INSTITUTE OF HYDROLOGY

GROUNDWATER INVESTIGATIONS OF SELECTED PLATEAUX IN THE REPUBLIC OF SEYCHELLES

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CHAPTER 1

INTRODUCTION

1.1 STUDY OBJECTIVES

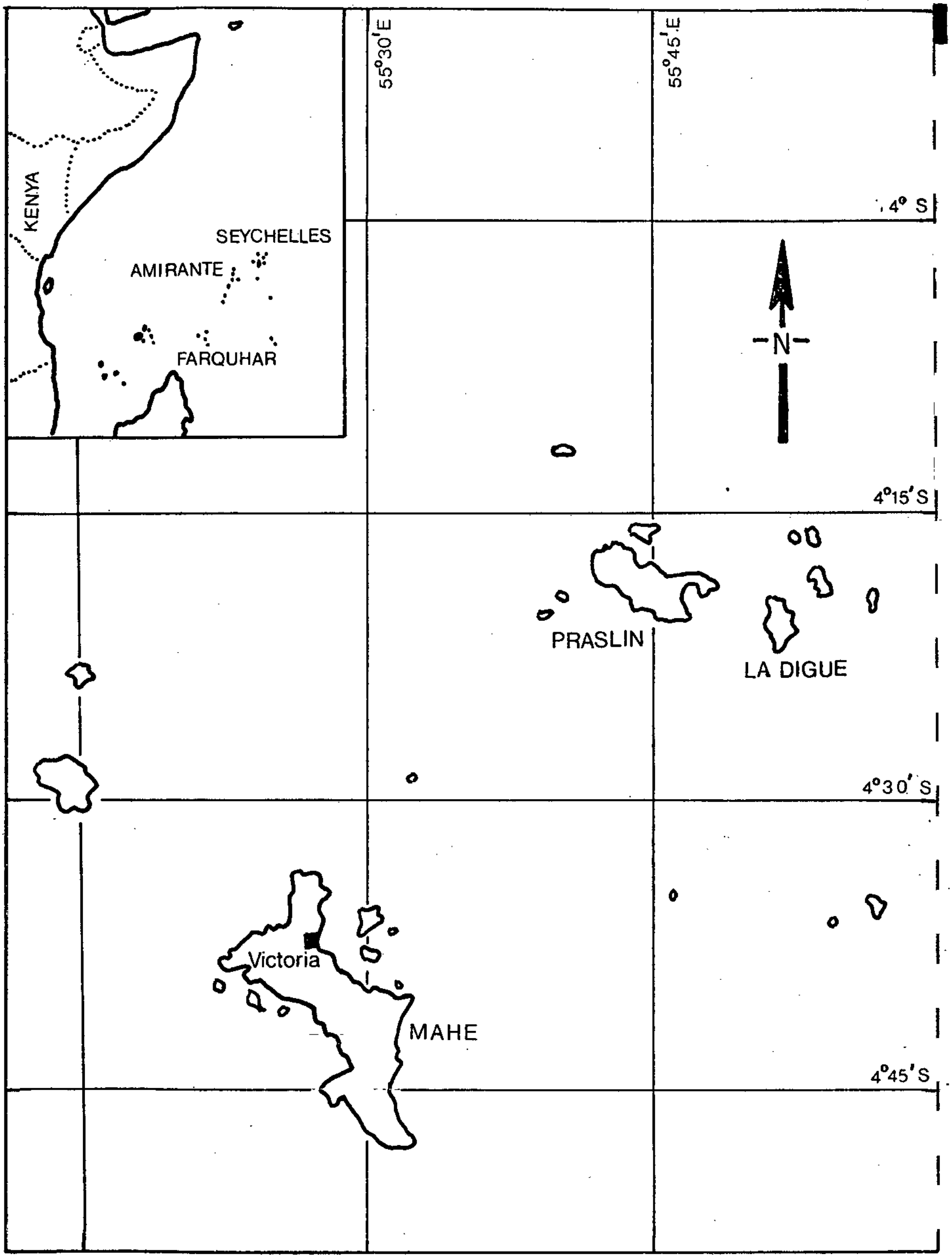
The water supply for the larger inhabited islands in the Seychelles - Mahe, Praslin and La Digue - has traditionally been taken from surface water resources. In a project funded by the Overseas Development Ministry, Buckley[1] made proposals for the exploration and possible development of the groundwater resources from the plateau areas on these and other islands to augment the existing water supply systems.

A groundwater exploration programme was proposed to collect basic hydrogeological information that would allow an assessment of the groundwater resources of selected areas to be made and thereby to enable the development of these resources to proceed.

Our investigations, which were carried out between June 1977 and May 1978, have implemented these proposals on selected low lying plateau areas on the islands of La Digue, Praslin and Mahe. These plateaux consist of unconsolidated deposits and form flat areas of limited extent and low elevation along the coasts of these and other islands of the Seychelles Group.

Groundwater is currently being abstracted from the plateau at La Digue, as dry weather water shortages are frequent. This area was selected to assess the groundwater availability to provide future water supply requirements.

[1] *1974, Buckley D.K., Assessment of the groundwater resources of Seychelles with recommendations for their development, Institute of Geological Sciences Report No: WD/ST/74/24*



GENERAL LOCATION MAP

Figure 1.1

Two other areas of investigation are located on Praslin: the L'Amitie area, part of a more extensive plateau (Grande Anse) on the south coast; and the Pasquiere area, which comprises a small upland basin, Plaine Hollandaise, providing recharge to a typical, small low lying plateau, Baie Pasquiere, on the northern coast.

Anse Intendance, situated on the south west coast of Mahe, was also included in our investigation. It was selected to test drilling equipment and to train local personnel in its operation and to advise Government on the availability of groundwater to supply a hotel development being built at this location.

During our survey, twenty boreholes were drilled and fourteen of these were test pumped to identify the main aquifers and their characteristics. An extensive survey of water quality was carried out to assess the extent of potable water. The existing hydrometric networks were also expanded and routine measurements of rainfall, streamflow and groundwater level fluctuations were made.

1.2 SEYCHELLES GROUP

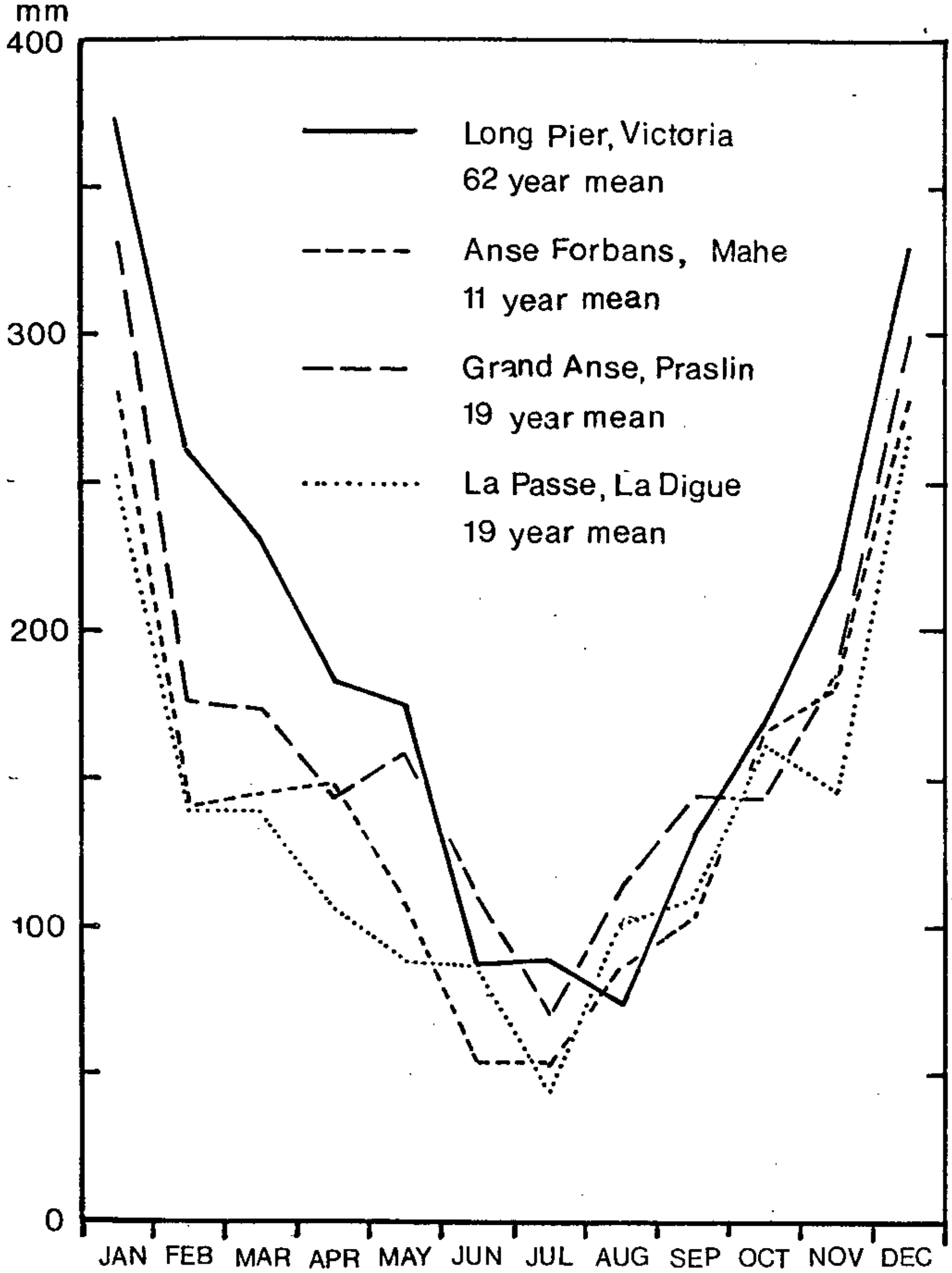
The Republic of Seychelles (see footnote) is situated between latitudes 3° and 11° south and longitudes 46° and 56° east in the western Indian Ocean. The Republic is an archipelago of over 140 islands with a total land area of 440km^2.

The Mahe-Praslin group account for over 98 per cent of the Republic's total population of nearly 62000[2] and nearly 50 per cent of the land area. The only urban area, the capital, Victoria, is located on Mahe and has a population of 23000, the remainder living in small settlements or isolated dwellings.

The Mahe-Praslin group (Figure 1.1) are of high relief, up to 905 m on Mahe, often rising steeply from the sea. The islands are composed of late Pre-Cambrian granites with some Tertiary dolerite and

Note: In this report, Seychelles refers to the main group of islands and not the Republic of Seychelles

[2] *1978, 1977 Census Report, Government of Seychelles*



MEAN MONTHLY RAINFALL

Figure 1.2

syenite (Baker[3]). The granite is weathered to form areas of clays and Seychelles Red Earth which is classified as a tropical red earth (Piggott[4]). Groundwater is probably present within the joints and fractures of the bedrock but this aspect was not investigated during our survey.

Climate

The islands are humid and tropical and have little variation in temperature (mean 27^{o}C) and humidity (80 per cent) throughout the year. The climate is dominated by two monsoons. The south-east monsoon, from May to October, is characterised by fresh winds and low rainfall and is referred to in this report as the dry season. The north-west monsoon, from November to April, has light variable winds, low cloud and heavy rain (the wet season). The monsoons are governed by the position of the intertropical convergence zone (ITCZ) which sweeps across the islands twice a year. During the wet season, the ITCZ lies about 15^{o} south and disturbances set up in this unstable air cause heavy rainfall; during the dry season, the ITCZ lies about 15^{o} north and so does not influence the climate.

The highest rainfall occurs on Mahe where it is mainly dependent on altitude and, to a lesser extent, on location. The rainfall on the high central area exceeds 3000 mm per year while the lower northern and southern ends of the island have about 1800 mm per year. Figure 1.2 shows the long term mean rainfall for selected islands.

Vegetation

The main agricultural areas are found on the plateaux as they have little urbanisation, shallow water conditions and better soils than the steeper areas. The coconut palm (*Cocos nucifera*) is widely grown in the Republic with large areas given over to plantations. The coconut palm is hardy and has a high tolerance to poor quality water. It can also abstract water directly from the shallow water

[3] *1963, Baker, B.H. Geological and Mineral Resources of the Seychelles Archipelago, Mem. Geol. Kenya, No. 3*

[4] *1968, Piggot, C.J. A soil survey of Seychelles, Land Res. Div. ODM. Tech. Bull. No. 2*

table and hence is ideally suited to cultivation on the plateaux. Other agricultural crops include small areas of tomatoes, bananas and other tropical plants. There are also small areas where vanilla is grown.

Stands of cedre (*Casurina equisetifolia*) a similar tree to the pine, are often interspersed with the coconut palms.

Marshy areas are common, particularly along the landward margin of the plateaux, and in most cases are connected to creeks through mangrove swamps.

Drainage and water use

The granitic islands are drained by numerous small streams in steep V-shaped valleys which are often choked with boulders. The catchments vary in size from a few hectares to over 5 km^2. Response to rainfall is rapid but most streams sustain a flow throughout the year. The steepness of the streams combined with the boulders make accurate measurement of stream discharge both expensive and difficult.

Water from these streams is impounded and used for local supply. These impoundments range in size from dams which supply large areas on the north of Mahe, to small barrages which are only sufficient to supply small settlements. On La Digue the existing surface water scheme was found to be inadequate to supply the local population and in November 1977 the Public Works Department commissioned a shallow well to abstract groundwater to augment the supply.

Water quality

The local population are prejudiced against the use of groundwater. This seems to stem mainly from the unpleasant smell produced by dissolved hydrogen sulphide, which can easily be removed by aeration. There may also be a fear of contamination from pit latrines which are extensively used on the islands.

As part of the survey we collected water samples for chemical and stable isotope analysis, (Appendix 3 and Annex B). To establish a limit of potability, the electrical conductivity (EC) was compared with the World Health Organisation's[5] maximum permissible level of total dissolved solids (1500 mg/1). An electricial conductivity value of 2250 μmhos was found to correspond to this standard and water with an EC greater than this value has been classified as non-potable.

1.3 AQUIFER CHARACTERISTICS

The main characteristics of an aquifer are transmissivity and storage coefficient (or specific yield when gravity drainage is complete). Transmissivity is an expression of the flow of groundwater through a column of unit width of the aquifer. Storage coefficient is the volume of water released from or taken into storage per unit surface area of aquifer per unit decline or rise of head. These characteristics are commonly derived from the analysis of pumping test data. We have applied both the Theis method and Jacob's modification of the Theis method[6] to the test data. In addition, we have included estimates of transmissivity from specific capacity data (yield per unit drawdown at a selected period of pumping) and attempted to confirm the ratio of transmissivity to storage from tidal lag response times.

Where an observation well was available estimates of both transmissivity and storage could be obtained, providing the test data were amenable to solution. Leakage (as gravity drainage) influenced most of the tests and with such conditions, the Theis method (Boulton's modification[7]) provided a more reliable estimate of transmissivity where observation well data were available as the Jacob method is only applicable to the early data. A value for storage coefficient could not be obtained where an observation well was unavailable and, as well losses influence water level data in the pumped well during abstraction, transmissivity was estimated from water level recovery data.

[5] *1963, International Standards for Drinking Water, WHO*

[6] *1946, Jacob, C.E. Drawdown test to determine effective radius of artesian well. Proc. Am. Soc. Civ. Eng. Vol. 72*

[7] *1963, Boulton, N.S. Analysis of data from non-equilibrium pumping tests allowing for delayed storage. Proc. Inst. Civ. Eng. Vol. 26*

Corrections are usually applied to pumping test data before analysis. These corrections include partial penetration, changes in rest water level during the test and storage in large diameter wells (at La Digue such wells were included in the test programme). However, most of the tested boreholes penetrated a significant aquifer thickness, the period of each test was short and observed drawdowns were small. Although corrections were applied to selected tests, there was found to be no significant alteration to the resulting estimates of the aquifer characteristics and thus the estimates given in this report are based upon the uncorrected water level data.

Specific capacities were computed for a period of 100 minutes of pumping to give consistency between results. However, such data are influenced by well losses and consequently transmissivity estimates from these data are less than actual transmissivities. They have therefore been used to indicate areal variations in transmissivity.

1.4 SUSTAINED YIELD

The sustained yield of an aquifer relates to the ability of the aquifer to transmit water and the mean annual recharge. In the low lying plateau areas it must also take account of the volume of recharge required to maintain the saline water interface at an acceptable position.

When the input to the aquifer exceeds the continuous output to sea by flow through the aquifer a rise in water level will occur. Each year the input and output are normally in balance maintaining a saline interface (or transitional zone) at some position within the aquifer. Without a seasonal input, throughflow loss would cause groundwater levels to decline at an exponential rate to sea level, at which point the aquifer would virtually be wholly contaminated by sea water. Abstraction will intercept part of the input thereby decreasing the output but with proper management the saline interface can be stabilized at an acceptable position further inland.

We have observed that recharge occurs several times each year with intervening periods of recession. The volume of recharge in each event can be estimated by multiplying the storage coefficient by the total rise in water level (that is the rise above the level that would otherwise have been observed if the previous recession had continued). The annual recharge is the sum of these events. The rate of recession is dependent upon the previous volume of recharge as this will vary both the hydraulic gradient and transmissivity.

Well hydrographs were prepared from rest water level measurements collected during the period of investigation. Due to the difficulties of travelling between the study areas, and also difficulties with the water level graph recorders, the hydrograph records are not all suitable for detailed analysis. The most complete hydrograph was obtained from La Digue and this was subsequently used to estimate water level changes in the other study areas.

1.5 HYDROLOGY

Water balances for the catchment areas above the plateaux are useful in that they indicate the total resources available for exploitation. However, they cannot contribute directly to the estimate of recharge to the aquifers as the volumes of freshwater discharged to sea by streams and drainage ditches are generally unknown.

Data are available for the main elements of a water balance; rainfall is measured at a number of stations on Mahe, and rather fewer stations, usually at sea level, on other islands; evaporation can be estimated from meteorological data collected at the International Airport at Victoria, and flow measurements are available for a number of streams.

The rainfall data appear reliable and indicate an average rainfall at sea level of about 1800-2000 mm; a marked orographic effect gives rainfalls in excess of 3000 mm on the higher ground. Potential evaporation from the largely perennial vegetation is about 1600 mm, using the Penman method applied to the meteorological data. Thus the excess rainfall over evaporation is of the order of 300-800 mm depending upon the average rainfall of the individual catchment areas.

However, the streamflow measurements, particulary those on Mahe, seem to indicate an annual runoff of the order of 1000-1500 mm in an average year. This is, in the main, consistent with the values obtained from a comparison of rainfall and evaporation, if we make the assumption that the vegetation transpires at its potential rate throughour the year. However, the accuracy of some of the streamflow measurements must be regarded as suspect; these inaccuracies may be due, in part, to the difficulties of flow measurement in the steep boulder-filled streams.

In the analysis presented in the following chapters and described in Annex C, we have used the difference between rainfall and potential evaporation as the basis of the calculation of the overall water resources of the catchments. These estimates, modified for dry years of various return periods, are useful only in that they provide an upper limit to the extent of the resources potentially available for direct abstraction and recharge to the plateau areas.

1.6 REPORT FORMAT

In Chapters 2 to 4 we present details of our investigations at La Digue, Praslin and Mahe respectively. Chapter 5 summarises our findings and presents recommendations on development and management of the potable groundwater resources.

The data collected during our survey are presented in the appendices. These include details of the wells constructed, the pumping test data, water chemistries and stable isotope determinations and an appraisal of the hydrological data.

CHAPTER 2

HYDROGEOLOGY OF LA DIGUE

2.1 STUDY AREA

Location, topography and vegetation

The island of La Digue, which is situated 50 km north-east of Victoria, is about 5 km from north to south and 3 km wide. A granitic ridge, which rises to 333 m, extends from north to south along the eastern side of the island. An area of high ground also extends from this ridge across the south west part of the island.

The granitic hills enclose an oval shaped plateau forming the study area on the western side of the island (Figure 2.1). This plateau is 2.75 km long by up to 1 km wide and is the largest of the plateau areas on this island, having an area of 1.87 km^2. A granitic inlier is to be found at L'Union and for ease of calculation this has been taken as the southern end of the plateau.

The predominant vegetation on the island is coconut palm with, on the plateau, intermixed stands of takamaka and cedre. Small areas of the plateau are also used to grow vanilla and, especially on the borders of the marsh, market garden produce.

Hydrology

There are long term mean rainfall data available for La Passe and also limited data for the study period from a raingauge at Belle Vue on the western side of the granite ridge. The rainfall data are presented in Table 2.1. The Belle Vue data are considered unreliable and we have used a value of 1640 mm/year as the mean annual rainfall of the study area.

