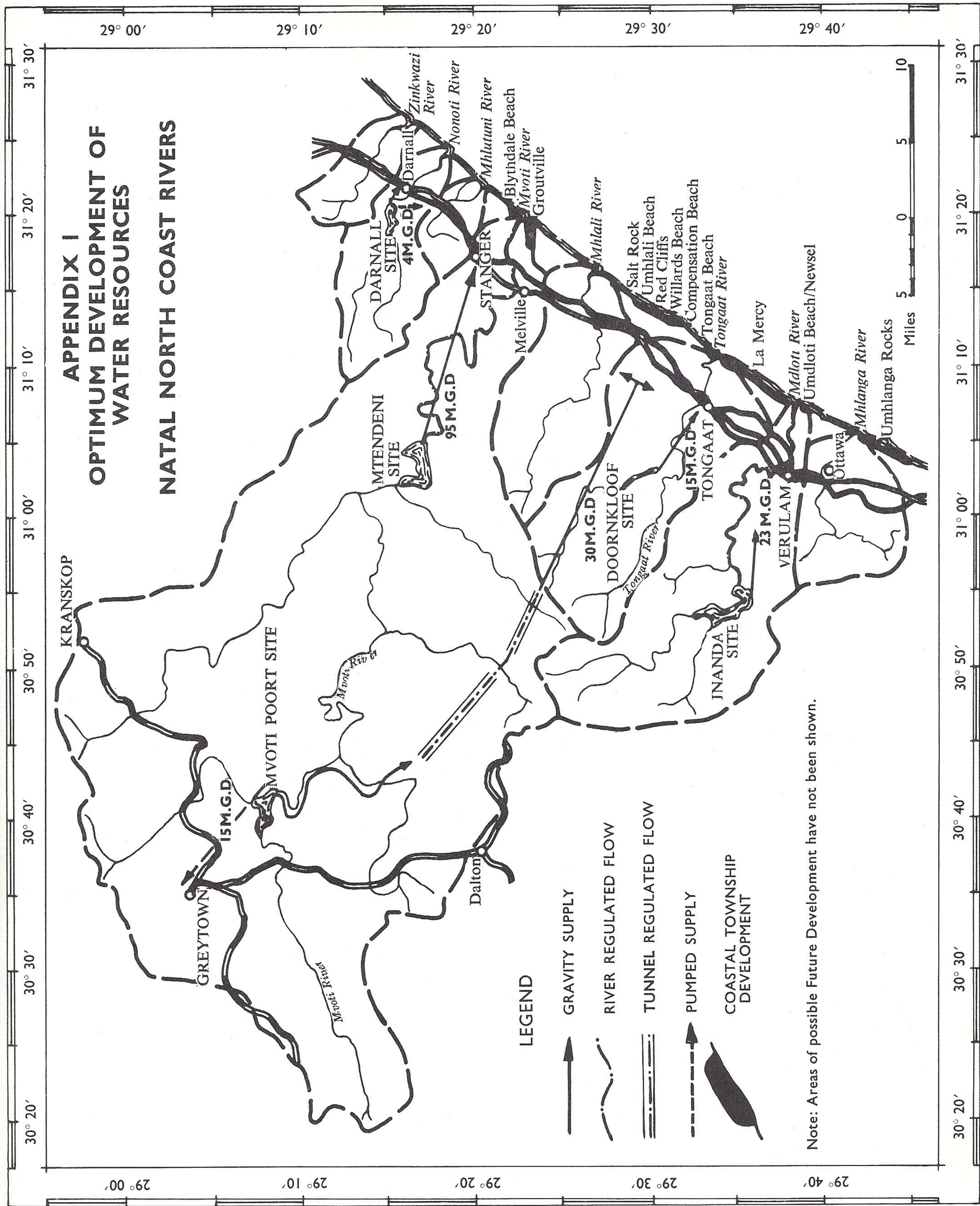
The Department of Water Affairs.

Council for Scientific and Industrial Research.

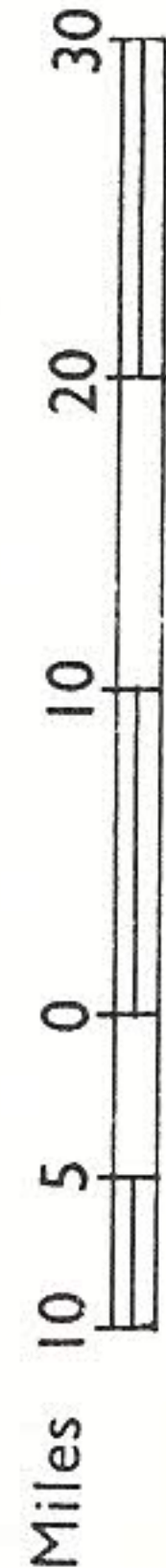
Professor D. C. Midgeley.