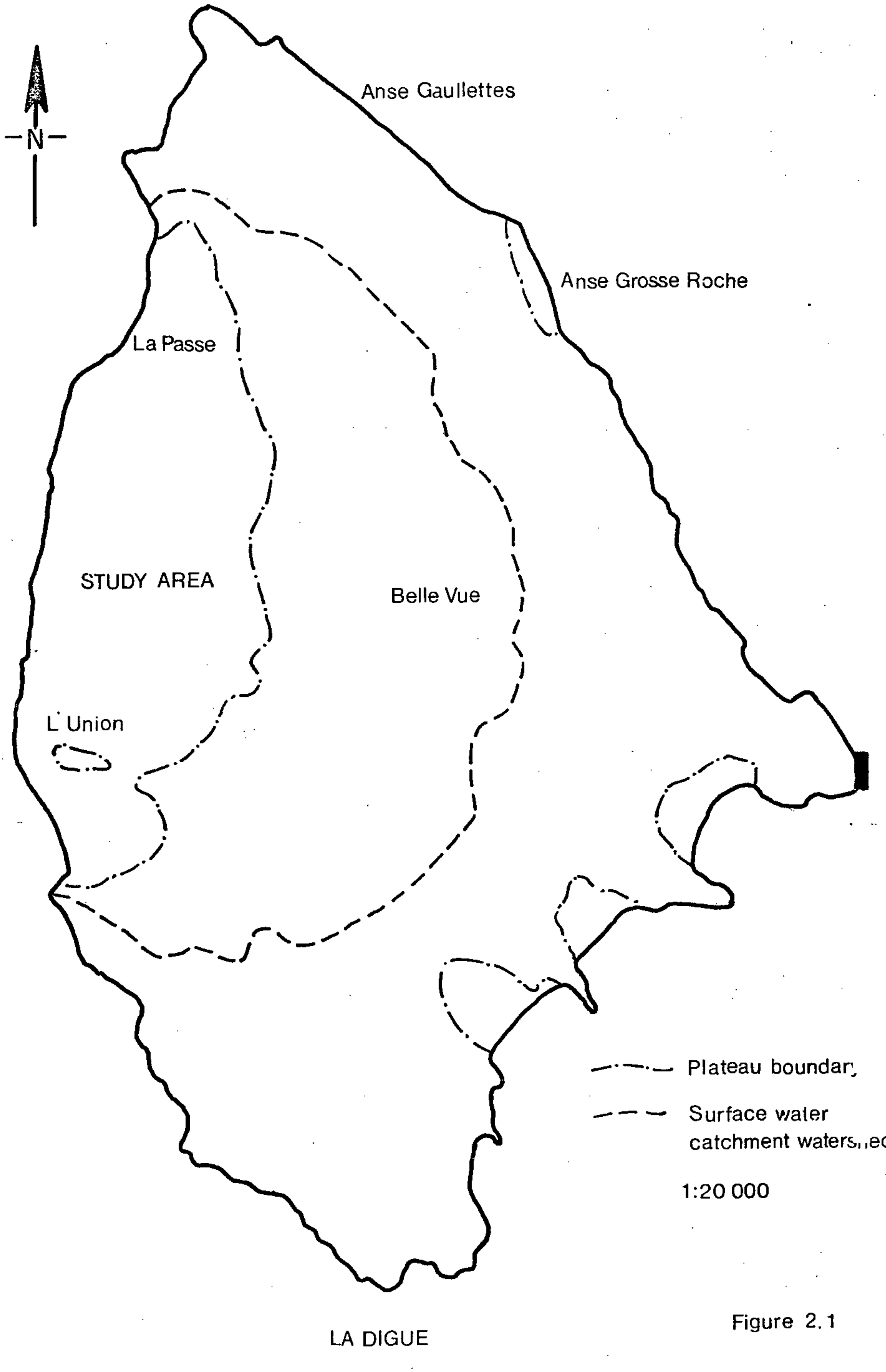

N
Anse Gaullettes
Anse Grosse Roche
La Passe
STUDY AREA
Belle Vue
L' Union
Plateau boundar,
Surface water
catchment waters,,ec
1:20 000
LA DIGUE

Figure 2.1

RAINFALL, LA DIGUE
(mm)

		Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec
Belle Vue	1977[1]	-	-	-	-	44	4	1	16	12	63	16	11
	1978	100	28	41	101	36	16	-	-	-	-	-	-
La Passe[2]		252	139	139	107	88	87	44	101	110	161	146	267

Notes: [1] *Measurements started May 1977 (see text)*

[2] *Mean for 19 complete years between 1944 and 1976*

GROUNDWATER ABSTRACTION[1] AND METERED DEMAND, LA DIGUE

Abstraction

Month	No. of days pumping	Mean daily abstraction (m^3/d)	Total abstraction during month (m^3)
1977 December	30	180	5400
1978 January	29	130	3762
February	27	120	3242
March	30	130	3931
	mean	140	
		mean annual	51000

Present metered demand

	No. of meters	Mean daily demand per meter (m^3)	Mean monthly demand per meter (m^3)
Non-domestic[2]	6	5.0	160
Domestic	65	0.7	20
Public standpipes	3	0.9	30

Notes: [1] *Abstraction from LD7. Supply from this source began in 1977. The total abstraction in December may not be wholly representative due to wastage.*

[2] *This category includes hotels, a school and a laundry but excludes Logan Hospital*

The mean daily abstraction includes non-metered demands

Eight rivers and a number of minor streams enter the plateau from the adjacent granitic hills. The total area of the surface water catchment is 2.81 km^2. From the existing surface runoff data for the Maurice Payet River, the total mean annual runoff has been estimated to be 330 mm (2500 m^3/day). The dry weather base flow for the river is less than 100 m^3/day.

We have estimated the annual evapotranspiration to be 1600 mm. This is based on the application of Penman's equation to meteorological data available from a meteorological site at the International Airport.

A small area (0.14 km^2) of reed covered marsh extends around the southern end of the plateau and drains to the sea. A drainage channel, which crosses the marsh, extends around the landward side of the plateau to discharge to the sea near the northern and southern limits of the plateau. This channel was constructed to prevent flooding of the plateau.

Present groundwater abstraction

Most of the population of La Digue, some 1900 persons[1], live on the plateau area. Traditionally, the population has obtained a water supply from impoundment schemes on some of the upland streams draining the granitic hills. In November 1977, these sources of supply were supplemented by groundwater abstraction from the plateau deposits.

The groundwater abstraction takes place from a single large diameter well, LD7, near the eastern margin of the plateau. The metered abstraction for December 1977 to March 1978 is given in Table 2.2, which also shows the average demand by consumers at present connected to this source of supply. Some dwellings are also served by private wells, such as LDH 1, for domestic and garden watering purposes.

1 *1978, 1977 Census Report, Republic of Seychelles*

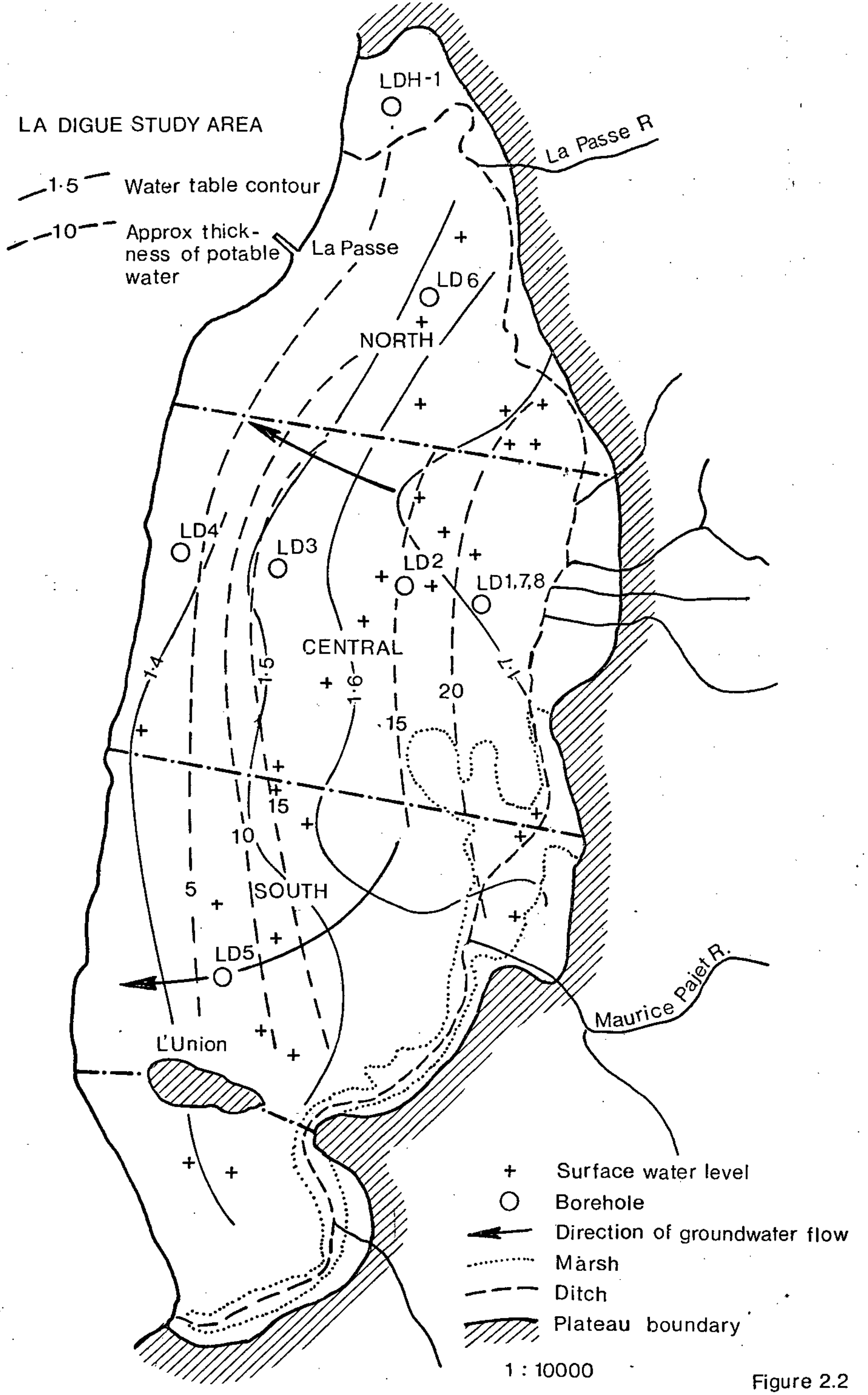

LA DIGUE STUDY AREA
1·5 Water table contour
10 Approx thickness of potable water
LDH-1
La Passe R
La Passe
LD 6
NORTH
LD4
LD3
LD2
LD1,7,8
CENTRAL
1·4
1·5
1·6
1·7
20
15
15
10
5
SOUTH
LD5
L'Union
Maurice Pajet R.
+ Surface water level
Borehole
Direction of groundwater flow
Marsh
Ditch
Plateau boundary
1 : 10000

Figure 2.2

2.2 GROUNDWATER OCCURRENCE AND MOVEMENT

Plateau deposits

Six boreholes were drilled through the unconsolidated deposits of the plateau to the underlying granitic bedrock. Their locations are shown in Figure 2.2. Four of the boreholes were drilled in a line from the government well compound in the east (LD1) to the social centre at La Reunion in the west (LD4) and the remaining two boreholes were drilled on the edge of the L'Union estate in the south (LD5) and at La Passe in the north (LD6).

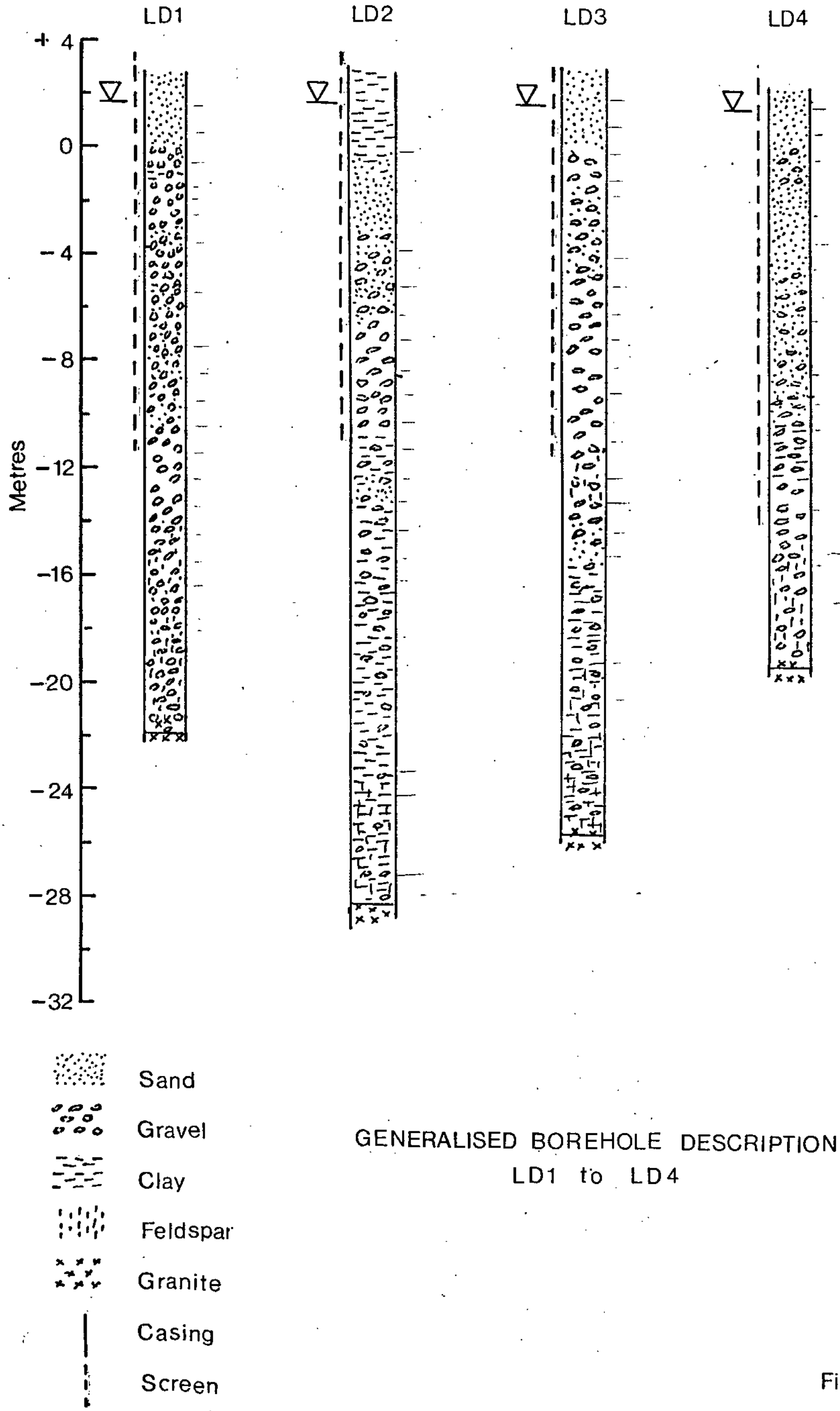
The lithology of the plateau is based on the examination of formation samples taken during the construction of the boreholes (Figure 2.3.1 and 2.3.2). The main aquifer consits generally of calcareous sands and gravels and quartz gravels. These deposits overlie cream coloured clays which are the weathered product of the underlying granite. The general sequence of the plateau deposits is illustrated by the sections shown in Figures 2.4 and 2.5.

A different sequence was encountered at borehole LD1. Underlying a clay layer at 4 to 5 m below ground level there occur gravels of granitic origin and not the more common sequence of calcareous sands and gravels.

We believe that the main aquifer has water table conditions, but locally, the occurrence of fine grained sediments result in semi-confined conditions. If there are joints and fractures within the granitic bedrock, these are likely to be confined beneath the clay derived from weathering of the granite.

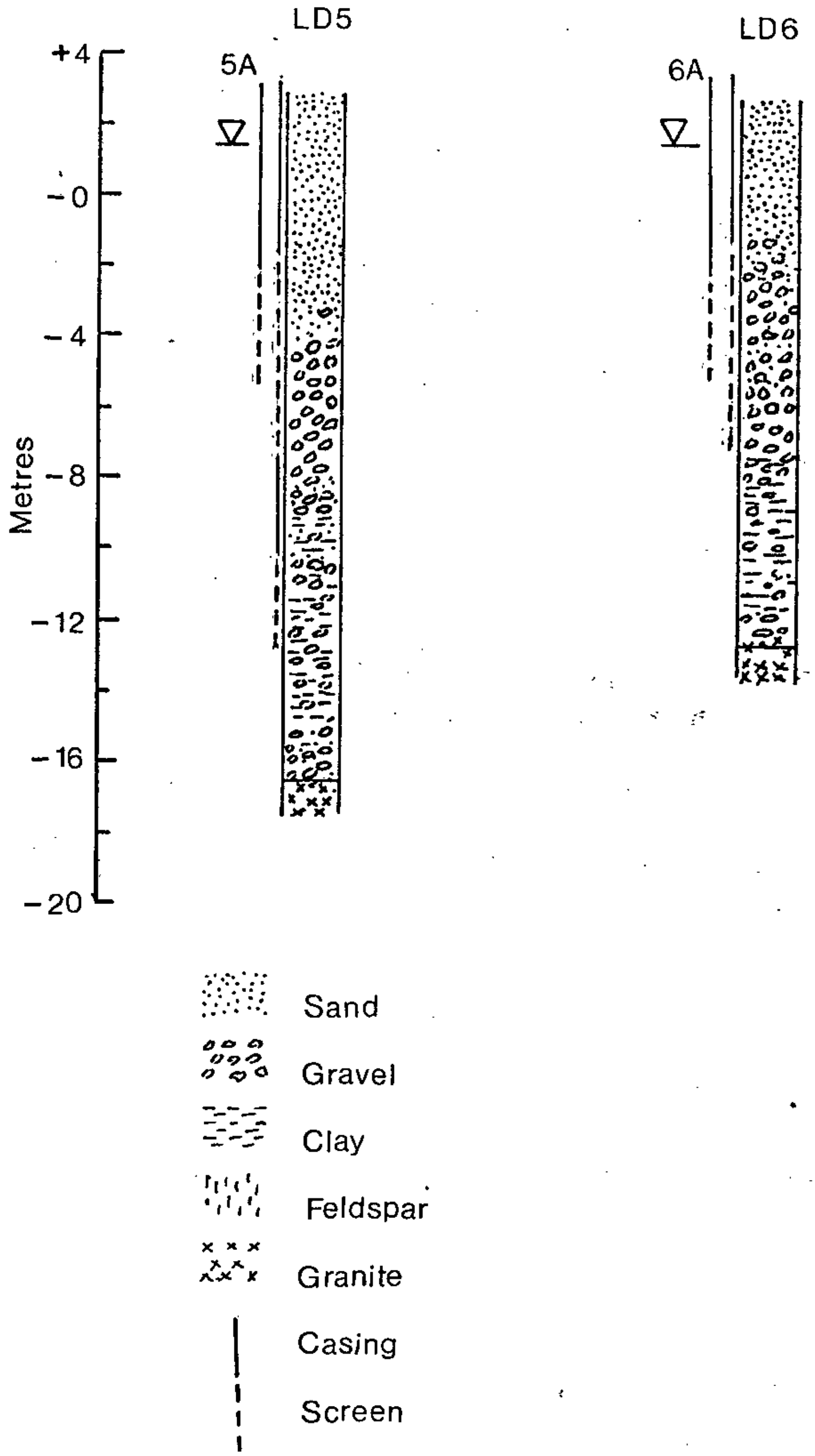
Groundwater occurrence

The main aquifer has been identified as a sequence of unconsolidated sands and gravels. The average saturated thickness of the aquifer is about 16 m, the water table occurring about 1 m below ground level and between 1 and 2 m above sea level. We have



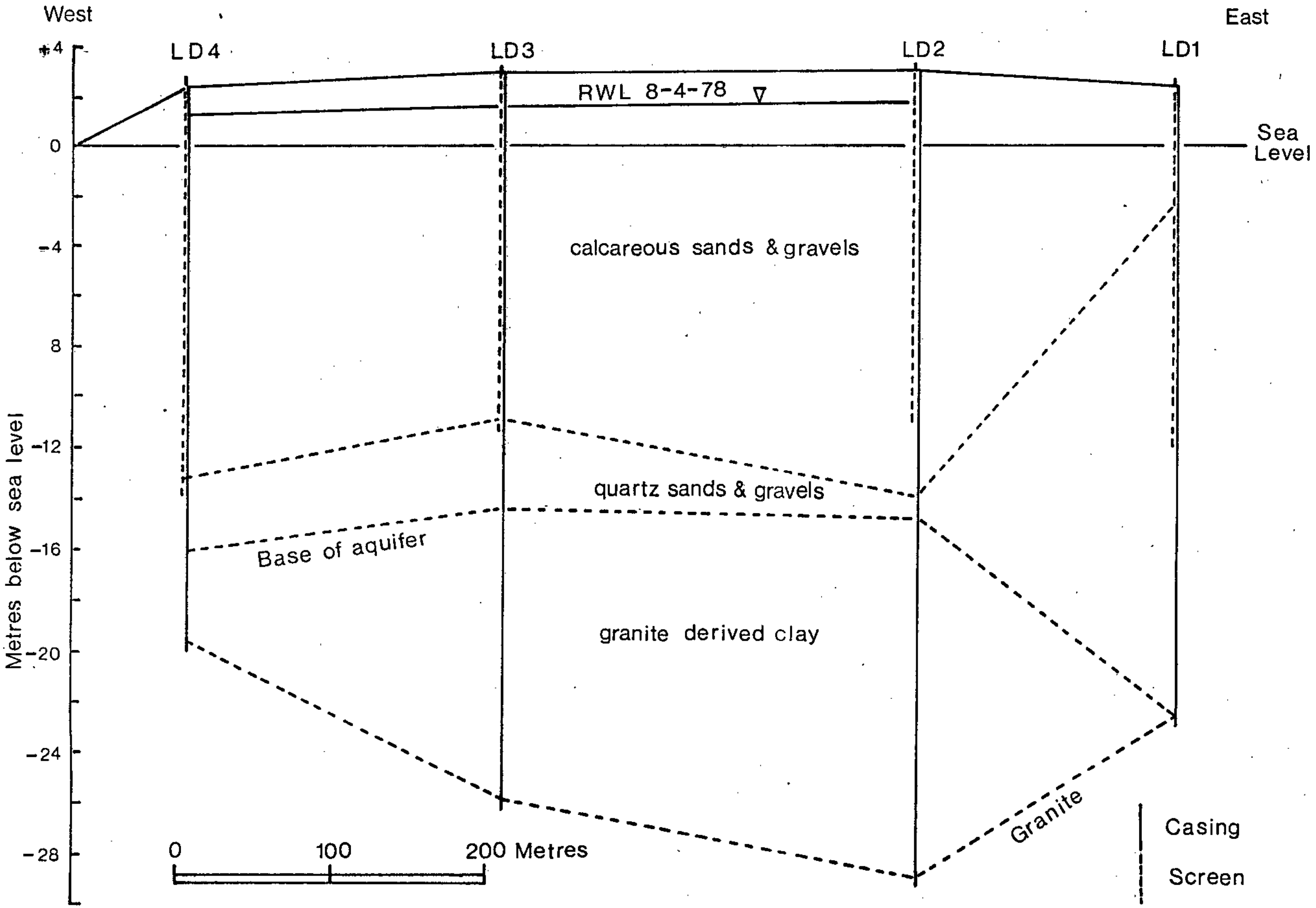
GENERALISED BOREHOLE DESCRIPTION
LD1 to LD4

Figure 2.3.1



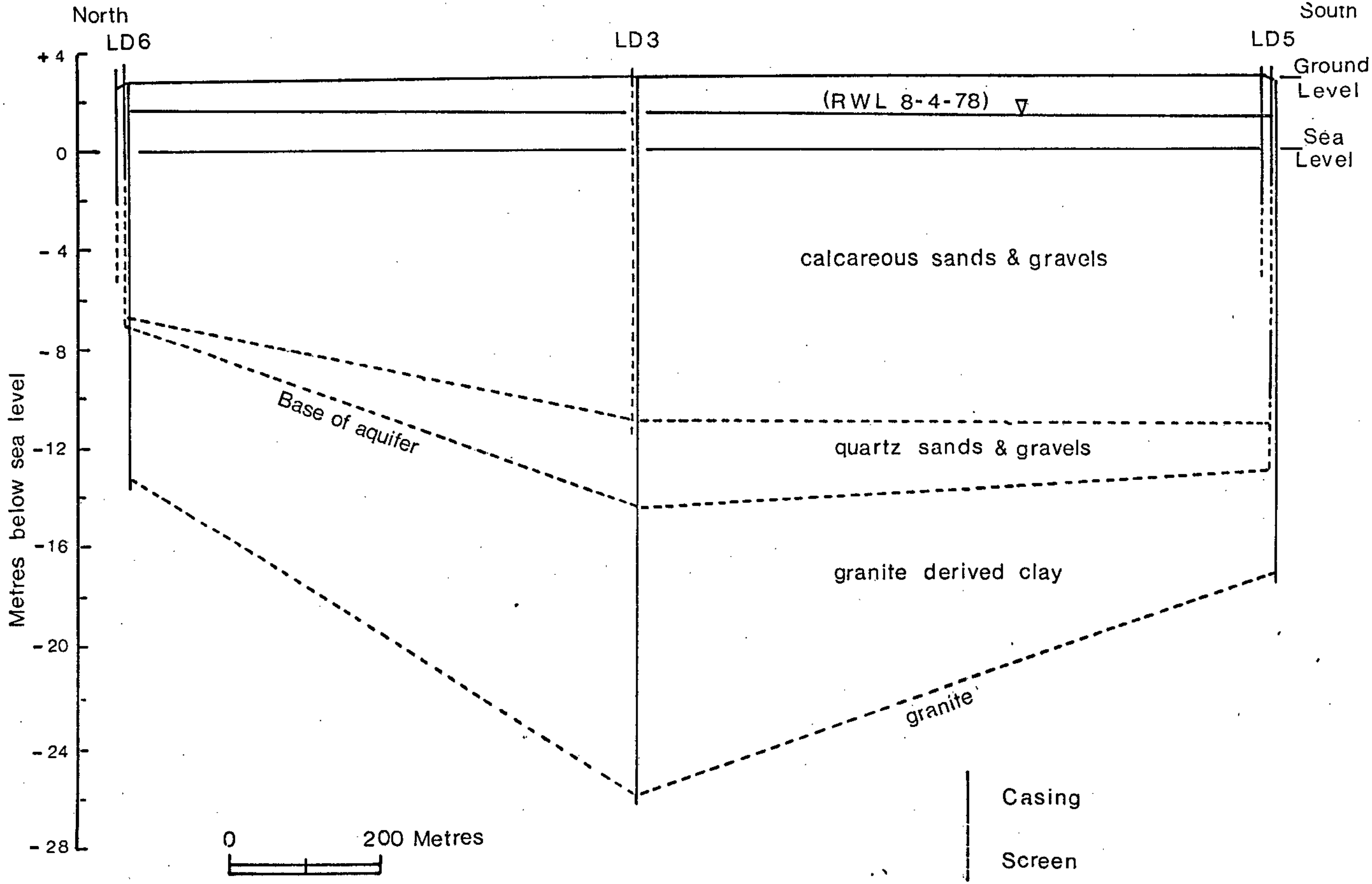
GENERALISED BOREHOLE LOG DESCRIPTION
LD5 and LD6

Figure 2.3.2



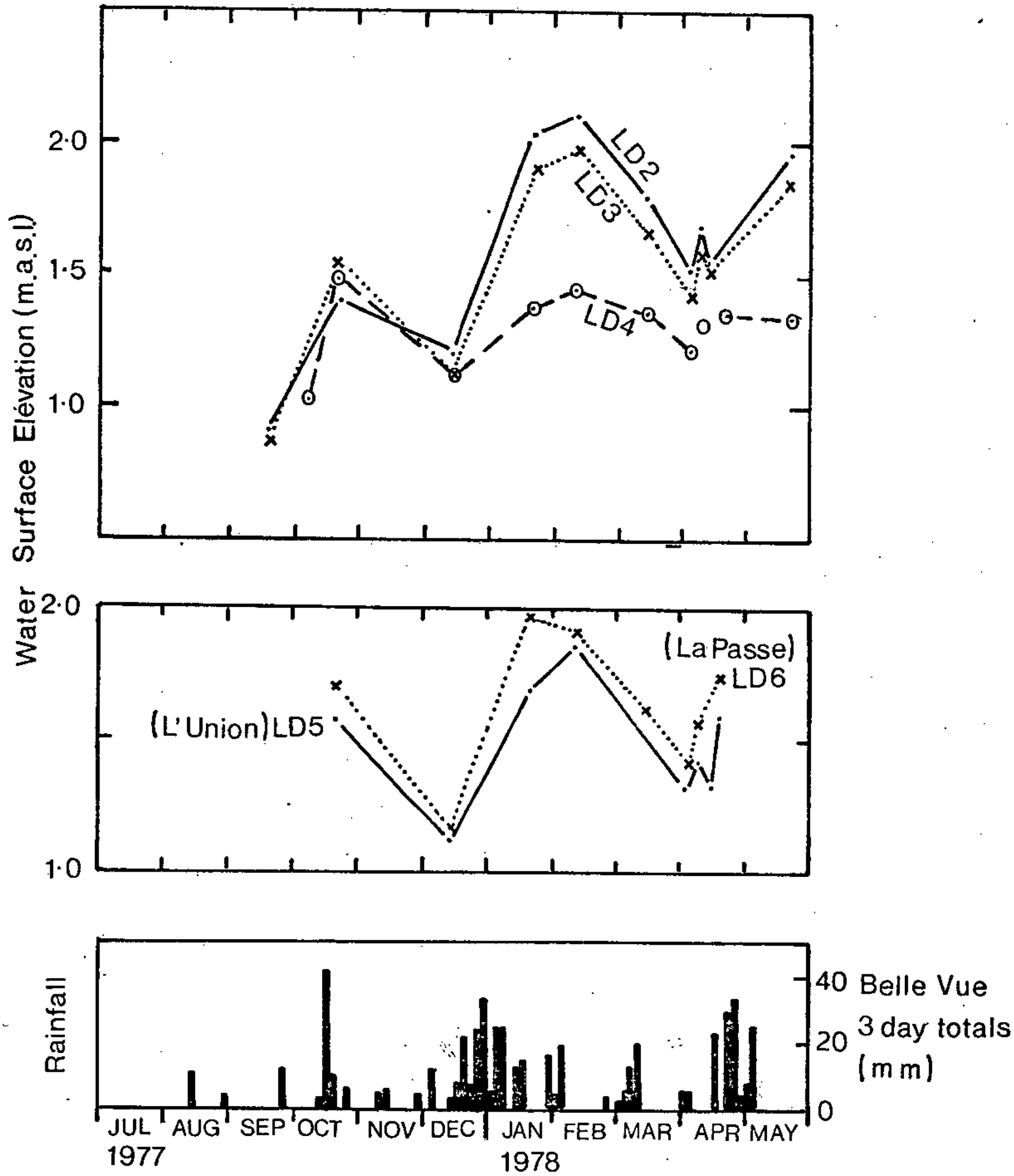
SCHEMATIC SECTION, WEST-EAST

Figure 2.4



SCHEMATIC SECTION, NORTH-SOUTH

Figure 2.5



WELL HYDROGRAPHS

Figure 2.6

assumed that the landward boundary of the plateau aquifer is marked by the surrounding granitic hills even though there may be a contribution of groundwater from fractures within the granite. The base of the main aquifer has been taken as the top of the granite-derived clays. The sea is considered to form the western limit of the aquifer, although a seepage zone of fresh groundwater may occur below sea level.

Figure 2.2 is a water table map, related to sea level, prepared from water level data for early April 1978 when the water levels were at their seasonal maximum. As the boreholes provided only limited data, the levels of surface water exposed in the marsh and depressions over the plateau were also used for the preparation of this map by assuming that the surface water and the groundwater were in hydraulic continuity over most of the area.

Water levels were measured at about monthly intervals in each borehole from September 1977 to May 1978 to estimate the seasonal variation in the water table. Borehole LD1 was excluded from the observation well network as this borehole is influenced by abstraction from the nearby government well (LD7). The water level data are given in Appendix 1.

Well hydrographs for all the boreholes except for LD1 are shown in Figure 2.6. During 1977/78 there were three major responses to rainfall: in October, 1977, January/February, 1978, and May 1978, with intervening recessions in water level of 0.33 m/month.

Our analysis of the hydrographs is based on data from boreholes LD2 and LD3, which are considered to be representative of the general plateau conditions. The rise in water level from September 1977 to May 1978 was 1.05 m. To compensate for losses due to through flow in particular, we have extrapolated each recession to the time of the subsequent peak. The difference in water level between the observed peak and the extrapolated recession will then include both the gains and losses from storage. The sum of the individual rises in water level is 2.80 m over the period of record and the measured decline is 0.88 m for the same period, giving a gain to

PUMPING TEST RESULTS, LA DIGUE

Well number		Specific capacity[1]		Jacob method[2]			Theis method	
Pumped	Observation	Q/s (m^2/d)	T (m^2/d)	T (m^2/d)	S %	T (m^2/d)	T (m^2/d)	S %
LD1		320	340	680				
	LD7			1260	14		1210	14
LD2		288	300	570[3]				
				180[4]		460		
LD3		860	900	630[3]				
				520[4]		640		
LD5		300	320	800				
	LD5A			1030	2	740	1230	1
LD6		325	340					
	LD6A			850	2	580		
LD7		680	375	740[4]				
	LD1			970	3	790	710	5
	LD8			620	6	440	440	9
LD8		310	160	210[4]		75		
	LD1			910	13	700	970	14
	LD7			600	10	340	620	11

Notes: [1] *Specific capacity at 100 mins after start of pumping*

[2] *Second transmissivity estimate is from the recovery data*

[3] *First stage of step-drawdown production test*

[4] *Constant discharge test*

storage of about 2.0 m. Thus, the hydrographs should decline from May to September 1978 at the previously observed rate of recession of 0.33 m/month to reach the previous September's position, to provide a balanced hydrological situation. The water level rise of 2.0 m has been used for our subsequent estimates of the aquifer recharge. The water level rise was smaller, about 1 m, at borehole LD4 and may reflect a greater volume of aquifer storage or greater distance from the source of recharge.

Aquifer characteristics

Seven pumping tests were carried out during the course of the study, including tests on two large diameter wells LD7 and LD8. Borehole LD4 was designed to monitor saline intrusion and consequently was not tested. Constant discharge tests were performed on these boreholes and each test included the measurement of water level response to pumping in at least one nearby borehole, with the exception of sites LD2 and LD3 where observation boreholes were unavailable. The test data are given in Appendix 2.

The test results shown in Table 2.3 include boreholes LD1, LD7 and LD8 which are all within 11 m of each other. The average of the Theis and Jacob methods for the observation wells at these sites is about 800 m^2/day (700 and 870 m^2/day respectively). Data from observation boreholes were available for analysis by the Jacob method for sites LD5 and LD6 for which we have estimated transmissivities to be 1030 and 850 m^2/day respectively. Recovery data provide the most reliable estimates of transmissivity for LD2 and LD3, 440 and 640 m^2/day respectively. The average of the transmissivity values for LD2, LD3, and LD6 is about 750 m^2/day. We have adopted the more conservative value of 750 m^2/day as the average transmissivity for the water resources calculations.

The storage coefficients range from 1 to 14 per cent with an average value of 9 per cent for the Theis method and 7 per cent for the Jacob method. We have adopted a value of 10 per cent as a representative value of storage coefficient.

The specific capacity data suggest that the transmissivity is relatively constant over most of the plateau area, except around LD3 where, because of the greater proportion of gravel in the sequence, the transmissivity is almost three times as high. The average specific capacity of the drilled boreholes is 300 m^2/day (excluding LD3).

Our estimates of the aquifer characteristics may be compared to the water level response to tidal fluctuations, using the following equation after Ferris (1951)[2]:

$$t_L = x\sqrt{t_p}\ S/4\pi T$$

where t_L is the time lag in the water level response to tidal loading in a well of distance x from the sea and t_p is the tidal period.

At the beginning of April 1978 borehole water levels were measured frequently for a period of a few hours to ascertain the aquifer response to tidal loading. A definite response was shown only by borehole LD4 where the tidal efficiency (the ratio of the water level and tidal amplitudes) was 3 per cent. The data are given in Appendix 1.

Substituting our estimates of transmissivity and storage coefficient, 750 m^2/day and 10 per cent respectively, into the above equation, a theoretical time lag of 0.14 days was computed compared to the observed time lag of 0.19 days, suggesting that our estimates of the aquifer characteristics are reasonably representative of the aquifer.

Aquifer throughflow

The hydraulic gradient differs throughout the aquifer. We have

[2] *1951, Ferris, J.G. Cycle fluctuations of water level as a basis for determining aquifer transmissivity. Assoc. Int. Hydrol. Sci. Pub. 33*

consequently sub-divided the area into three sub-areas as shown in Figure 2.2. Our estimates of the groundwater flow through each, using Darcy's equation, are given in Table 2.4. The total annual flow through the aquifer is calculated to be 0.36 million m^3.

2.3 GROUNDWATER QUALITY

Water samples were collected for chemical analysis during the pumping tests on boreholes LD1 to LD3 and LD6. Samples were also collected from the government production well (LD7) during normal production and from a small domestic well (LDH 1) at the northern end of the plateau. The analyses of these samples are presented in Appendix 3. Although water samples were collected for bacteriological analysis the results have not been made available to us.

The relative concentrations of the major ions are illustrated by a trilinear diagram (Figure A.3.1), which indicates the samples to be of $CaHCO_3$ to mixed-HCO_3 composition.

The absolute concentrations of the major ions are shown as pattern diagrams in Figure 2.7. The samples show a resemblance to those from the large plateau on Praslin, except in their slightly higher chloride and sodium concentrations.

The sampled sources have a total dissolved solids content in the range 200 to 650 mg/l. They are all suitable for domestic consumption, based on potability limits recommended by the World Health Organisation[3]. Although the iron and hydrogen sulphide concentrations are high in borehole LD7 shortly after the start of pumping (nearly 1 and 10 mg/l respectively) both constituents can usually be reduced to acceptable levels by aeration.

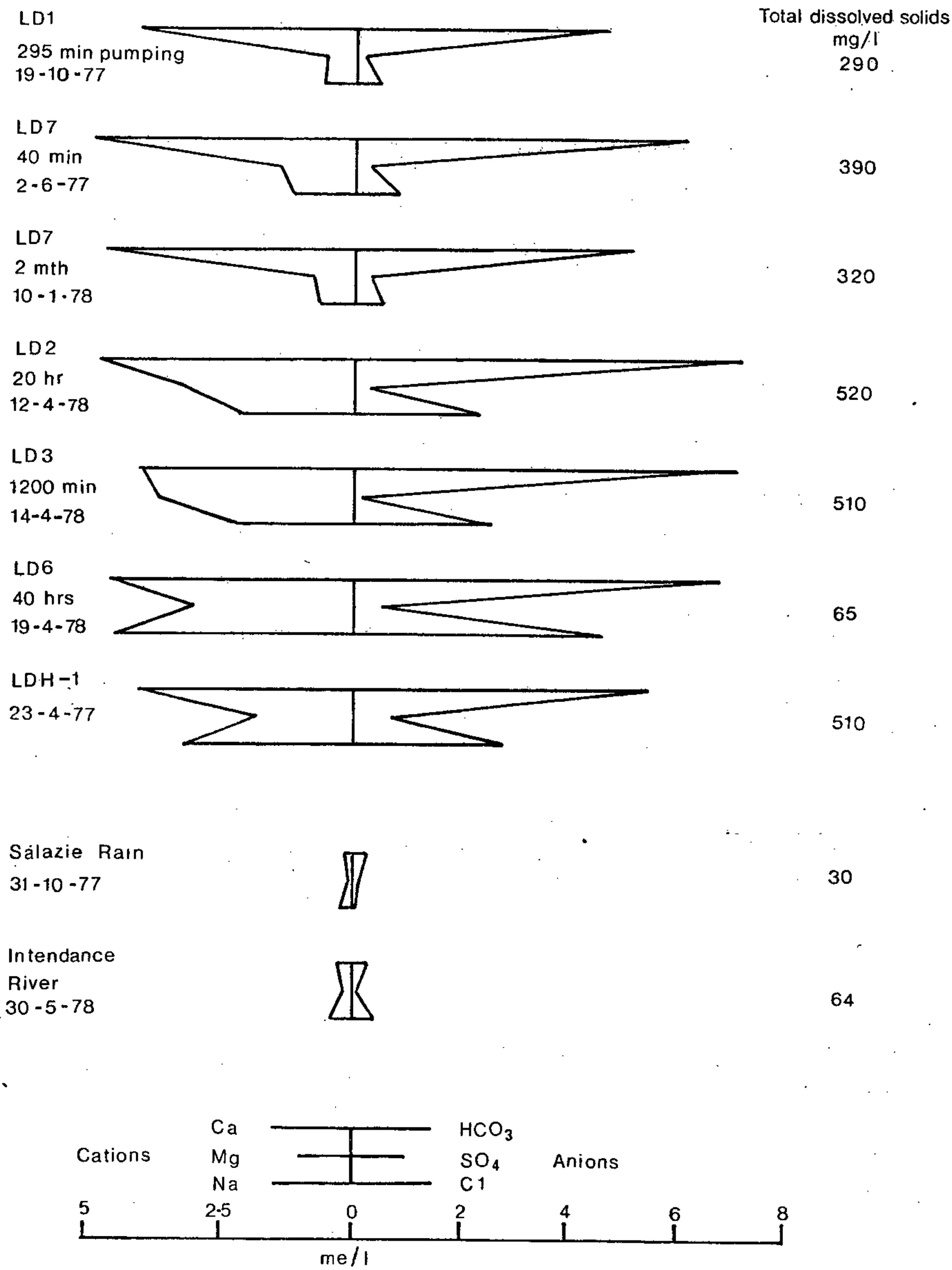
The relatively high concentrations of fluoride in the samples, ranging from 0.4 to 1 mg/l, may, we believe, be derived from contact with fluoride-bearing minerals in the granitic bedrock or its weathered products.

[3] *1963, International Standards for Drinking Water. World Health Organisation*

AQUIFER THROUGHFLOW, LA DIGUE

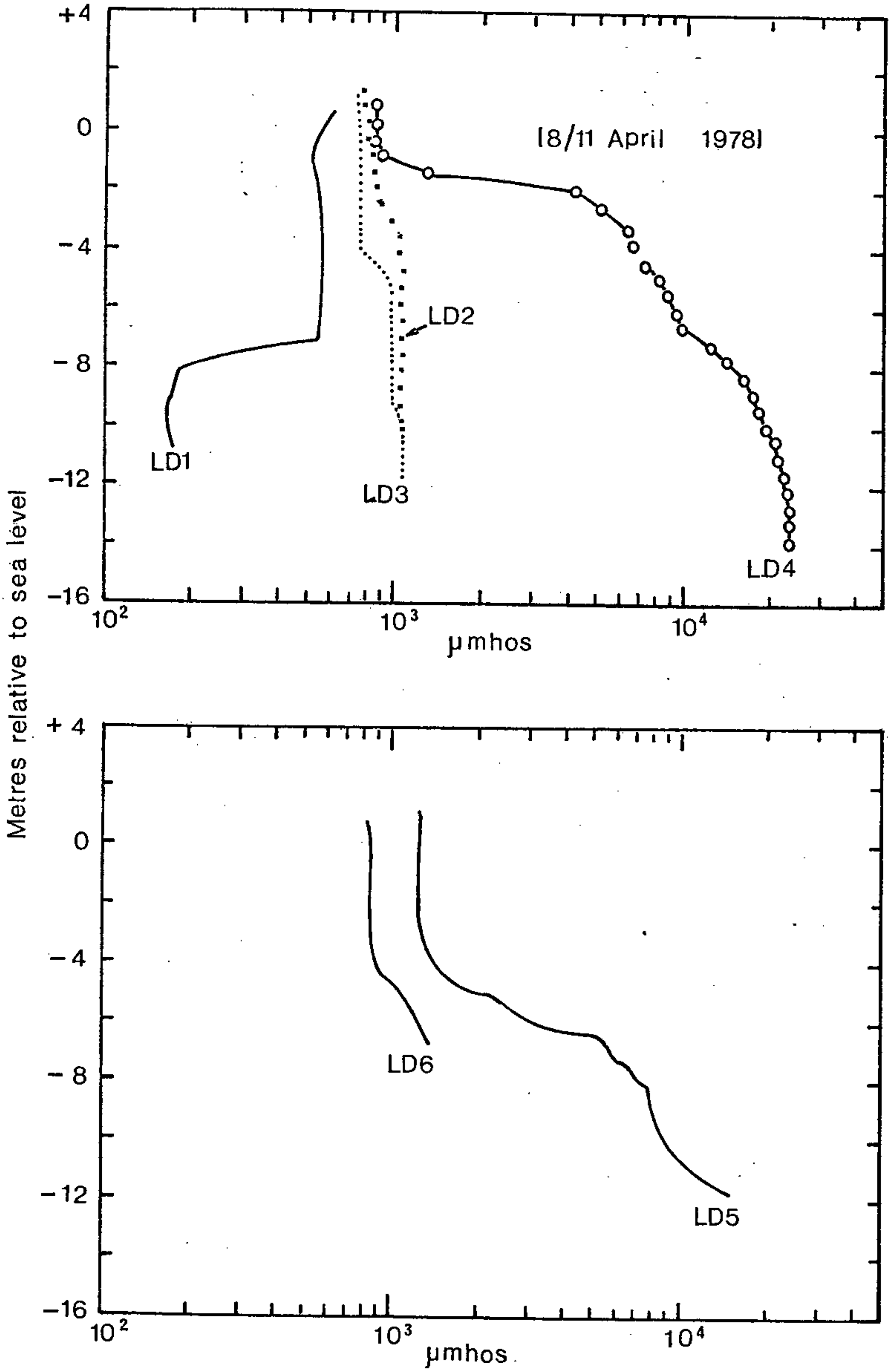
Sub-area	Transmissivity (m^2/d)	Width (m)	Gradient	Throughflow (m^3/year)
North	850	680	0.0008	169 000
Central	750	720	0.0006	106 000
South	1100	670	0.0003	81 000

Total throughflow : 0.36 million m^3/year



PATTERN DIAGRAMS

Figure 2.7



CONDUCTIVITY PROFILES

Figure 2.8

The presence of nitrogen as ammonia was recorded in all of the groundwater samples. This usually indicates recent organic contamination, which perhaps occurs during the periods when the aquifer is being recharged. Bacteriological analyses are not available to confirm any organic contamination. The concentrations of nitrate are very low and do not consistute any health risk.

In addition to the water sampling programme, electrical conductivity measurements (EC) were taken with depth in boreholes LD1 to LD6 during April 1978, prior to the pumping test programme. Similar measurements were repeated in boreholes LD4 and LD5 after completion of the pumping test programme. The conductivity profiles are shown in Figure 2.8.

The conductivity profiles did not show a significant change with depth in boreholes LD2 and LD3. At borehole LD1 the conductivity decreased from about 550 μmhos to 175 μmhos between 7 and 8 m below sea level (bsl). The change appears to coincide with a lithological change from dominantly quartz gravels to an alternating sequence of calcareous and quartz gravels. We would expect an increase in conductivity with such a lithological change due to the more soluble nature of the calcareous sequence, but the calcareous gravels may be in contact with a source of river water recharge.

At boreholes LD4 to LD6 an increase in conductivity with depth was recorded. The increase is particularly marked at a depth of between 1 and 2 m bsl at LD4, which is situated closest to the sea. From a depth of 2 m bsl the conductivity rises from 4000 to 24000 μmhos at a depth of 13 m bsl. The conductivity profile at this borehole did not significantly alter following the pumping test programme. At boreholes LD5 and LD6 the increase in conductivity is more gradual, rising from 1500 μmhos at a depth of 4 m bsl to 15000 μmhos at 12 m bsl at borehole LD5. An increase in conductivity of 500 μmhos was recorded in the upper 6 m of borehole LD5 following the pumping test programme and indicated a lateral inflow of saline water rather than an upward movement as the transition to more saline water remains constant.

We have used the conductivity profiles to indicate the volume of potable water (electrical conductivity less than 2250 µmhos) held in aquifer storage. The potable water occurs only in the upper part of the aquifer at LD6 (thickness of aquifer with potable water, 10 m), LD5 (6 m) and LD4 (3 m) but is considered to be present throughout the whole aquifer thickness at LD1 to LD3. We have attempted to contour the aquifer thickness containing potable water as shown in Figure 2.2 and have thereby estimated the total potable groundwater reserves to be 2 million m^3, based on a storage coefficient of 10 per cent. It should be noted that the volumes in storage in the north and southern sub-areas are based upon single measurements of the potable water aquifer thickness and we have excluded the area south of the outlier at L'Union.