South African Sugar Association.

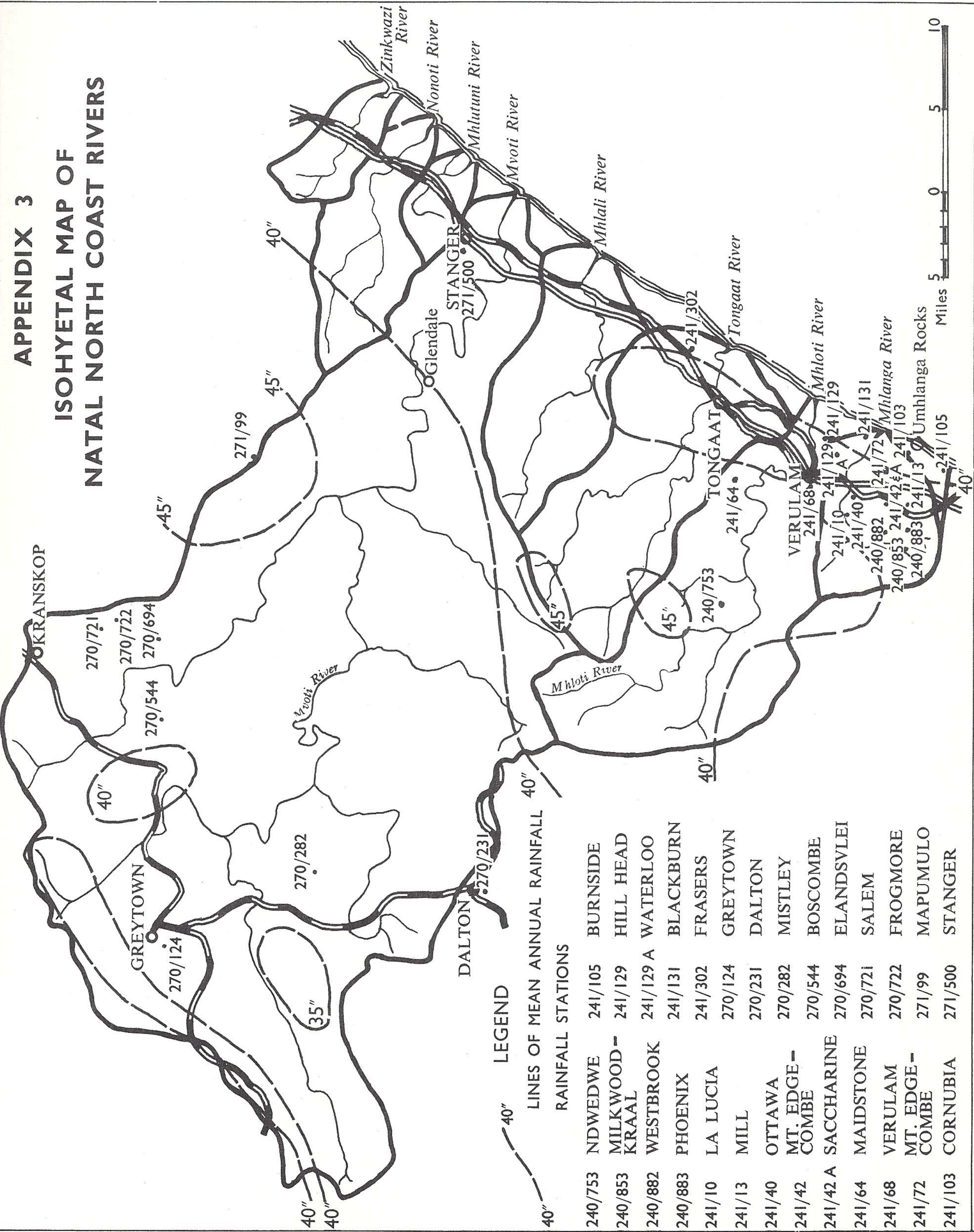
All Local Authorities and others who have kindly provided information.



APPENDIX 2

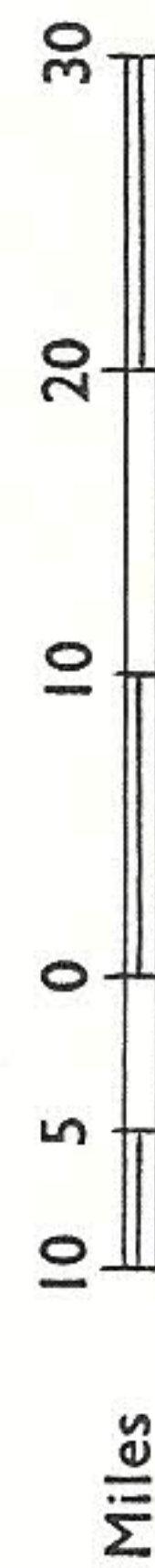


APPENDIX 3 ISOHYETAL MAP OF NATAL NORTH COAST RIVERS



Miles 5 10

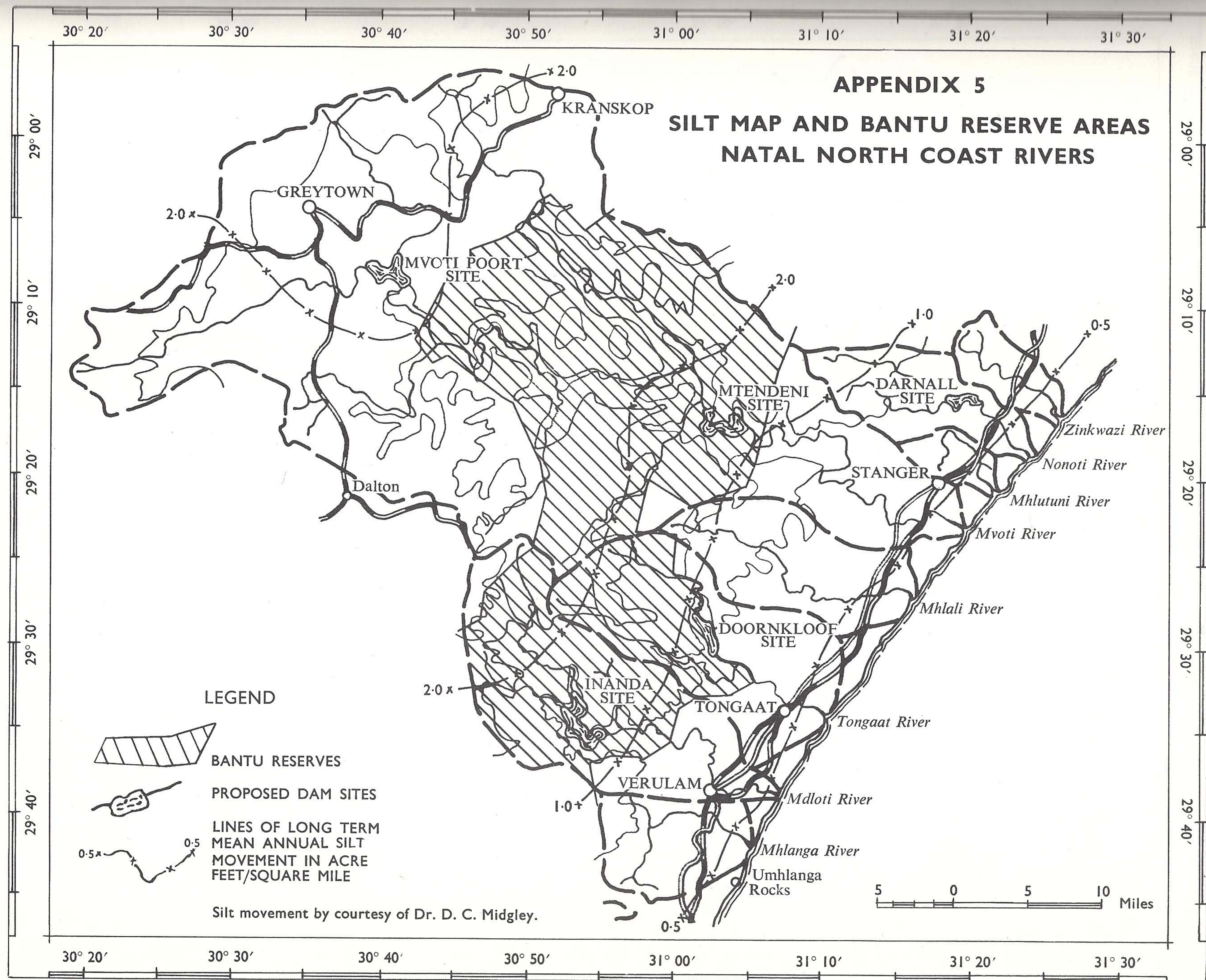
ISOHYETAL MAP OF ZULULAND COASTAL RIVERS