The conductivity profiles indicate that there is a transition zone from fresh to saline water, which is at least 10 m in thickness at borehole LD4, caused by tidal and seasonal water level fluctuations. If there exists the relationship at La Digue between sea water and fresh water as proposed by Ghyben-Hertzberg (see Annex A), where salt water should occur at a depth below sea level of about forty times the height of fresh water above sea level, conductivities of normal sea water (40,000 - 50,000 µmhos) should be encountered at depths of not less than 52 m at LD4, within the granitic bedrock. The length of the intruded saline wedge inland is estimated to be about 300 m in the area of LD4 with a seaward groundwater flow of 0.36 million m^3 (see Annex A).

2.4 GROUNDWATER RESOURCES

Water levels were measured for a period of only 8 months, from September 1977 to May 1978. However, the water level measured in May 1978 must decline to the same position as in the previous September, assuming a balanced hydrological situation. Thus the observed rise in water level of 2 m during the period of measurement is representative of the net increase in storage that would occur in a complete hydrological year. Using a storage coefficient of 10 per cent, derived from the analysis of pumping test data, we have estimated the recharge to be 0.33 million m^3, which agrees closely with the estimated flow through the aquifer of 0.36 million m³. The recharge in each sub-area is given in Table 2.5

We have prepared the following hydrological budget (in million m³) using mean year meteorological data applied to the period of water level observations (September to May):

Inputs

Runoff from upland catchments	0.70
Precipitation on plateau	2.63
	3.33

Outputs

Evapotranspiration from plateau	2.34
Borehole abstraction	0.02
Aquifer throughflow	0.27
Runoff to sea	not measured
(not less than)	2.63
Difference	0.70

If the difference in output to input is runoff loss to the sea then it would appear that recharge is largely derived from direct rainfall. For the period of water level observation, precipitation exceeds evapotranspiration by 0.29 million m³, very similar to the estimated recharge. It is likely that the short reach of the rivers as they cross the plateau reduces the potential recharge from this source.

The permanent storage within the aquifer is about 3 million m³, based on a storage coefficient of 10 per cent and an average saturated aquifer thickness of 16 m. However, only 2 million m³ of this storage is of a potable water quality (electrical conductivity less than 2250 µmhos). Our estimates of the potable water in permanent storage for each sub-area are given in Table 2.5.

POTABLE GROUNDWATER RESOURCES, LA DIGUE

Sub-area	Permanent (thousand m^3)	Temporary storage (thousand m^3)
North	350	77
Central	1030	142
South	670	114
Total	2050	333

The present groundwater abstraction from the plateau area is about 0.05 million m^3/year but we estimate that a full level of supply would require an abstraction of 0.09 million m^3/year, or about 25 per cent of the recharge. The effect of such abstraction on the position of the saline intrusion is discussed in Chapter 5.

CHAPTER 3

HYDROGEOLOGY OF PRASLIN

3.1 STUDY AREAS

Location, topography and vegetation

Praslin is the second largest island of the Seychelles and is situated 42 km north-east of Victoria. The island has a central granitic ridge rising to 367 m and is 12 km long from west to east and up to 4 km wide.

Along the south-west coast, there is an extensive plateau, Grande Anse, which is 6.5 km long and up to 0.75 km wide. Part of this plateau, around the airstrip at L'Amitie, forms the largest of the study areas on Praslin, some 1.27 km^2 in extent.

The second study area, Pasquiere, can be subdivided into two areas. A small bowl shaped depression, Plaine Hollandaise, with an area of 0.03 km^2 lies within the central granitic ridge about 100 m above sea level. This depression is drained by the Pasquiere River No. 2, which flows across a small plateau (0.01 km^2) to discharge into the sea at Baie Pasquiere (Figure 3.1).

The plateaux are predominantly covered with coconut palm although at L'Amitie there are also small areas of market gardening. The hill catchments draining onto the plateau are eroded granite covered with scrub vegetation. Plaine Hollandaise is mainly a reed covered marsh with some screw pines (*Pandulus spp*).

Hydrology

From a 19 year record of rainfall data for Grande Anse village, to the east of the study area (elevation 2 m above sea level) we have estimated the mean annual rainfall to be 2000 mm/year. These data,

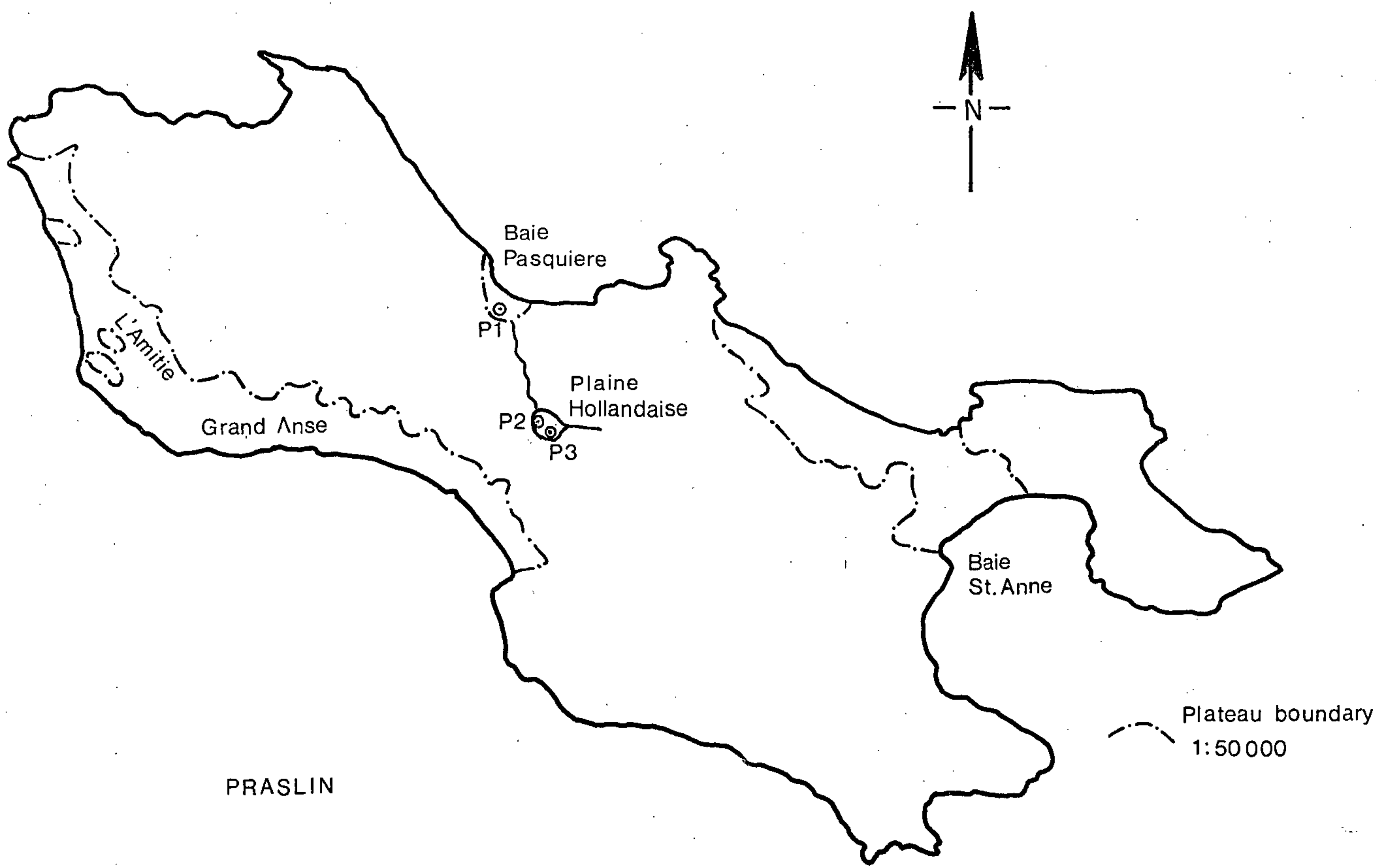

N
Baie
Pasquiere
P1
Plaine
Hollandaise
P2
P3
L'Amitie
Grand Anse
Baie
St. Anne
PRASLIN
Plateau boundary
1:50000

Figure 3.1

together the 1977-1978 rainfall data for the airstrip, are shown in Table 3.1.

The evapotranspiration is estimated, using Penman's equation, to be 1600 mm/year, based on meteorological data collected at the International Airport on Mahe. It has not proved possible to estimate the runoff from infrequent point discharges on various streams and a maximum runoff value of the difference between rainfall and evapotranspiration has been used.

A number of minor streams discharge onto the plateau at L'Amitie. The catchment area of these streams is 0.68 km^2. Surface water on the plateau is drained through a system of ditches to creeks at either end of the study area.

The Pasquiere study area consists of ephemeral streams draining onto Plaine Hollandaise. A perennial stream, Pasquiere River No. 1, drains Plaine Hollandaise and flows across Baie Pasquiere plateau to the sea.

Water use

Just over 50 percent of the population of Praslin, some 4300, live in the Grande Anse area[1]. Impoundment water schemes on the hill streams at either end of the Grand Anse plateau supply water to the whole area and this supply is adequate for the water requirements of the population. As a consequence, the groundwater resources have not been developed. The only groundwater exploitation at present is made by the Police Training School near borehole P7, where groundwater is abstracted for non-drinking purposes only.

3.2 L'AMITIE PLATEAU

Plateau deposits

Four boreholes were drilled in the study area at the locations shown in Figure 3.2 The three inland boreholes were drilled through

1 *1978, 1977 Census Report, Government of Seychelles*

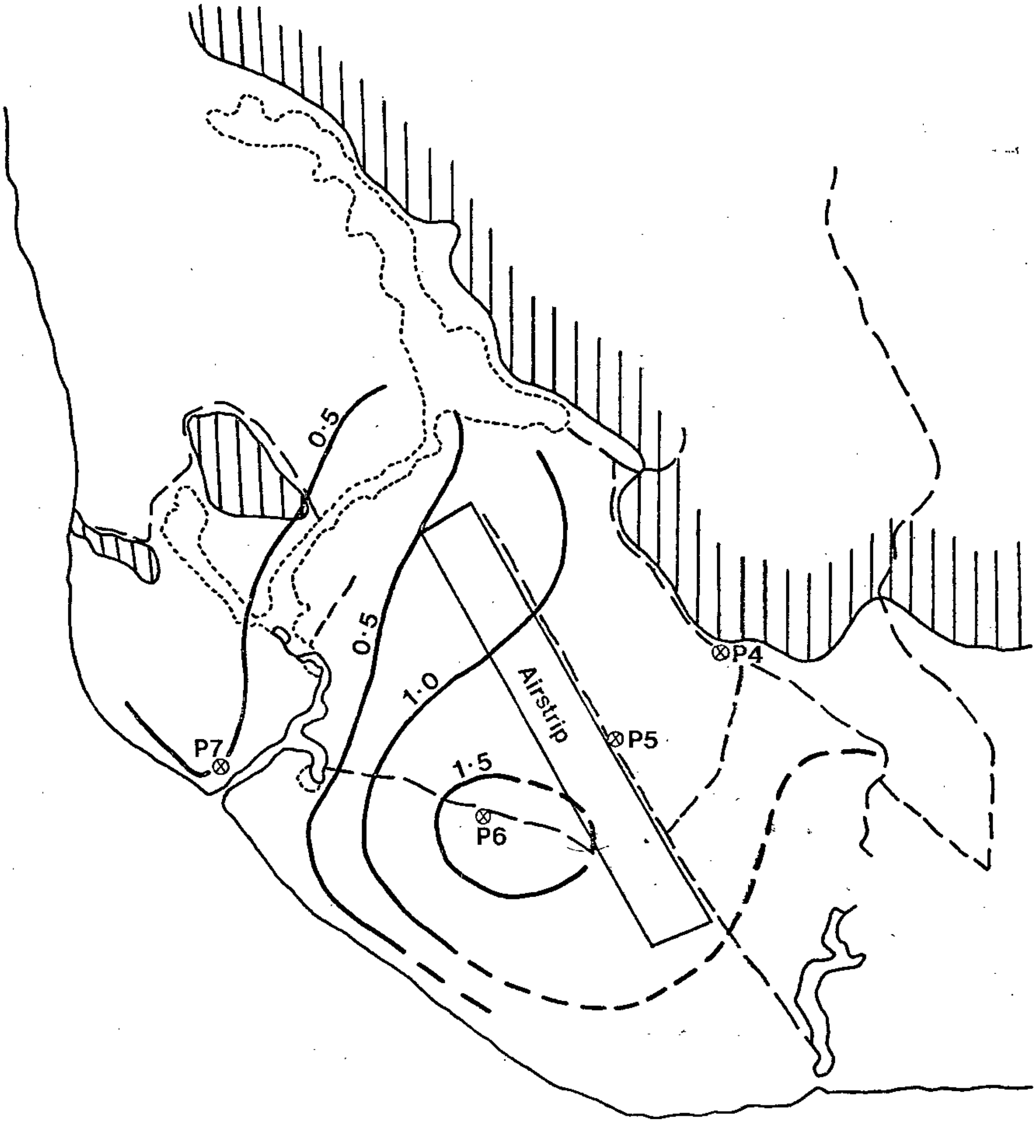
TABLE 3.1

RAINFALL, PRASLIN
(mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Airstrip 1977[1]	-	-	175	290	91	34	53	86	56	289	32	276
1978	242	202	46	369	134	42	data not available					
Grande Anse [2]	331	177	173	144	159	101	71	114	144	144	143	302

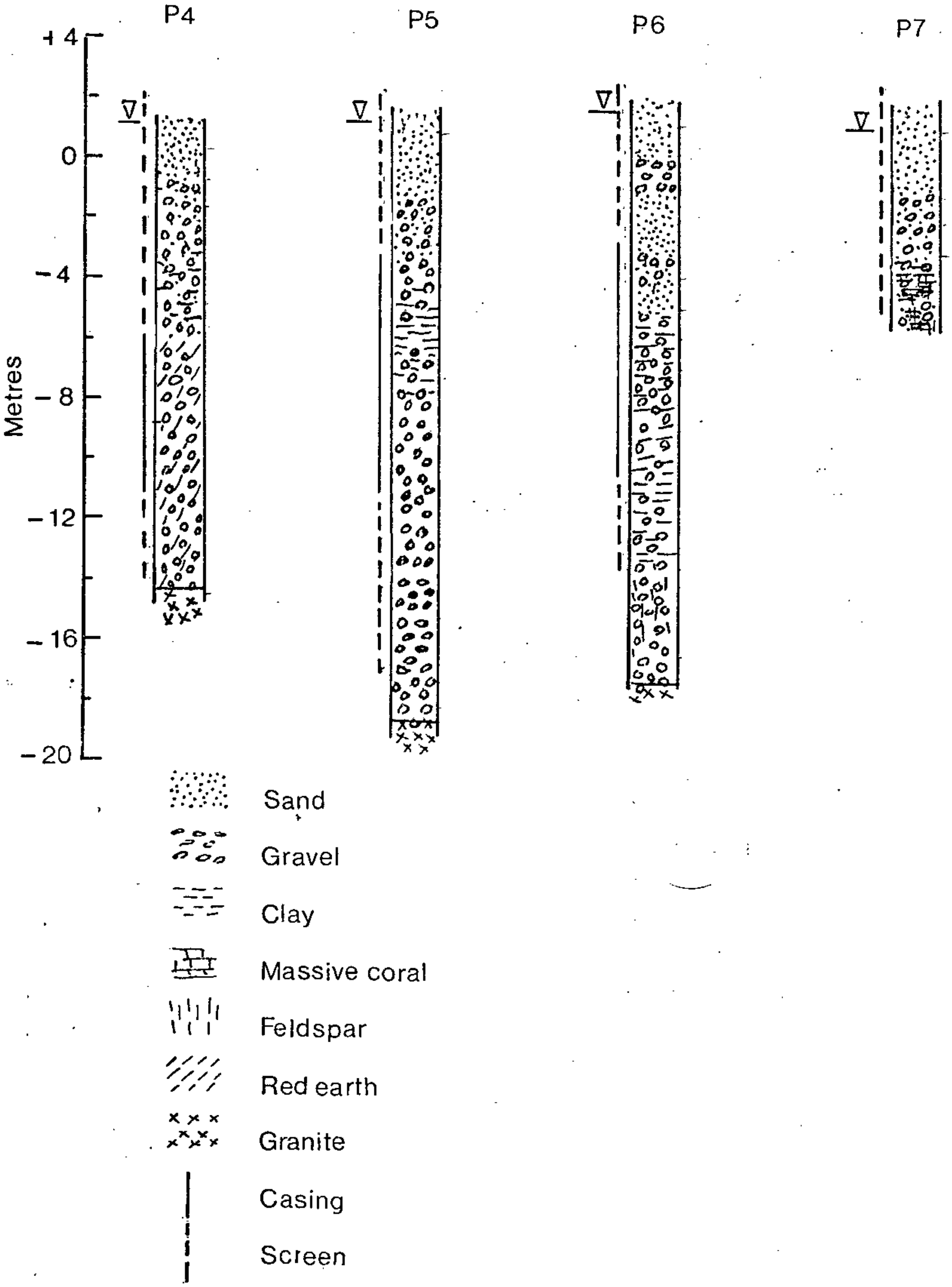
Notes: 1 *Measurements started in Febaury 1977*

2 *Long term mean for 19 complete years between 1946 and 1968*



WATER TABLE MAP (L'AMITIE)

Figure 3.2



GENERALISED BOREHOLE LOG DESCRIPTIONS
(L AMITIE)

Figure 3.3

the unconsolidated deposits of the plateau to the underlying bedrock, but the most seaward borehole, P7, was completed before reaching bedrock. The lithology is based on the examination of formation samples taken during the construction of the boreholes.

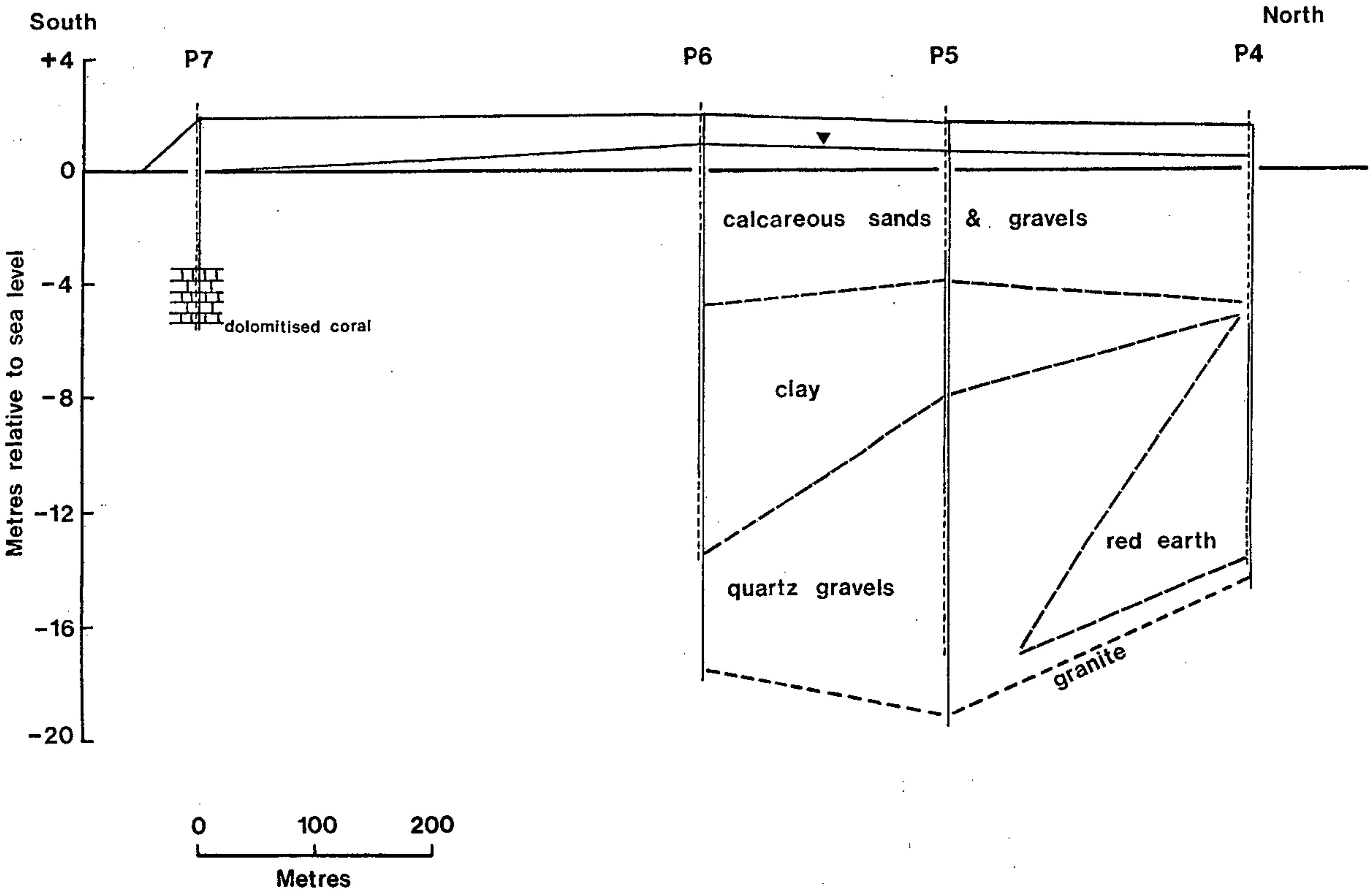
The sequence encountered in boreholes P5 and P6 indicates that there are two aquifers, which are separated by fine grained deposits (Figures 3.3 and 3.4). The upper of the two permeable zones consists of calcareous sands and gravels and we regard this sequence as the main aquifer. The lower aquifer consists of granite derived gravels, mainly quartz with some mica and feldspar. The aquiclude separating the two aquifers comprises cream coloured clays. Only the upper aquifer appears to be present at borehole P4 which is underlain by about 9 m of red earth deposits, although there is a thin layer of quartz gravels immediately overlying the granitic bedrock and these gravels could represent the lower aquifer at this site. Borehole P7 penetrated only the upper aquifer, which contained partly dolomitized massive corals.

In the absence of fined grained deposits, we believe that the main (upper) aquifer has water table conditions. The lower aquifer, together with any water that is present in the joints of the granitic bedrock, is likely to be at least partly confined by the clay layer.

Groundwater occurrence

A sequence of calcareous sands and gravels has been identified as the main aquifer; the base of this aquifer being the top of the clay sequence. The average saturated thickness of this aquifer is about 5 m, the water table occurring about 1 m below ground level and about 0.5 m to 1 m above sea level.

Although there may be a contribution to groundwater from fractures within the granite bedrock, we have taken the adjacent granitic hills as the landward boundary of the aquifer. The water table contour map (Figure 3.2) suggests that the creeks act as line sinks and they have been taken as the lateral boundaries of the study area. The shoreline has been taken as the other remaining boundary, although there may be a seepage zone of freshwater below sea level.



SCHEMATIC SECTION, SOUTH-NORTH

Figure 3.4

A water table map, related to sea level was constructed from water level data for May 1978 (Figure 3.2). This map is based partly on additional water levels which were measured in depressions and ditches on the plateau. We have assumed that the surface water is in continuity with the groundwater.

The water table for May 1978 indicates a hydraulic gradient radiating from the area around borehole P6. Although the water table configuration may reflect errors in measurement, it is likely that the drainage ditches and the creeks exert a control on the flow of groundwater and consequently the water table configuration. Thus the low density of drainage ditches around borehole P6 could result in the groundwater mound which apparently occurs in this area.

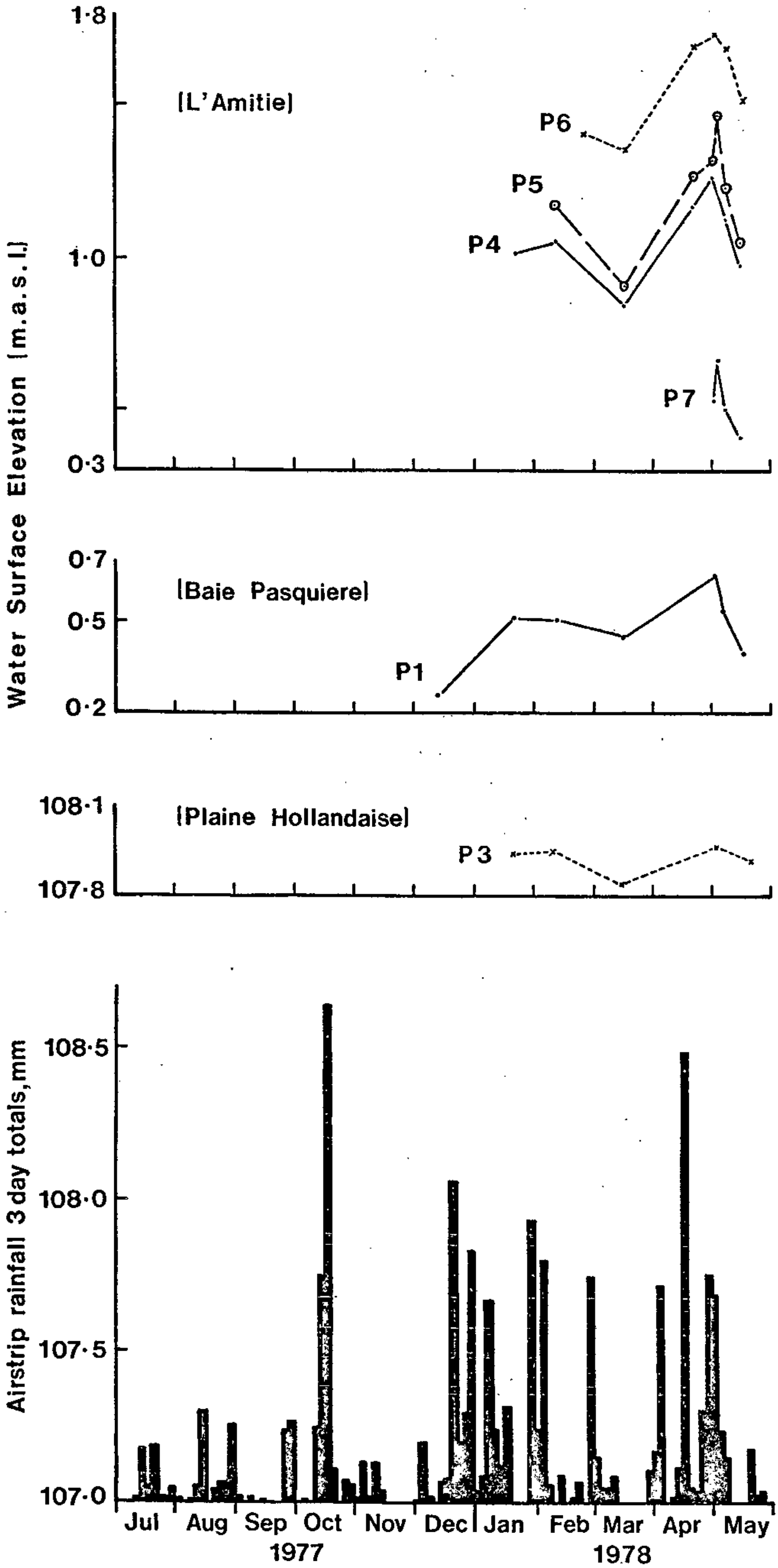
Well hydrographs for the boreholes are shown in Figure 3.5. The water levels were measured at monthly intervals from January to May 1978. Although it is not possible to assess accurately the seasonal fluctuation in groundwater levels with this short period of water level observations, the increase in this period was 0.5 m and we estimate that the total seasonal variation would be at least 1 m.

Aquifer characteristics

Three constant discharge pumping tests were carried out on boreholes P4, P5 and P6. Borehole P7 was not tested as this borehole was drilled to only 7 m. Observation wells were not available for these tests. The pumping test data are presented in Appendix 2.

The water level data from the pumping tests were analysed by the Jacob recovery method to estimate the aquifer characteristic of transmissivity (T). In the absence of observation wells, it is not possible to derive an estimate of the storage coefficient. Our estimates of the aquifer transmissivity for both the L'Amitie and Pasquiere areas are given in Table 3.2.

The transmissivity estimates using the recovery data for L'Amitie range from 180 to 520 m^2/day, averaging 400 m^2/day. We have used this average value in our resources calculations. The



WELL HYDROGRAPHS

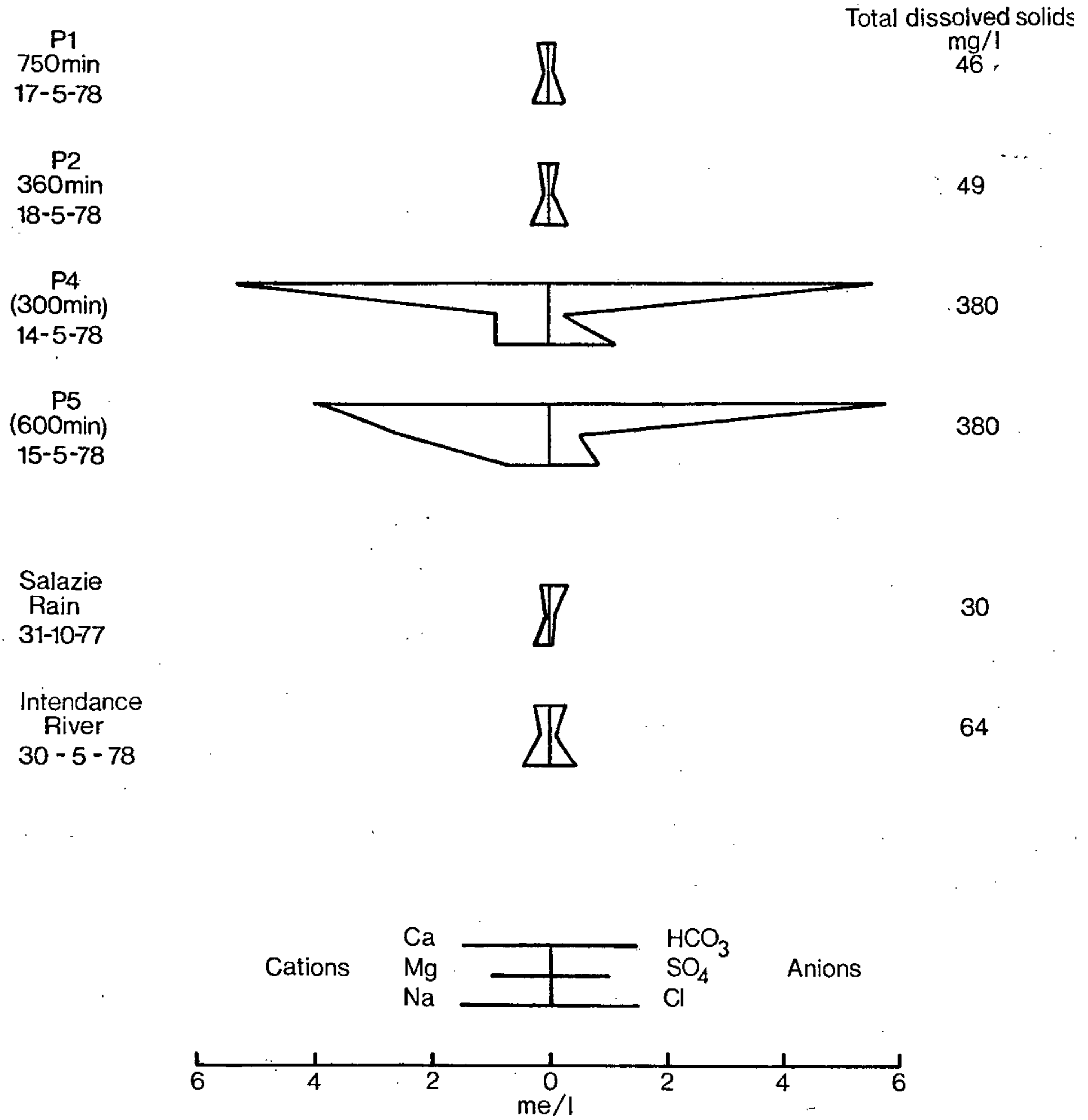
Figure 3.5

PUMPING TEST RESULTS, PRASLIN

Well number	Jacob method T (m^2/d)	T[1] (m^2/d)	Specific capacity[2] Q/s (m^2/d)	T (m^2/d)
P1	140	70	155	160
P2	60	160	125	130
P4	360	520	288	280
P5	120	180	139	150
P6	330	430	134	140

Notes: [1] *Recovery method*

[2] *Specific capacity at 100 mins after start of pumping*



PATTERN DIAGRAMS

Figure 3.6

specific capacity data suggest that the transmissivity is relatively constant for the area, except at borehole P4, where the specific capacity is 260 m^2/day compared with about 136 m^2/day at the other two sites.

At the beginning of May 1978, water levels in the boreholes were measured several times an hour for at least six hours to measure the water level response to tides. Only borehole P7 showed a definite response. Although it was possible to determine the lag time of the well, the data were insufficient to calculate the tidal efficiency.

A storage coefficient of 6 per cent was computed by substituting in the Ferris equation (see Chapter 2) our transmissivity estimate of 400 m^2/day. We believe that a representative estimate of storage coefficient by comparison with La Digue, would be 10 per cent.

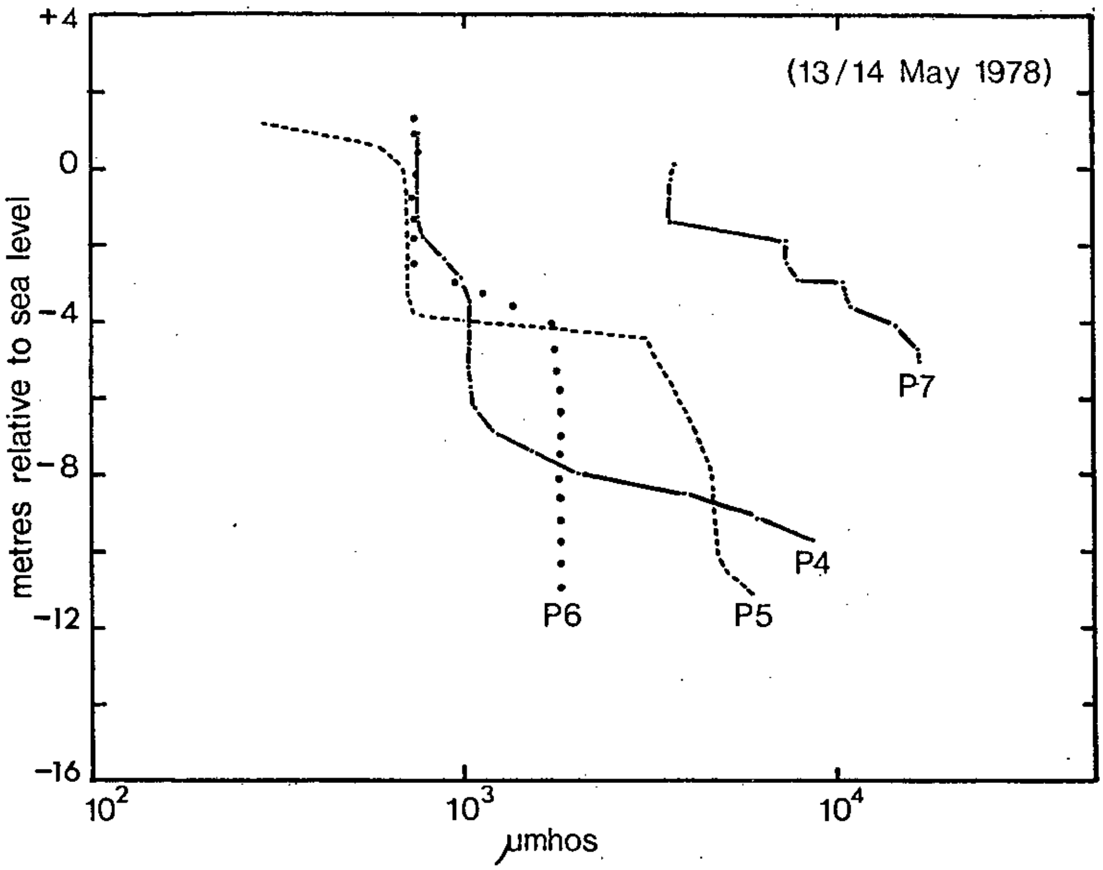
Aquifer throughflow

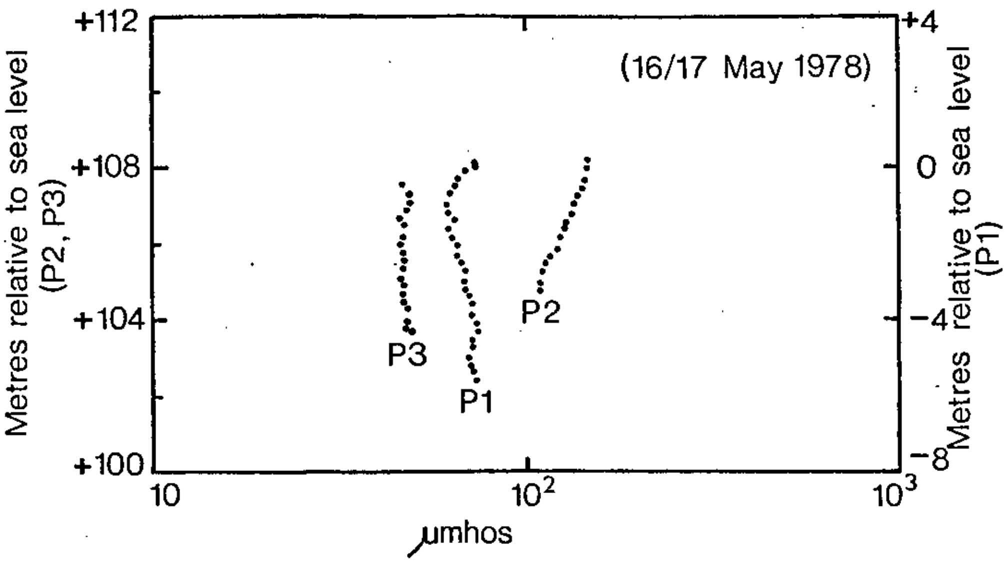
The configuration of the water table does not allow the hydraulic gradient to be calculated. We have therefore assumed that the throughflow is in balance with the temporary storage. Expansion of the present network of water levels in the area would help to give a better estimate of the water table configuration and it may then be possible to calculate the aquifer throughflow.

Groundwater quality

Water samples were collected for chemical analysis from boreholes P4 and P5 during the pumping tests at these sites. The analyses are presented in Appendix 3. In addition, electrical conductivity measurements were taken of the surface waters and also with depth in boreholes P4 to P7.

The samples from boreholes P4 and P5, which are situated between the airstrip and the granitic hills, have a $CaHCO_3$ composition (Figure A.3.1.) and a low total dissolved solids of 380 mg/l. Neither sample showed chemical evidence suggesting saline water or organic contamination. Both samples are suitable for drinking water purposes, although a hydrogen sulphide concentration of 0.32 mg/l and a fluoride concentration





ONDUCTIVITY PROFILES

Figure 3.7

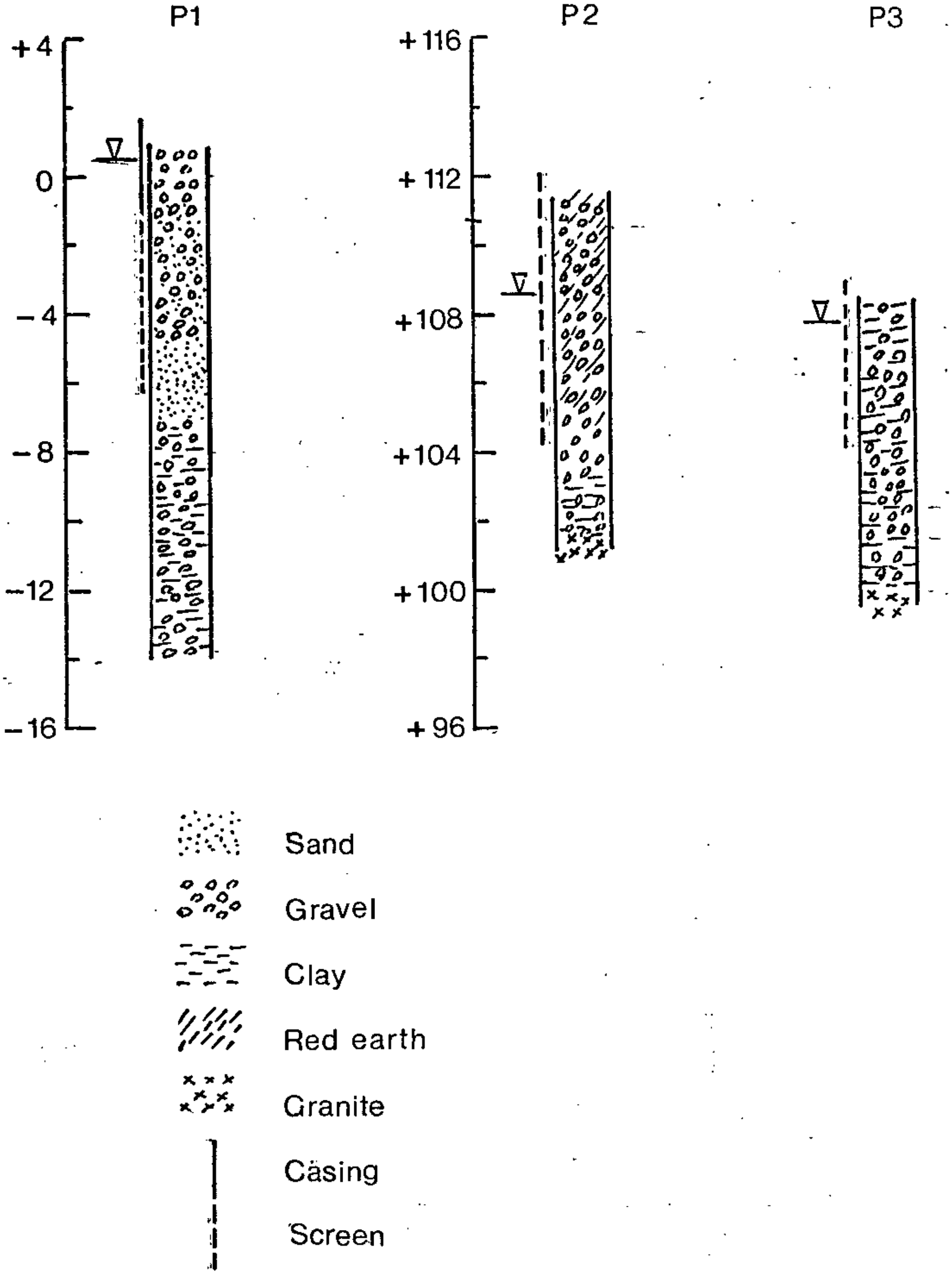
of 0.92 mg/l were recorded in the sample from P5. In their overall composition, the sample from P4 shows most similarity to that from LD7 and the sample from P5 to LD3 but with an increased magnesium content (Figure 3.6).

The areal conductivity survey indicated three areas of differing conductivity values (Figure 3.2). In the rivers draining the hills, conductivities of 70 to 80 μmhos were measured but within a short distance from the hills, conductivities of 300 to 700 μmhos occur. These higher conductivities are similar to those of shallow groundwaters and suggest a groundwater component to the flow in the drainage ditches as would be expected. Water in the creeks has a conductivity of more than 4000 μmhos.

The conductivity measurements taken with depth in boreholes P4 to P7 are plotted in Figure 3.7. All the conductivity profiles showed an increase in conductivity with depth to maximum values ranging from 1800 to 17000 μmhos (at P6 and P7 respectively). The increase in conductivity is most marked in P4 and P6 and occurs at the base of the upper screen. A slight decrease is shown at the top of the lower screen. We cannot determine the cause of the increased conductivity within the cased portion of these boreholes.

Non-potable groundwater (more than 2250 μmhos) is indicated from the conductivity profiles to occur at depths of 12 m below sea level (bsl) in P6, 8 m bsl in P4, 4 m bsl in P5 and from the water table in P7. However, conductivities of about 500 μmhos were measured in the samples collected during the pumping tests at P4 and P5. We have therefore assumed that potable water occurs throughout the upper permeable zone in boreholes P4 to P6 and non-potable water in the lower permeable zone present at P5 and from the water table at P7. The conductivity profile at P7 represents a transitional zone between saline groundwater and normal sea water, although sea water within the nearby creek may produce localized saline groundwater..

From the Ghyben-Hertzberg relationship (see Annex A), we would expect a sea water composition to be encountered at 8 m bsl at



GENERALISED BOREHOLE LOG DESCRIPTIONS
(PASQUIERE)

Figure 3.8

P7 and at depths exceeding 50 m in the other boreholes. The transitional zone is at least 40 m in thickness in the area of of P7 and possibly elsewhere.

We have selected an arbitrary limit of 100 m as the distance inland at which potable water occurs within the upper permeable zone. We have also assumed, in the absence of other information, that this boundary extends inland to the same extent within the upper permeable zone for the whole width of the study area. Of the total water in storage, within the upper permeable zone, about 0.76 million m^3, 0.01 million m^3 are non-potable. The potable groundwater reserves are thus about 0.75 million m^3.

3.3 PASQUIERE (BAIE PASQUIERE AND PLAINE HOLLANDAISE)

Plateau deposits

Three boreholes were drilled in this study area, two on Plaine Hollandaise and one on the Baie Pasquiere plateau (Figure 3.1). All three boreholes were drilled to bedrock and our description of the sequence is based on the examination of samples taken during drilling.

The sequence at Baie Pasquiere appears to differ from those encountered in the other low lying plateau study areas as calcareous deposits were not encountered in the borehole (P1) drilled in this study area. The sequence comprises 8 m of quartz sands and gravels overlying 7 m of fine grained material with some quartz gravel. The bedrock at this site is microsyenite.

Boreholes P2 and P3 were drilled on Plaine Hollandaise to bedrock. Borehole P2 encountered bedrock at 9.5 m below ground level after passing through a sequence comprising 6.5 m of red-earth deposits, 1.5 m of quartz gravels and 2 m of feldspathic clay. Borehole P3 struck bedrock at 8 m after passing through a sequence of clays with a 1 m horizon of quartz gravels at 2 to 3 m below ground level (Figure 3.8). The bedrock at both sites was granite.

Groundwater occurrence

The Baie Pasquiere plateau aquifer has been identified as a sequence of quartz sands and gravels. The water table is about 1 m below ground level and the saturated thickness is about 7 m. The base of the aquifer has been taken as the top of the clays. We have assumed that the granitic hills adjacent to the plateau form the landward boundary of the aquifer while the sea forms the northern boundary.