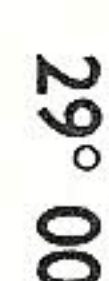
LINES OF LONG TERM ANNUAL RAINFALL

- RAINFALL STATIONS

1	272/2	Amatikulu	45	272/121	Gingindlovu
2	272/127	Amatikulu (Leper In)	46	272/272	Fairbreeze Estate
3	272/301	Emoyeni	47	303/122	Nkandla
4	303/391	Keurplaats Estate	48	303/473	Ashstead
5	303/633	Springvale	49	303/695	Melmoth
6	303/741	Sutton	50	303/801	Belmont
7	303/833	Eshowe	51	304/43	Nkwalini
8	304/283	Kwayaya	52	304/327	Obanjani
9	304/426	Ntambamana	53	304/446	Mtunzini
10	304/487	Lavoni	54	304/534	Port Durnford
11	304/633	Dingwell	55	304/680	Felixton
12	304/681	Port Durnford	56	304/712	Mhlatuze
13	304/736	Empangeni	57	304/822	Kulu Halt
14	305/37	Mposa	58	305/43	Nseleni
15	305/126	Kwa-Mbonambi	59	305/167	Richards Bay
16	305/241	Etoza	60	305/302	Woodford
17	305/308	Kwa-Mbonambi	61	336/594	Rondspring
18	336/704	Swartkop	62	336/863	Babanango
19	337/6	Goedgelooft	63	337/22	Babanango
20	337/32	Verden	64	337/143	Babanango
21	337/148	Welverdiend	65	337/150	Wonderdraai
22	337/204	Verdiend	66	337/431	Surprise Store
23	337/622	Overvloed	67	337/628	Mtonjaneni
24	337/687	Tevreden	68	337/795	Mhlabatini
25	338/668	Hlabisa	69	338/797	Nagana (Research)
26	339/65	Potters Camp	70	339/252	Entandweni
27	339/282	Landsdowne	71	339/352	Kangela
28	339/354	Mtubatuba	72	339/357	Rivers View
29	339/415	Hill Farm	73	339/224	Hluhluwe Lot 29
30	339/426	Walls Place	74	339/440	Palm Ridge
31	339/481	Hluhluwe Exp. Stn.	75	339/502	St. Lucia Estuary
32	339/523	Nyalazi	76	339/538	Uloa
33	339/705	St. Lucia Lake	77	339/720	Cape St. Lucia
34	372/467	Vryheid	78	372/570	Waterval
35	372/850	Hlobane	79	373/58	Gluckstadt
36	373/80	Langkrans	80	373/329	Vlakfontein
37	373/376	Welkom	81	373/447	Uitkomst
38	373/485	Louwsburg	82	373/680	Nongoma
39	374/194	Gutewahl	83	374/264	Nongoma
40	374/275	Magut	84	374/402	Silverhout
41	374/817	Clerkness	85	374/872	Nkonkoni
42	375/37	Mkuze	86	375/86	Dukumbane
43	375/124	Ubombo	87	375/322	Umbukwane
44	375/506	Hluhluwe			