The sequence of deposits encountered in boreholes P2 and P3 at Plaine Hollandaise indicates unfavourable aquifer conditions with clay deposits forming 80 to 90 per cent of the sequence. The main aquifer consists of thin (1 to 1.5 m) quartz gravel horizons, which are perhaps lenticular and of limited lateral extent and continuity. Gravel horizons were encountered at a depth of only 2 m in borehole P3 and at 6.5 m in borehole P2. The water level in P2 and P3 occurred at 3.4 and 0.6 m below ground level respectively. The shallow groundwater may be the origin of the marsh area as loss of groundwater from the aquifer is probably restricted by the bedrock.

It is not possible to construct a water table map of either sub-area from water level data from the boreholes alone. However, surface water levels were measured druing May 1978 and assuming that there is hydraulic continuity between the surface and groundwater, we have used these date to estimate a hydraulic gradient of 0.0013 for the Baie Pasquiere plateau. Water levels were monitored at monthly intervals from January to May 1978 for boreholes P1 and P3 (Figure 3.5). However, borehole P2 was blocked between February and May 1978 so only a few measurements were taken. Whilst it is not possible to assess the complete seasonal variation, a water level rise of 0.4 m and 0.1 m was measured in boreholes P1 and P3 respectively.

Aquifer characteristics

Constant discharge pumping tests were performed on boreholes P1 and P2; borehole P3 had insufficient water to perform a pumping test. The test data are presented in Appendix 2.

It was not possible to estimate a value for the storage coefficient for either area from the pumping test data as observation boreholes were not available. Our estimates of transmissivity, using the Jacob recovery method are given in Table 3.2. Transmissivity was also estimated from specific capacity data for comparison with that from the pumping test analysis.

From the single pumping test at borehole P1 the transmissivity has been estimated as 70 m^2/day for Baie Pasquiere. This estimate is lower than the transmissivities for the other plateaux and may reflect the smaller aquifer thickness and the higher proportion of sand present in the sequence.

Borehole P1 showed a response to tidal influence (tidal efficiency, 2 per cent) and from the Ferris method, we have estimated the storage coefficient to be 0.1 per cent. This low value compared with the other areas is not suggested by the pumping test data which indicate water table conditions and therefore we would expect a much higher storage coefficient. We believe that a storage coefficient of 10 per cent to correspond with the other areas is perhaps more representative.

A single pumping test was carried out at Plaine Hollandaise. The Jacob recovery estimate of transmissivity is 160 m^2/day and test data indicate that confined conditions occur. It was not possible to estimate the storage coefficient but if the gravel aquifer zone can draw upon storage in the overlying clays (leaky confined conditions) then there may be a specific yield of 5 per cent.

Aquifer throughflow

We have estimated the annual flow of groundwater through the aquifer at Baie Pasquiere to be about 16000 m^3. This estimate is based upon a transmissivity of 70 m^2/day, an aquifer width of 500 m and a hydraulic gradient of 0.0013 using Darcy's equation.

It was not possible to estimate a hydraulic gradient for Plaine Hollandaise from the limited data available. The low transmissivity suggests that this flow will be small. Due to bedrock surrounding the basin the groundwater outflow is probably restricted to a contribution to the marsh and subsequently as part of the surface runoff.

Groundwater quality

Water samples were collected during the pumping tests at boreholes P1 and P2 for chemical analysis. The results are presented in Appendix 3. Electricial conductivity measurements were taken with depth in boreholes P1 to P3.

The water samples from P1 and P2 have a similar composition to the runoff with a very low total dissolved solids of about 50 mg/1, (Figures 3.6 and A.3.1.). They have a low total hardness of 10 mg/1. Both are suitable for drinking purposes, although the iron content is 3.25 mg/1 in the sample from P1 and this would have to be removed by aeration. There is slight evidence of organic contamination. Sodium and chloride are the dominant ions in these samples and reflect the rainfall composition.

The conductivity profiles from boreholes P1 to P3 are shown in Figure 3.7. None showed an increase in conductivity with depth. The profile at borehole P1 indicates that good quality groundwater extends throughout the sands forming the main aquifer to depths of at least 6 m bsl at this location.

A direct indication of the occurrence of non-potable water cannot be determined from the drilling at Baie Pasquiere. However, from the Ghyben-Hertzberg relationship, we would expect a sea water composition to occur 20 m below sea level at borehole P1, which is within the underlying bedrock. The intruded saline wedge should underlie the whole aquifer area but extend 30 m inland within the aquifer thickness. If, in common with the other plateau areas, there is a zone of mixing of 50 m in width, non-potable groundwater should occur about 100 m inland, or over about 50 per cent of the area of the aquifer.

3.4 GROUNDWATER RESOURCES

Due to the lack of suitable data concerning water level changes and storage coefficients, it is only possible to give an indication of the temporary storage at Praslin. It is not possible to compute a water balance for the areas as the stream flow data are insufficient to provide reliable runoff estimates. In the discussion on Plaine Hollandaise, the difference between the rainfall and evapotranspiration values both of which we consider to be more reliable than the available runoff data, has been taken as the maximum runoff value.

L'Amitie plateau

Using a storage coefficient of 10 per cent (which is based on both the Ferris method and a comparison of lithology with other areas) and an average saturated aquifer thickness of 6 m, we have estimated the permanent storage within the upper aquifer to be 0.76 million m^3. However, from the electrical conductivity measurements, we estimate that 0.01 million m^3 of this stored volume is of a non-potable water quality (electrical conductivity more than 2250 μmhos), and thus we estimate the permanent potable storage to be about 0.75 million m^3.

The measured rise in water level of 0.5 m over the study period of January to May 1978 represents a temporary storage increase of 0.06 million m^3/year. The assumed seasonal variation of 1 m represents a temporary storage change of 0.13 million m^3/year. The aquifer throughflow is assumed to be equal to this temporary storage change.

Baie Pasquiere plateau

The volume of groundwater in permanent storage at Baie Pasquiere is estimated to be 0.07 million m^3. Our estimate is based on a storage coefficient of 10 per cent, from comparison with the lithologies of other plateau areas, and an aquifer thickness of 7 m, from the sequence of deposits encountered at borehole P1. From indirect evidence using the Ghyben-Hertzberg relationship, we estimate that only 50 per cent of the groundwater in permanent storage is likely to be of a potable quality, or 0.035 million m^3.

The observed rise in water level between January and May 1978 of 0.4 m at borehole P1 represents an increase in temporary storage of 4000 m^3 over the plateau area in this period. We estimate that the total seasonal fluctuation in water level is perhaps 1 m and thus the temporary storage might be as high as 10000 m^3/year, which is low compared with our estimate of flow through the aquifer of about 16000 m^3/year. This discrepancy may be due to errors in estimating the hydraulic gradient, which would affect the estimated aquifer throughflow, an incorrect estimate of the storage coefficient, or errors in the estimate of seasonal water level fluctuations.

An increase in the storage coefficient to 15 per cent would give a reasonable agreement between the flow through the aquifer and temporary storage.

Plaine Hollandaise

The average annual rainfall at Plaine Hollandaise is estimated to be 2000 mm and the evapotranspiration 1600 mm. The difference of 400 mm (equivalent to 0.2 million m^3 from the catchment area of 0.51 km^2 serving the plateau) has to supply runoff in the Pasquiere river as well as any storage changes in the aquifer. As it was not possible to derive a storage coefficient for Plaine Hollandaise we are unable to make a reliable estimate of the resources. In view of both the predominantly clay sequence encountered and the limited extent of the plateau, it is likely that the groundwater resources are small.

CHAPTER 4

HYDROGEOLOGY OF ANSE INTENDANCE, MAHE

4.1 STUDY AREA

General

Before proceeding to the major study areas on La Digue and Praslin, equipment tests were carried out on a small plateau of some 0.22 km^2 in area at Anse Intendance. This plateau is situated on the south-west coast of Mahe, 19 km from Victoria (Figure 4.1). An hotel development has begun in this area and an investigation of the groundwater resources would aid the planning of a water supply for this development.

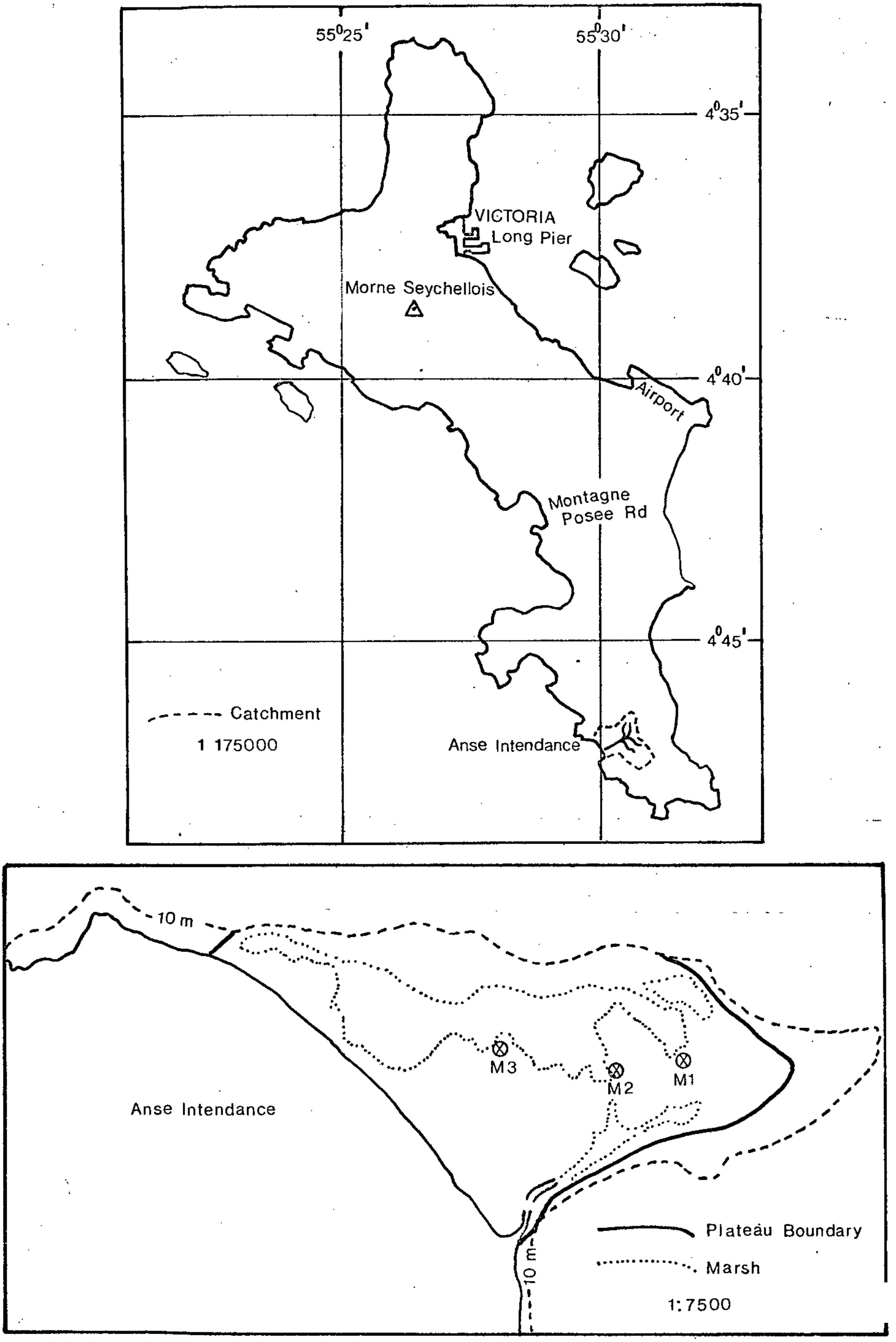
The plateau has an elevation of less than 5 m above sea level and is surrounded by granitic hills. The vegetation on the plateau is predominatly coconut palms with cedre. There is also a comparatively large marsh which is reed covered.

Hydrology

Although a rainfall gauge has been established at Quatre Bornes (elevation 95 m above sea level), less than one year's record is so far available (Table 4.1). However, from an examination of rainfall data from Victoria, we conclude that the average rainfall on the plateau is 1800 mm/year.

We estimate the annual evapotranspiration to be 1600 mm, based on application of the Penman equation to meteorological data from the station at the International Airport.

The adjacent granitic hills are drained by a number of surface streams, the largest of which is the Intendance River, which flows



LOCATION OF ANSE INTENDANCE STUDY AREA

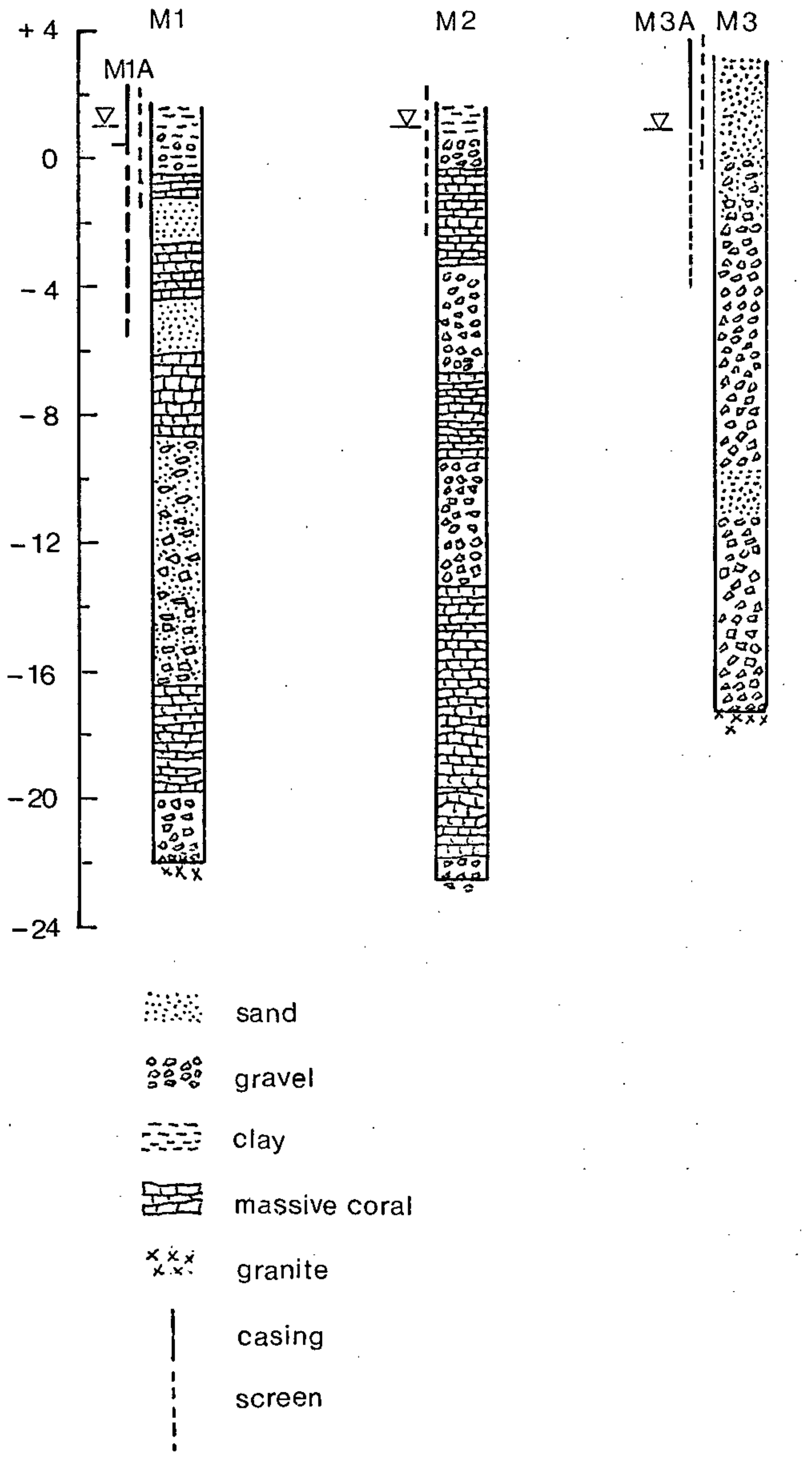
Figure 4.1

TABLE 4.1

RAINFALL, MAHE
(mm)

	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec
Quatre Bornes 1977[1]	-	-	240	219	13	57	76	63	42	303	113	366
1978	241	186	197	261	85	51	no further data					
Long Pier, Victoria[2]	383	260	230	183	175	87	88	74	131	169	219	330
Anse Forbans[3]	284	141	145	148	108	54	53	87	104	166	182	279

Notes: 1 *Readings commenced February 1977*
2 *Mean for 62 years between 1909 and 1970*
3 *Mean for 11 years between 1966 and 1976*



GENERALISED BOREHOLE LOG DESCRIPTION

Figure 4. 2

along the southern boundary of the area. Only point monthly flow measurements are available for this river from May 1977. From the records of streamflow from other gauging sites on Mahe, where daily measurements are taken, we estimate the total mean annual runoff from the catchment area of the streams (1.71 km^2) entering the study area to be 900 mm/year.

About one third (0.065 km^2) of the study area is covered by marsh, which appears to have an intermittent connection with the Intendance River. This marsh area is currently being drained to form an artificial lake as part of the hotel development.

Present water use

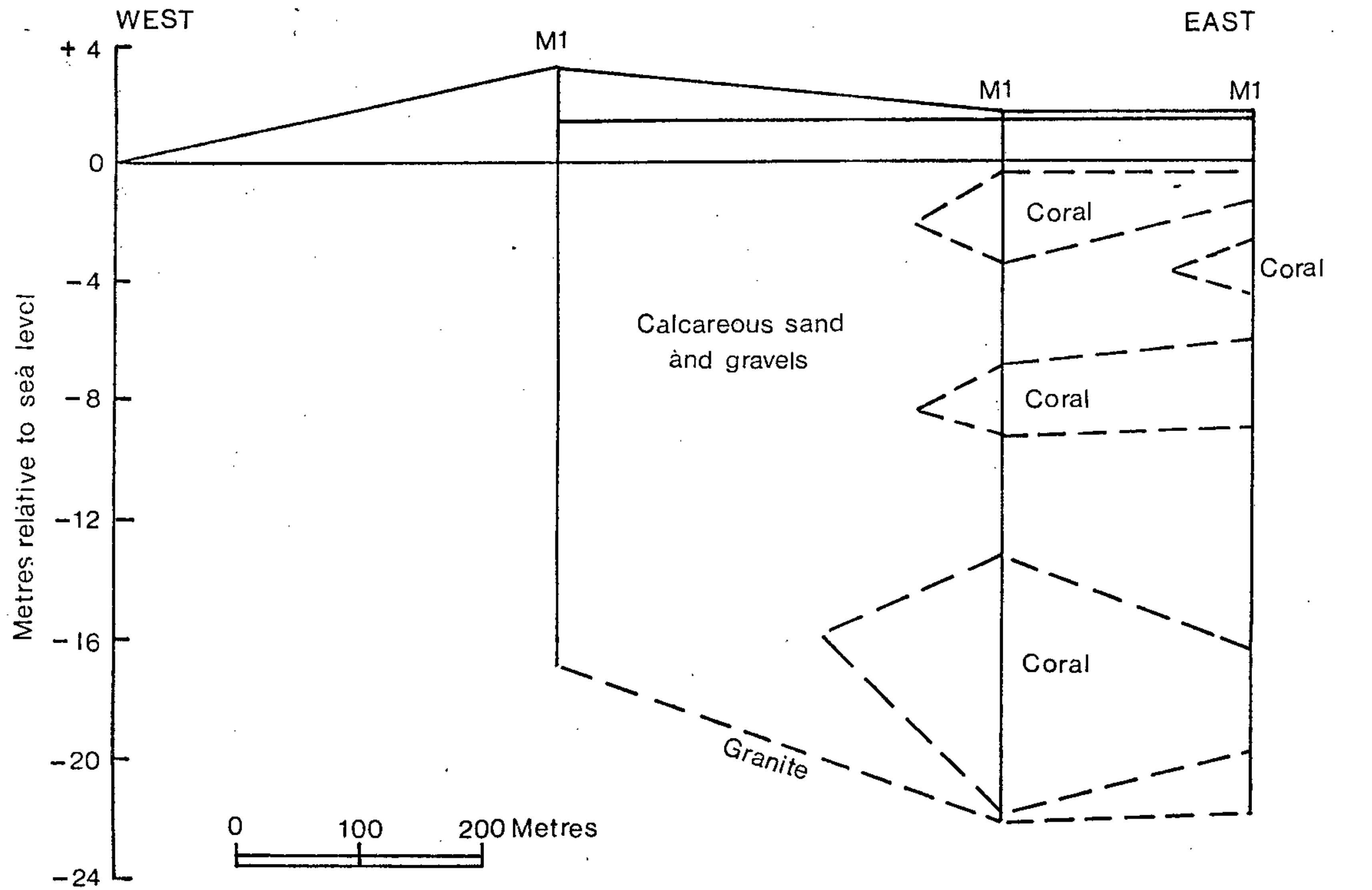
At present water is not abstracted from surface water or groundwater in the study area, although the village of Quatre Bornes draws a supply from the upper reaches of the Intendance River. However, the hotel project will have a likely water supply requirement of 380 m^3/day when completed.

4.2 GROUNDWATER OCCURRENCE

Plateau deposits

Three boreholes were drilled in a line east to west along the centre of the plateau as part of the study. Each penetrated the granite bedrock underlying the plateau deposits. The sequence of deposits was identified from samples collected during drilling. The deposits encountered at each borehole are shown in Figure 4.2 and the generalized sequence is shown as a cross-section in Figure 4.3.

Granite underlies the unconsolidated plateau deposits at 23 to 24 m below ground level at boreholes M1 and M2 and at 20 m at M3. The unconsolidated sequence is predominantly calcareous, with massive coral interbedded with gravels present in both M1 and M2. The coral is not present at borehole M3 nearest to the sea where the sequence consists of gravels with coral reef talus. Clay deposits are



SCHEMATIC SECTION, WEST–EAST

Figure 4.3

absent from the sequence. The sequence of deposits indicates that the plateau originated as several reef-structures with fore- and back-reef deposits.

Groundwater occurrence

The granitic bedrock is weathered and fractured. However, there is no information regarding the degree of hydraulic continuity with the plateau deposits which comprise the aquifer. We have therefore regarded the bedrock as the base and the landward boundary of the aquifer. The sea is assumed to form the western boundary. However, the distribution of potable groundwater occurrence is of greater importance than the apparent physical extent of the plateau deposits (see section 4.3). Since clays or other fine-grained deposits are absent from the sequence, we expect the unconsolidated deposits to occur under water table conditions.