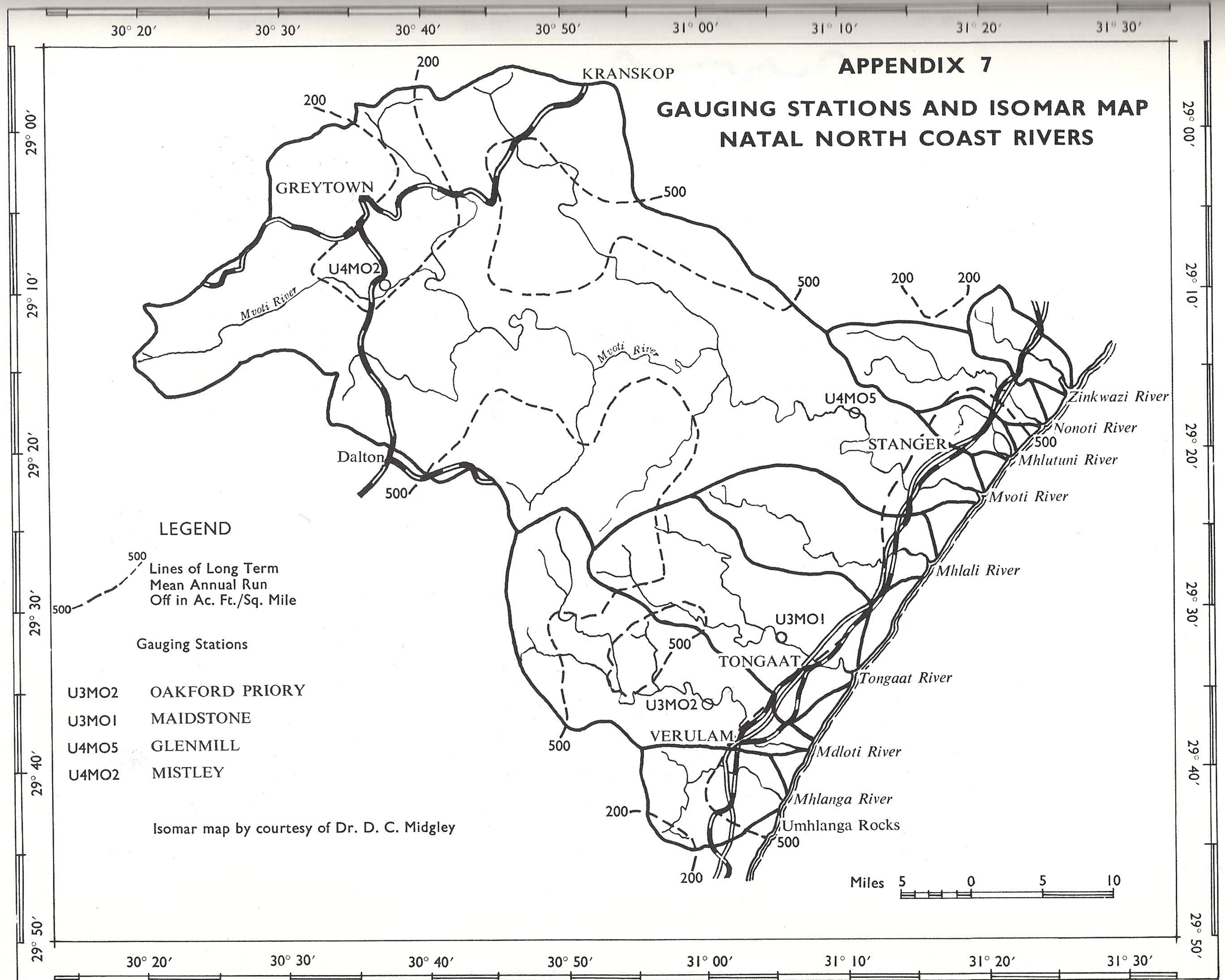
32° 30'



3
LINES OF LONG TERM
MEAN ANNUAL SILT
MOVEMENT IN ACRE
FEET/SQUARE MILE

Miles 10 5 0 10 20 30

32° 30'



[illegible]

Isomar Map by courtesy of Dr. D. C. Midgley.

APPENDIX 9

PROFILE OF MHLANGA RIVER

Scales: Horiz. 1 inch to 3 miles
Vert. 1 inch to 300 feet.

Lat. 29° 40' 16"
Long. 30° 56' 44"

Mean gradient
250 ft./mile

Mean gradient
67.3 ft./mile

Mean gradient
26 ft./mile

Mean gradient
13.5 ft./mile

DATUM 0-0

Table Mountain
Sandstone

Dwyka
Conglomerates

Ecca
Shale

Road & Rail Bridges

Ottawa

Road Bridge

Indian Ocean

FEET ABOVE SEA LEVEL	MILES FROM SPRING	MILES FROM OCEAN
1,125	0	17.7
1,000	0.2	17.5
800	0.8	16.9
700	1.2	16.5
600	1.7	16.0
500	2.3	15.4
400	2.9	14.8
350	3.4	14.3
300	4.2	13.5
275	4.6	13.1
250	5.2	12.5
225	5.5	12.2
200	6.5	11.2
175	7.2	10.5
150	8.0	9.7
125	9.1	8.6
100	9.6	8.1
75	10.3	7.4
50	11.2	6.5
25	12.6	5.1
0	14.5	3.2
	15.0	2.7
	17.7	0

APPENDIX 10 PROFILE OF MDLOTI RIVER