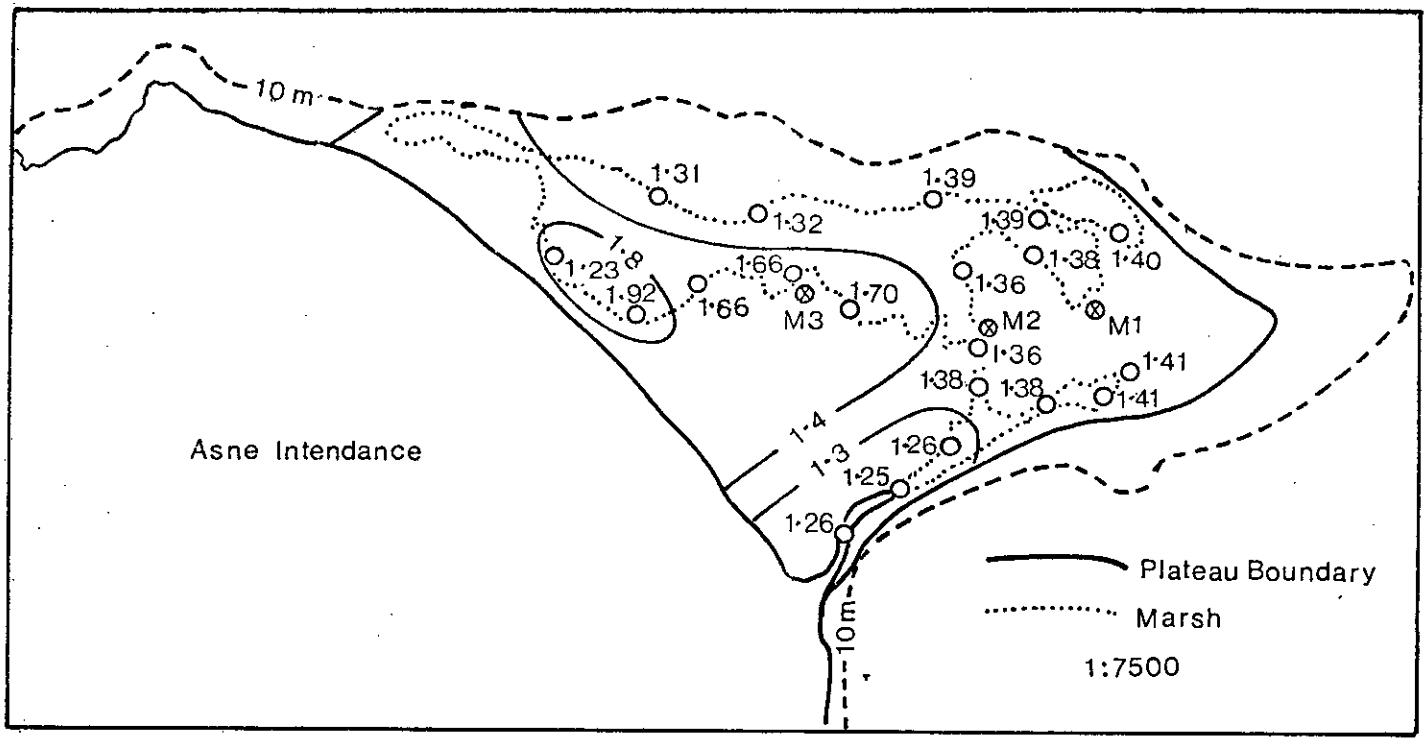
The average saturated thickness of the aquifer is about 22 m, the water level occurring about 1.0 m below ground level and 0.7 m above sea level.

A water table map related to sea level, shown in Figure 4.4, was prepared from water level data for March 1978 and a survey of surface water levels, assuming continuity between the groundwater and surface water.

Water levels were measured in boreholes M1 to M3 at about monthly intervals from August 1977 to May 1978, which covers the period from the end of the dry season through the following wet season. The water level data are plotted as hydrographs in Figure 4.5. The rise in water level during the monitoring period was similar at each site, 0.6 m. This water level rise has been used in our subsequent estimates of the aquifer recharge.

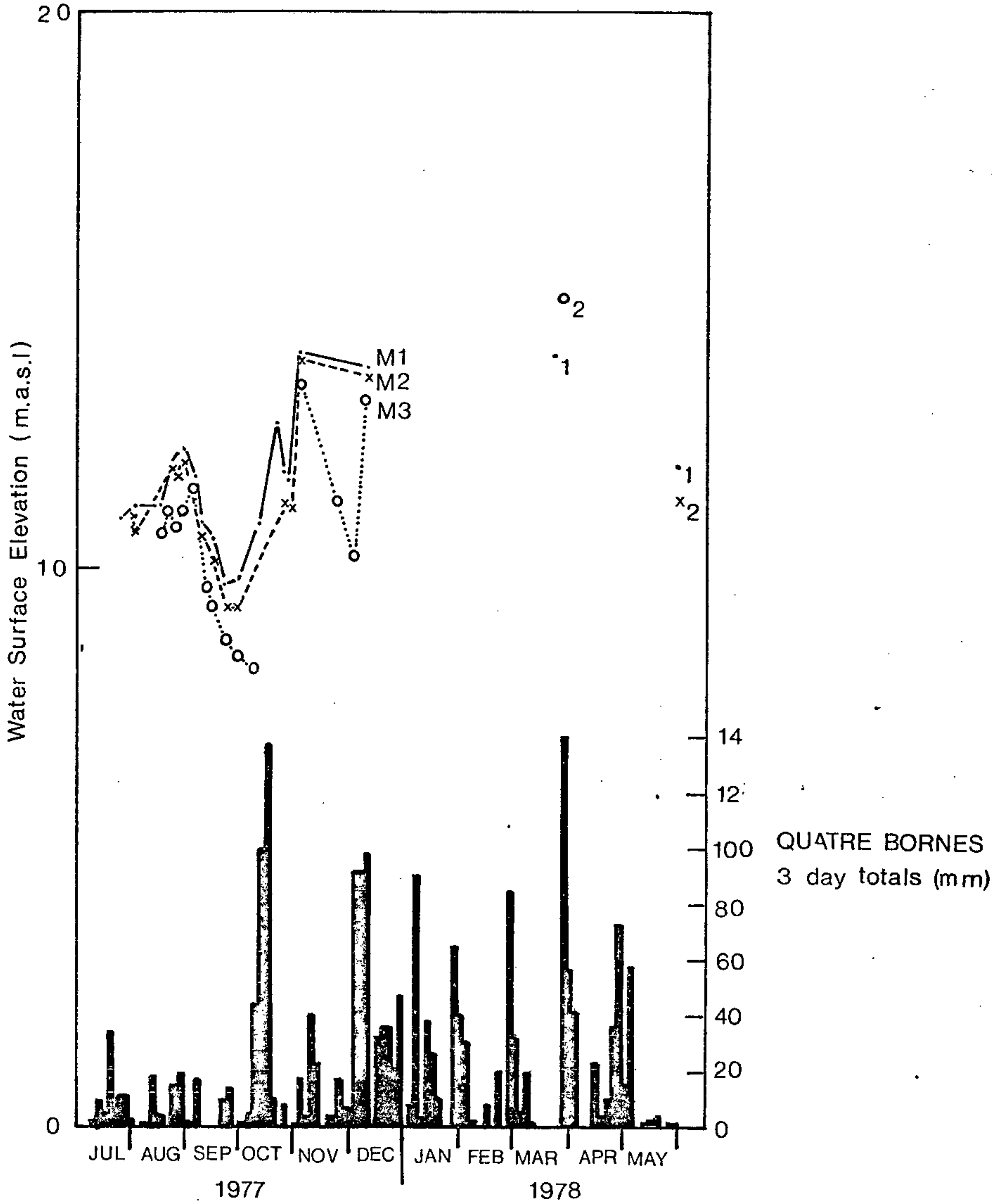
Aquifer characteristics

Constant rate and step-drawdown pumping tests were carried out in March 1978 on boreholes M1A and M3A to estimate the aquifer



WATER TABLE MAP

Figure 4.4



WELL HYDROGRAPHS

Figure 4.5

PUMPING TEST RESULTS, ANSE INTENDANCE

Well number		Specific capacity[1]		Jacob method[2]			Theis method	
Pumped	Observation	Q/S (m^2/d)	T (m^2/d)	T (m^2/d)	S %	T (m^2/d)	T (m^2/d)	S %
M1A		623	660	4200[3] 4680[4]				
	M1			5230[4]	0.7		670	0.4
M3A		738	780	1160[3] 530[4]				
	M3			460[4]	6	580	310	11

Notes:
1 *After 100 minutes of continuous abstraction*
2 *Second transmissivity estimate is from the recovery data*
3 *First stage of step-drawdown production test*
4 *Constant discharge test*

characteristics of transmissivity (T) and storage (S). Wells M1 and M3 were used as observation wells. The pumping test data are presented in Appendix 2.

Difficulties with the pumping equipment caused the constant rate test at M1A to be abandoned after 17 hours of pumping and subsequent measurements of recovery water levels were not possible. The test at borehole M3A continued for 48 hours with recovery water levels being measured following shutdown.

Our estimates of the aquifer characteristics are given in Table 4.2. The Theis method provides a more reliable estimate of transmissivity as both boreholes M1A and M3A were influenced by drainage from the marsh. We have therefore taken the mean transmissivity estimate of 500 m^2/day from the Theis method and suggest that the high transmissivity estimates given by the Jacob method are unrepresentative of natural flow through the aquifer.

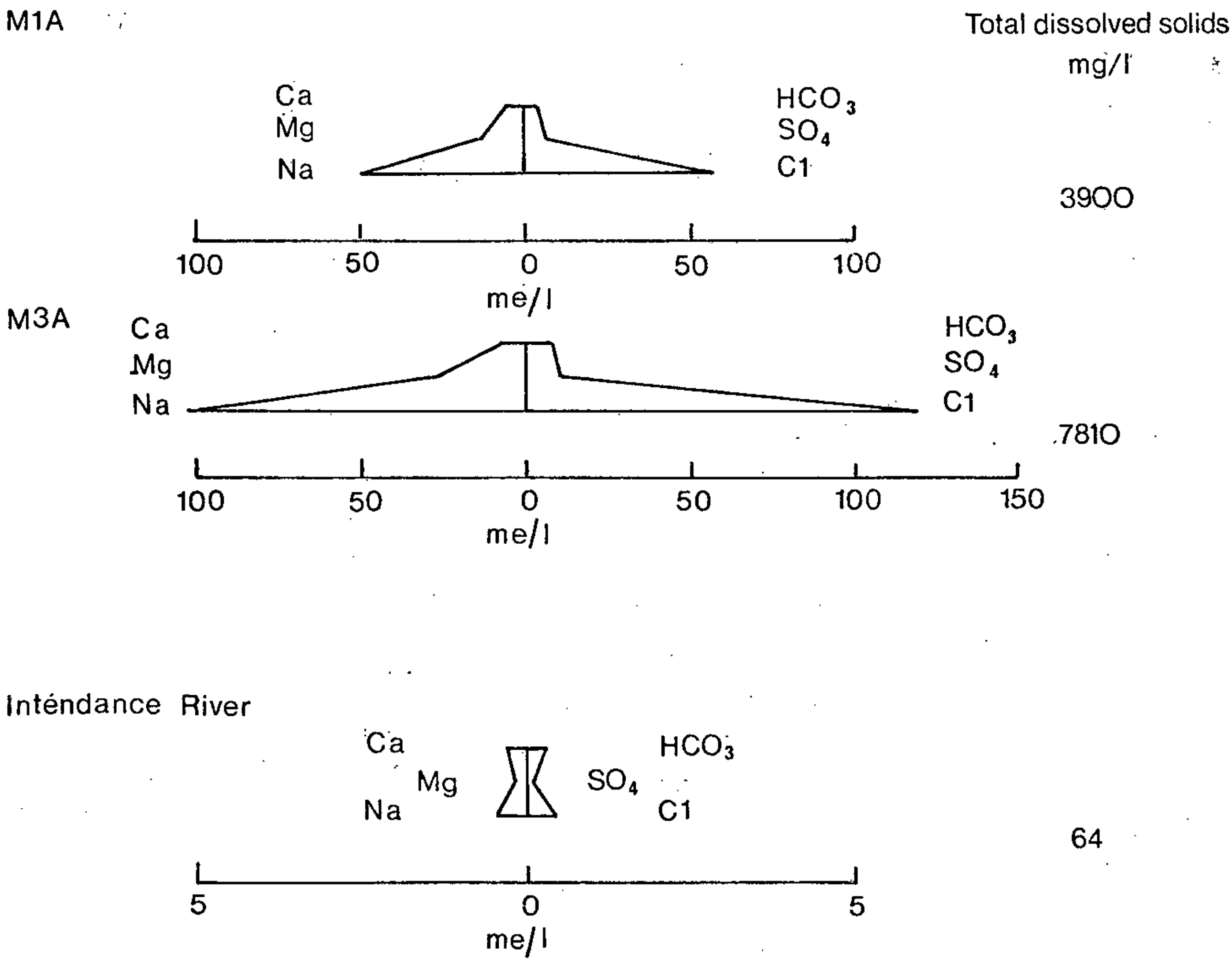
A low storage coefficient of 0.4 to 0.7 per cent was estimated for borehole M1. However, from consideration of the type of deposits and from the mean storage coefficient for the test at borehole M3A of 8 per cent, we have adopted a value of 10 per cent for the storage coefficient.

The specific capacities are higher, from 620 to 740 m^2/day, than those computed from the pumping tests in the other study areas. These, however, also reflect the influence of leakage from the marsh but would be representative of conditions during abstraction.

Although the water levels in each borehole were measured frequently during a tidal period, a response to tidal fluctuations was not observed. We are unable therefore to check our estimates of aquifer parameters by the Ferris method (see Chapters 2 and 3). The lack of response is due to the distance of these boreholes from the sea.

Aquifer throughflow

The flow through the aquifer, which is subsequently lost to the sea, has been estimated by the Darcy equation. We have applied this



PATTERN DIAGRAMS

Figure 4. 6

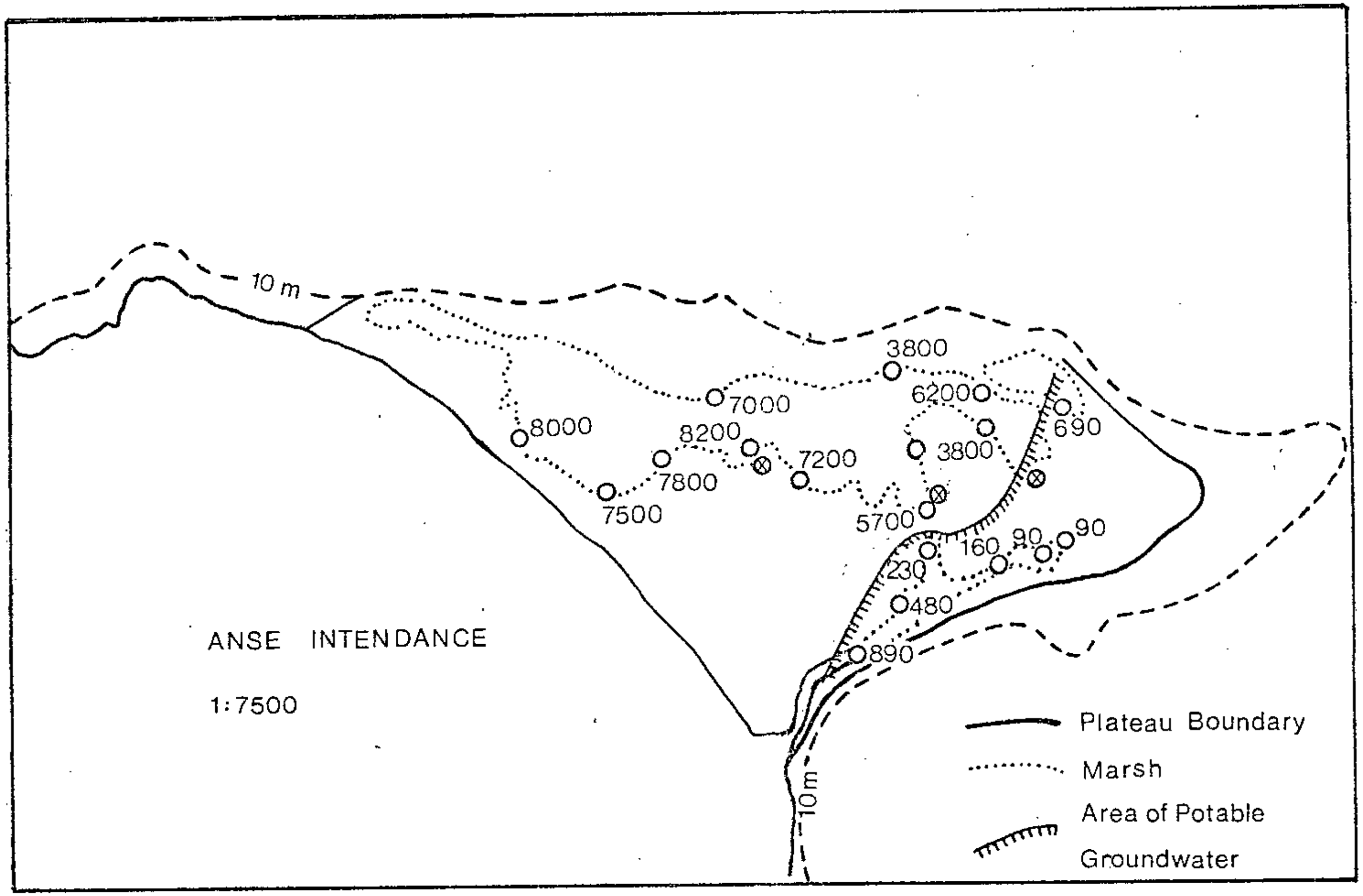
equation to a width of 125 m of aquifer with potable water (see section 4.3) and used a permeability of 20 m/d for an aquifer thickness of 4 m. The hydraulic gradient was computed from the water table map (Figure 4.4) to be 0.0006 beneath the Intendance River. The annual loss of potable water is estimated to be about 2000 m^3. This is perhaps an underestimate due to the mixing of fresh and saline water.

4.3 GROUNDWATER QUALITY

Water samples for chemical analysis were collected during the pumping tests at boreholes M1A and M3A from the Intendance River just upstream of where it enters the plateau and of rainfall from the raingauge at Salazie (elevation 410 m). The analyses of these samples are presented in Appendix 3. Electrical conductivity measurements were taken in the marsh and drainage channels and also at depth in boreholes M1A, M2 and M3A.

The water samples from boreholes M1A and M3A are of a NaCl composition (Figure 4.6) with a high total dissolved solids of 4000 to 8000 mg/l. They are non-potable and the high $Cl:HCO_3$ ratio of 15 to 23 indicates moderate contamination by saline water. The hydrogen sulphide concentrations are high, from 0.5 mg/l at M1A to about 1.8 mg/l at M3A. The presence of ammonia indicates a moderate degree of organic contamination. In their overall composition, they are markedly dissimilar to groundwater samples from the other study areas, due to their high sodium and chloride content, although the calcium and bicarbonate concentrations are similar to the other samples (Figure A.3.1).

The measurements of surface water conductivities are shown in Figure 4.7. Conductivity values of over 5000 μmhos are found in the marsh with localised conductivity values of 500 to 1000 μmhos on its eastern fringe where small streams enter the marsh from the granite hills. Lower conductivities, less than 100 μmhos, were measured along the upper part of the Intendance River as it crosses the plateau but they increase to nearly 1000 μmhos in the lowermost reach of the river, perhaps indicating a contribution to river flow from shallow groundwater.



SURFACE WATER CONDUCTIVITIES

Figure 4.7

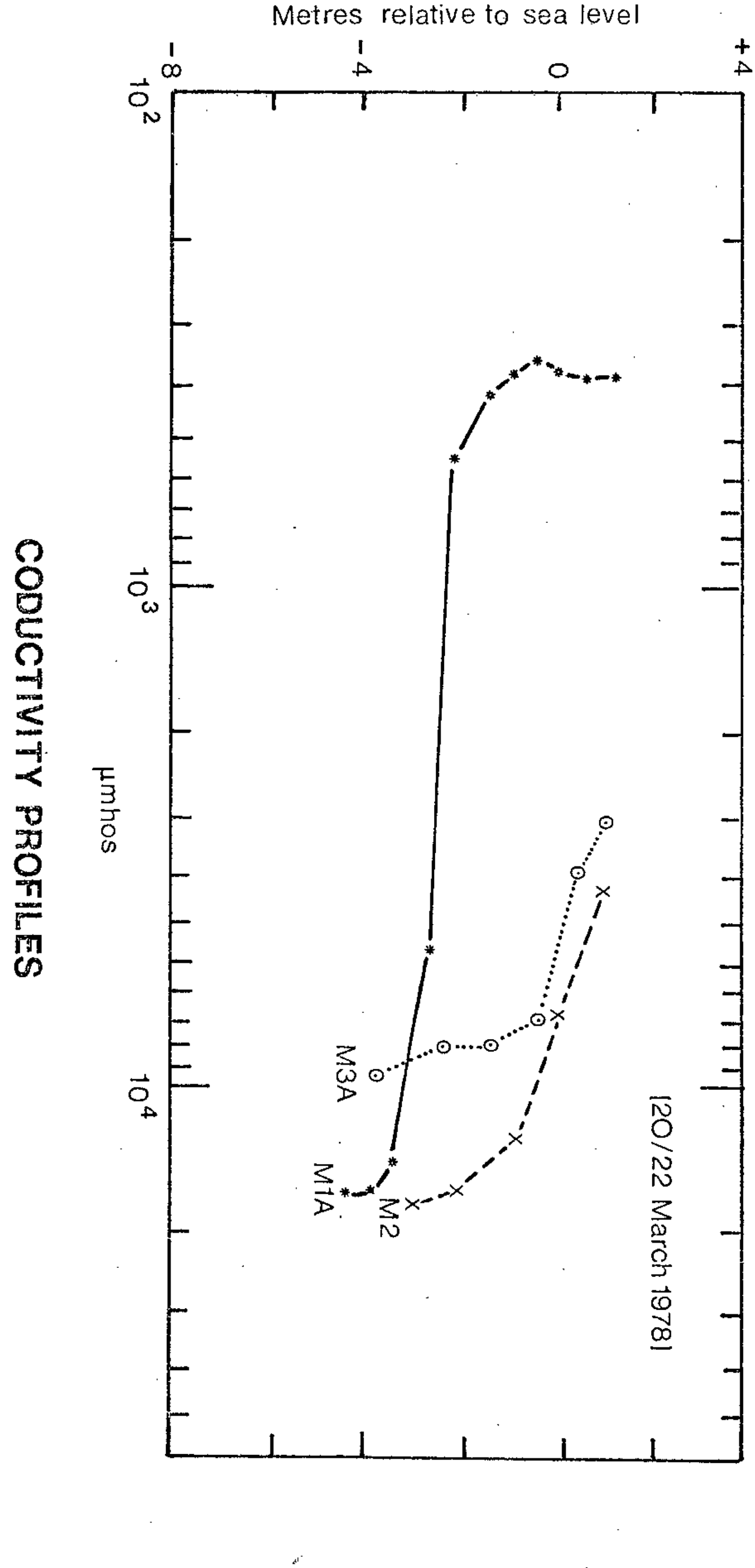
The conductivity profiles for boreholes M1A, M2 and M3A are shown in Figure 4.8. An increase in conductivity with depth was recorded at each site, particularly at M1A where the conductivity increased from 400 μmhos at 2 m below sea level (bsl) to 15000 μmhos at 3 m bsl. The conductivities in the upper 1 m of boreholes M2 and M3A range from 3000 to 8000 μmhos, which is very similar to the conductivities of water in the marsh and would suggest a hydraulic connection between the groundwater and the marsh.

Potable water (less than 2250 μmhos) extends to 2.5 m bsl at borehole M1A but is not present at boreholes M2 and M3A. A second, lower inflection point on the conductivity profiles occurs at 0.5 m bsl at M3A, 1m bsl at M2, and 3.5 m bsl at M3A. This would seem to indicate that the thickness of aquifer with potable water may correspondingly increase beneath the Intendance River. We estimate that potable water underlies an area of some 40000 m^2 south of M2, approximately coincident with the area of seasonal flooding adjacent to the Indendance River (Figure 4.7). Whilst the potable water may occur as a lenticular shape, with the greatest depth beneath the river course, we have assumed a simple wedge shape increasing in thickness from 3 m at M1A to 5.5 m at the southern bedrock boundary. This is based on the extrapolated gradient of the lower inflection point and a conductivity of 2250 μmhos above 1.5 m indicated by the profile at M1A. The average thickness of aquifer with potable water, using a storage coefficient of 10 per cent, is estimated to be 16000 m^3.

From the Ghyben-Hertzberg relationship, we estimate that water of sea water composition should occur at depths of not less than 50 m at M1A to M3A, and at this depth would be within the underlying bedrock. The zone of mixing between fresh groundwater and sea water is therefore about 50 m, similar to that postulated for the other islands.

4.4 GROUNDWATER RESOURCES

The total volume of groundwater in storage within the plateau deposits assuming an average saturated thickness of 22m, is estimated to be nearly 0.5 million m^3. However, the volume of potable groundwater in storage is tentatively estimated to be only 0.02 million m^3, or



Metres relative to sea level
+4
0
-4
-8
10²
10³
10⁴
µmhos
CODUCTIVITY PROFILES
[20/22 March 1978]
M3A
M2
M1A

Figure 4.8

less than 5 per cent of the total groundwater storage, and is restricted to the area of flooding along the Intendance River.

The recharge to the area of potable groundwater is estimated to be 2000 m^3/year which is balanced by a similar outflow of potable groundwater. This volume of recharge represents a very small proportion of the flow in the Intendance River (1.1 million m^3/year). This extremely low recharge rate is probably a consequence of the short reach of river crossing the plateau. The excess of rainfall over evapotranspiration (0.04 million m^3/year) possibly contributes to the marsh. Because of the salinity of the marsh, we cannot distinguish the contribution of rainfall to the recharge.

We would not recommend the development of the very limited potable groundwater in storage, except as a standby supplementary supply to surface water abstraction in periods when demand may exceed the surface water availability.

CHAPTER 5

GROUNDWATER DEVELOPMENT

5.1 GENERAL

Aquifer description

A summary of the main features of the aquifer in each study area is given in Table 5.1. The main aquifer in the low-lying plateau area consists of an unconsolidated sequence of calcareous sands and gravels which have originated from reef debris. The greatest aquifer thickness proved by drilling was about 22 m at Anse Intendance. The base of the main aquifer is generally granite-derived gravelly clays which overlie the bedrock. The aquifer is unconfined; water levels are encountered at shallow depths of about 1 m, giving rise to marshy areas where drainage channels have not been constructed, and are usually less than 2 m above sea level. The water table slopes at a shallow gradient towards the coast and its configuration may alter locally during the year as shallow groundwater is removed by drainage channels. Water levels near the coast show a slight response to tidal loading.

Transmissivities are moderately high, in the range of 400 to 750 m^2/day on an areal basis for the different areas. A representative value for the storage coefficient appears to be 10 per cent.

Groundwater quality

The groundwater is of a suitable quality for drinking purposes, where uninfluenced by saline intrusion. However, concentrations of hydrogen sulphide may locally exceed 1 mg/l, causing the water to have an unpleasant odour, although concentrations can be reduced to acceptable levels by aeration. The presence of hydrogen sulphide may be associated with the areas of marsh.

SUMMARY OF AQUIFER PARAMETERS

	La Digue	Praslin			Intendance
		L'Amitie	Baie Pasquiere	Plaine Hollandaise	
Area (km^2)	1.87	1.27	0.10	0.03	0.022
Main aquifer	CSG	CSG	QG	QG	CSG
Aquifer thickness (m)	15	6	7	1.5	22
Transmissivity (m^2/d)	750	400	70 (?)	160	500
Storage coefficient (%)	8	7	(10)	0.1 (?)	10
Permanent storage					
Total	3.0	0.76	0.07	3750 m^3	0.5
Potable	2.0	0.75	(0.035)	3750 m^3	0.02
Temporary storage	0.33	(0.13)	(0.01)	500 m^3	2500 m^3

Notes: CSG : *Calcareous sands and gravels*

QG : *Quartz gravels*

Storage values are shown in million m^3, unless otherwise indicated

Whilst nitrate levels were quite acceptable at those boreholes from which samples were collected, the additional presence of nitrogen as ammonia suggests recent, but perhaps localised, organic contamination. Due to the filtering effect of unconsolidated deposits, the bacteriological quality is likely to be better than that of surface water.

From the Ghyben-Hertzberg relationship, a water composition similar to that of sea water should occur generally at depths of more than 40 m below sea level, apparently within the underlying bedrock. There is no well-defined saline water interface and the transition from potable to saline water is represented by a zone of diffusion at least 50 m in width. This zone, which is the result of seasonal and tidal water level fluctuations, may be present up to several hundred metres inland.

At Anse Intendance, brackish groundwater appears to be associated with a large marsh area. This marsh may represent a remnant lagoon and we postulate that this plateau area represents an immature stage of development where trapped saline water has not been replaced by rainfall and runoff recharge. Similarly, saline water could also have remained in the clays which commonly underlie the main aquifer, such as at L'Amitie.

Aquifer storage

The seasonal changes in storage and of potable and total water in permanent storage are given in Table 5.1. These estimates have been derived from a programme of drilling and test pumping to obtain aquifer characteristics, a short period of water level observations, and an assessment of water quality. Although reliable hydrological data are not yet available, we have attempted to confirm our estimates of seasonal storage changes by water budget calculations.

5.2 AVAILABILITY AND DEVELOPMENT OF GROUNDWATER

Only limited supplies of groundwater can be developed from the Pasquiere area, due to a limited aquifer extent, and from the Anse Intendance area, where the potable groundwater in storage is small.

Any development of groundwater supplies from these areas would be best suited to a short term, standby role to supplement alternative surface water supplies at times when demands may exceed the availability of surface water.

In contrast the reserves of potable groundwater at La Digue and L'Amitie are capable of controlled development. The following discussion primarily concerns the sustained yield of these two areas.

The practical sustained yield of an aquifer may be defined as the amount of water which can be abstracted annually without undesirable effects for the hydrological conditions existing at the time. It should not exceed the mean annual recharge. Usually, it is limited by the volume of groundwater in storage or the ability of the aquifer to transmit water but in the low lying plateau areas, where sea water is in close proximity, the sustained yield must also take account of the ingress of saline water resulting from abstraction.

It is likely that at present, each study area is in a state of natural balance, with recharge being balanced by a corresponding output of groundwater to the sea. Abstraction will disturb this balance, deleteriously so if water levels were lowered to sea level.

Our study year, 1977/78, appears to be representative of average year hydrological conditions. The assumption that this is so is implicit in our recommendations concerning the availability of groundwater for development. In an average year, direct rainfall on the plateau areas is more important than runoff from the upland catchments as a source of recharge, due to the short reach of rivers in contact with the aquifer. However, an appraisal of the available hydrological data (Annex C) suggests that in years of deficient rainfall the potential availability of water for recharge is restricted mainly to the volume of surface runoff. Consequently, in response to the reduced recharge the saline front will move inland. In future, borehole abstraction will also be superimposed upon this condition.

The plateau areas are characterised by a water table of low elevation and a limited aquifer thickness. A decrease in saturated aquifer thickness of, say, only 1 m in these areas can represent a decrease in transmissivity of as much as 20 per cent, which in turn has a more significant effect on the position of the saline water by reducing the volume of outflow. The extent of the saline intrusion will be a complex function of the volume, temporal and spatial distribution of abstraction, and the change in hydraulic gradient and transmissivity. Consequently, careful management of the aquifer is essential.

The anticipated water supply requirement of La Digue is 0.09 million m^3/year, or about 25 per cent of the annual recharge. At present, non-potable water extends inland within the aquifer for an average distance of about 200 m. To meet the water supply requirement by groundwater abstraction would cause the non-potable water to move inland to 250 m. This would be acceptable compared to the plateau width of 800 m.

We have assumed that the throughflow at L'Amitie is equal to the annual recharge of about 0.13 million m^3. A more direct estimate of throughflow was not possible due to the configuration of the water table at the time of the survey. The recharge estimate itself is based upon only a short period of water level observations and as a consequence, the present position of the inland limit of non-potable water is less certain. As an approximation, a distance of 100 m agrees reasonably well with evidence from conductivity profiles. The situation is further complicated by the occurrence of non-potable water in the underlying clays at shallow depth, which may be trapped sea water.

As an indication of the groundwater availability at L'Amitie, we have selected a limit of 200 m inland as the allowable inland extent of non-potable water. This would allow an abstraction of 0.065 million m^3/year, or 50 per cent of the recharge. Borehole P6 would suitably serve to monitor saline intrusion.

The method of abstraction should be designed to minimize drawdowns thereby preventing a deleterious inland movement of non-potable water. Simple shallow wells to spread the abstraction, situated near to sources of surface water recharge, and also suitably protected against organic contamination, are the most suitable method of abstraction for these circumstances. Well losses and interference between wells should be kept to a minimum and pumping water levels should not fall below sea level.

At La Digue, we suggest that wells should be located in the eastern part of the central area around boreholes LD7, the present source of groundwater supply, and LD2. At L'Amitie, we suggest that abstractions should take place from the area east of the airstrip.

5.3 RECOMMENDATIONS

We recommend the following studies to improve the understanding of the groundwater conditions in the low-lying plateau areas.

1. Our investigation of the L'Amitie area suggests that further exploration of the Grande Anse area would be worthwhile. Our estimates of storage and permeability may also be applicable to similar plateau areas. Therefore, where a water demand is envisaged, an initial estimate of the groundwater availability in such areas could be obtained from shallow seismic enhancement surveys (which do not require explosives) to determine depths to bedrock, resistivity surveys to indicate the occurrence of clays and saline water, and a suitable period of natural water level fluctuations.

2. The variation in annual recharge, and its relationship to changes in the position of the saline front, should be investigated to avoid saline water contamination during abstraction in years of deficient rainfall. This would require an extended period of detailed water level monitoring, using observation boreholes fitted with water level recorders and penetrating a few metres into the aquifer near to rivers and in interfluvial areas.

3. Saline water encroachment is a major constraint on the development potential of the available groundwater resources and a closer understanding of the position, movement and width of the saline water transition zone is essential. Once abstraction begins, it will become necessary to monitor the response of the saline water interface to the rate of abstraction. This could be achieved by careful observations of pumping water levels, the volume and

duration of pumping and also the measurement of salinity levels before and during abstraction in boreholes between the source of abstraction and the saline interface. The boreholes drilled during the investigation could also serve as part of a more extensive network for the observation of salinity levels.

4. The method, design and location of the groundwater abstraction has been discussed earlier in this chapter, where we recommended the use of shallow wells with small drawdowns specifically to avoid saline intrusion.

5. Whilst there is some chemical evidence to suggest organic contamination concentrations are still well within acceptable limits. It would seem advisable to investigate this aspect further by a routine programme of chemical and bacteriological sampling and to make provision for the chlorination of public supplies, but the risk of contamination can be reduced by careful siting of wells. Avoidance of local organic contamination and unacceptable hydrogen sulphide concentrations would perhaps help overcome the local prejudice to groundwater supplies.

6. In the longer term, should groundwater abstraction be developed to augment current surface water supplies, there would be benefit in attempting to increase recharge to the aquifer. This could be achieved most easily by reducing artifical drainage to the sea, although careful management would be required to avoid deleteriously high water tables.

APPENDIX 1

WELL RECORDS

This appendix presents details of the wells constructed during the survey and descriptions of the samples taken during drilling. Also included are the detailed water level measurements, taken over a period of a few hours, on which the Ferris estimates are based. This includes the tide details for Victoria and measurements taken on the tide gauges installed at La Digue and Baïe Pasquiere, Praslin.

Well Description
Area : Plateau, La Digue
Well No: LD1
Grid Ref: $^{3}705$ $^{95}188$

Location: Government well compound

Datum : Top of casing : 3.51 m asl
Ground level : 2.77 m asl

Well Construction

Total depth : 25.0 m
Depth to screen : 0
Screen length : 14.9 m

Pump Test Details

Type	Duration
Step drawdown	300 min
Constant discharge	100 min

Well Characteristics

Pump rate m^3/d	Specific Capacity m^2/d	Formation loss m	Well loss m	Well efficiency %
341	385	0.08	0.80	9
415	323	0.10	1.19	8
475	171	0.11	1.67	7
323	325			

Aquifer Characteristics

Transmissivity : 680 m^2/d

Water Level Observations

Date	SWL (m)	Date	SWL (m)
19.9.77	2.700*	4.4.78	2.136*
13.10.77	2.520*	8.4.78	1.938*
20.1.78	1.608	26.4.78	1.646
10.2.78	1.704*	27.4.78	1.685
14.3.78	1.880	20.5.78	1.763

* pumping LD7 about 10 m away.

Well Description
Area : La Reunion, La Digue
Well No: LD2
Grid Ref: $^{3}703\ ^{95}188$

Location : 150 m west of Government well compound

Datum: Top of casing : 3.71m asl
Ground level : 2.98 m asl

Well Construction

Total depth : 32.1 m
Depth to screen : 0
Screen length : 14.7 m

Pump Test Details

Type	Duration
Constant discharge	1440 min
Step drawdown	720 min

Well Characteristics

Pump rate m^3/d	Specific Capacity m^2/d	Formation loss m	Well loss m	Well efficiency %
219	540	0.23	0.17	57
328	456	0.34	0.39	47
419	363	0.43	0.63	41
472	240	0.49	0.81	38
448	259			

Aquifer Characteristics

Transmissivity : 570, 180 m^2/d; 960 m^2/d

Water Level Observations

Date	SWL(m)	Date	SWL(m)
19.9.77	2.799	4.4.78	2.193
20.10.77	2.301	6.4.78	2.043
13.12.77	2.514	8.4.78	2.018
20.1.78	1.680	12.4.78	2.156
10.2.78	1.604	20.5.78	1.778
14.3.78	1.922		

Well Description
Area: La Reunion, La Digue
Well No: LD3
Grid Ref: $^{3}701$ $^{95}189$

Location: 200 m east of La Digue Social Centre

Datum : Top of casing : 3.27 m asl
Ground level : 2.98 m asl

Well Construction

Total depth	:	29.0 m
Top of screen	:	0
Screen length	:	14.8 m

Pump Test Details

Type	Duration
Constant discharge	1530 min
Step drawdown	525 min

Well Characteristics

Pump rate m^3/d	Specific capacity m^2/d	Formation loss m	Well loss m	Well efficiency %
276	814	0.32	0.03	92
381	784	0.44	0.05	89
424	695	0.49	0.07	88
430	785			

Aquifer Characteristics

Transmissivity : 520 m^2/d, 460 m^2/d

Water Level Observations

Date	SWL(m)	Date	SWL(m)
19.9.77	2.397	4.4.78	1.846
20.10.77	1.732	6.4.78	1.718
13.12.77	2.149	8.4.78	1.677
20.1.78	1.372	13.4.78	1.756
10.2.78	1.295	14.4.78	1.807
14.3.78	1.607	20.5.78	1.440

Well Description
Area : La Reunion, La Digue
Well No : LD4
Grid Ref: $^{3}699$ $^{95}189$

Location : By La Digue Social Centre

Datum : Top of casing : 2.99 m asl
Ground level : 2.39 m asl

Well Construction

Total depth : 22.0 m
Depth to screen: 0
Screen length : 17.1 m

Pump Test Details

Not tested

Water Level Observations

Date	SWL (m)	Date	SWL (m)
7.10.77	1.952	4.4.78	1.778
20.10.77	1.477	5.4.78	1.735
13.12.77	1.866	6.4.78	1.634
20.1.78	1.614	8.4.78	1.672
10.2.78	1.539	19.4.78	1.639
14.3.78	1.633	20.5.78	1.751

Well Description
Area : L'Union, La Digue
Well No: LD5
Grid Ref: $^{3}700\ ^{95}180$

Location: 300 m from the sea

Datum : Top of casing : 3.51 m asl
Ground level : 2.86 m asl

Well Construction

Total depth : 20.0 m
Depth to screen: 5.0; 13.6 m
Screen length : 5.7; 2.8 m

Pump Test Details

Type	Duration
Constant discharge	327 min
Constant discharge	1080 min

Well Characteristics

Pump rate m^3/d	Specific capacity m^2/d
197	286

Aquifer Characteristics

Transmissivity: 800 m^2/d

Water Level Observations

Date	SWL(m)	Date	SWL(m)
20.10.77	1.936	4.4.78	2.197
13.12.77	2.404	8.4.78	2.094
20.1.78	1.819	15.4.78	2.182
10.2.78	1.660	19.4.78	1.928
14.3.78	2.003		

Well Description
Area : L'Union, La Digue
Well No : LD5A
Grid Ref: $^{3}699\ ^{95}180$

Location : 4.90 m from LD5

Datum : Top of casing : 3.24 m asl
Ground level : 2.99 m asl

Well Construction

Total depth	:	8.5 m
Depth to screen	:	5.5 m
Screen length	:	2.8 m

Pump Test Details

Type	Duration
Constant discharge	327 min
Constant discharge	1080 min

Aquifer Characteristics

Storage Coefficient : 2.0×10^{-2}
2.1×10^{-2}
(Thies)

Transmissivity : 990 m^2/d, 1690 m^2/d
1000 m^2/d (Thies)

Water Level Observations

Date	SWL (m)
20.10.77	1.671
13.12.77	2.132
9.4.78	1.831
15.4.78	1.910

Well Description

Area : La Passe, La Digue
Well No : LD6
Grid Ref: ^{3}704 ^{95}194

Location : 250 m east of La Passe Police Station

Datum : Top of Casing : 3.59 m asl
Ground Level : 2.76 m asl

Well Construction

Total depth : 16.0 m
Depth to screen : 4.8 m
Screen length : 5.8 m

Pump Test Details

Type	Duration
Constant discharge	2760 min

Water Level Observations

Date	SWL(m)	Date	SWL(m)
20.10.77	1.889	4.4.78	2.179
13.12.77	2.431	5.4.78	2.155
20.1.78	1.631	8.4.78	2.017
10.2.78	1.682	17.4.78	1.850
14.3.78	1.968		

Well Description
Area : La Passe, La Digue
Well No : LD6A
Grid Ref: $^{3}703\ ^{95}194$

Location: 4.85 m from LD6

Datum : Top of casing : 3.52 m asl
Ground level : 2.67 m asl

Well Construction

Total depth : 9.0 m
Depth to screen : 5.7 m
Screen length : 2.9 m

Pump Test Details

Type	Duration
Constant discharge	2760 min

Aquifer Characteristics

Storage coefficient: 1×10^{-3}

Transmissivity: 850, 580 m^2/d

Water Level Observations

Date	SWL (m)	Date	SWL (m)
13.12.77	2.368	5.4.78	2.094
20.1.78	1.568	8.4.78	1.952
10.2.78	1.616	17.4.78	1.787
14.3.78	1.903		
4.4.78	2.113		

Well Description
Area: Plateau, La Digue
Well No: LD7
Grid Ref: ^{3}705 ^{95}189

Location : Government well compound, 9.90 m from LD1

Datum : Top of casing : 3.51 m asl
Ground level :

Well Construction:

Total depth : 7 m

Depth to screen : 0

Screen length : 7 m

Pump Test Details

Type	Duration
Step drawdown	720 min
Constant discharge	1710 min

The pipe well is constructed of 4 m of porous concrete and 3 m of slotted PVC pipe

Well Description:
Area : Plateau, La Digue
Well No: LD8
Grid Ref: $^{3}705^{95}187$

Location : Government well compound, 11.37 m from LD1

Datum: Top of casing:
Ground level :

Well Construction:

Total depth: 4 m
Depth to screen: 2 m
Screen length: 2 m

Pump Test Details:

Type	Duration
Constant discharge	450 min
Constant discharge	840 min

The well is constructed of glass fibre with a double slotted screen section

Well Description:

Area : Praslin, Pasquiere
Well No : P1
Grid Ref: $^{3}581$ $^{95}234$

Location : Rear of Baie Pasquiere plateau

Datum : Top of casing : 1.71 m asl
Ground level : 1.02 m asl

Well Construction:

Total depth : 15.0 m
Depth to screen : 2.8 m
Screen length : 5.2. m

Pump Test Details

Type	Duration
Constant Discharge	1155 min

Well Characteristics

Pump rate m^3/d	Specific Capacity m^2/d
309	146

Aquifer Characteristics

Transmissivity: 140 m^2/d, 100 m^2/d

Water Level Observations

Date	SWL(m)	Date	SWL(m)
13.12.77	1.452	4.5.78	1.135
20.1.78	1.198	5.5.78	1.168
10.2.78	1.207	6.5.78	1.170
15.3.78	1.257	16.5.78	1.310
2.5.78	1.055		

Well Description

Area : Praslin
Well No : P2
Grid Ref: $^{3}585$ $^{95}223$

Location : Plaine Hollandaise by the Pasquiere track

Datum : Top of casing : 112.16 m asl
Ground level : 111.47 m asl

Well Construction

Total depth : 10.3 m
Depth to screen : 0
Screen length : 8.0 m

Pump Test Details

Type	Duration
Constant discharge	425 min

Well Characteristics

Pump rate m^3/d	Specific Capacity m^2/d
131	113

Aquifer Characteristics

Transmissivity: 60; 180 m^2/d

Water Level Observations

Date	SWL (m)
20.1.78	3.481
10.2.78	3.468
17.5.78	3.474
18.5.78	3.507

Well Description

Area : Praslin
Well No : P3
Grid Ref: $^{3}586\ ^{95}222$

Location: Plaine Hollandaise by the Salazie track

Datum: Top of casing: 109.14 m asl
Ground level : 108.52 m asl

Well Construction

Total depth : 9.0
Depth to screen : 0
Screen length : 5.0

Pump Test Details

Insufficient water to test

Water Level Observations

Date	SWL (m)
20.1.78	1.212
10.2.78	1.200
15.3.78	1.307
3.5.78	1.186
15.5.78	1.227

Well Description

Area : Praslin, L'Amitie
Well No : P4
Grid Ref: $^{3}552\ ^{95}228$

Location: Near PWD quarry

Datum: Top of casing : 2.10 m asl
Ground level : 1.58 m asl

Well Construction

Total Depth	:	16.0 m
Depth to screen	:	0; 13.2 m
Screen length	:	7.5; 2.8 m

Pump Test Details

Type	Duration
Constant discharge	552 min
Constant discharge	340 min

Well Characteristics

Pump rate m^3/d	Specific capacity m^2/d
344	269
367	308

Aquifer Characteristics

Transmissivity: 360 m^2/d, 820 m^2/d

Water Level Observations

Date	SWL (m)	Date	SWL (m)
20.1.78	1.088	7.5.78	0.972
10.2.78	1.048	13.5.78	1.090
15.3.78	1.260	14.5.78	1.123
20.4.78	0.932		
30.4.78	0.833		

Well Description

Area : Praslin, L'Amitie
Well No : P5
Grid Ref: $^{3}550$ $^{95}226$

Location: North side of airstrip

Datum: Top of casing : 2.33 m asl
Ground level : 1.73 m asl

Construction Details

Total depth : 20.9 m
Depth of screen : 0; 13.7 m
Screen length : 5.1; 5.7 m

Pump Test Details

Type	Duration
Constant discharge	1560 min

Well Characteristics

Pump rate m^3/d	Specific capacity m^2/d
262	130

Aquifer Characteristics

Transmissivity : 120 m^2/d; 180 m^2/d

Water Level Observations

Date	SWL (m)	Date	SWL (m)
10.2.78	1.160	7.5.78	1.099
15.3.78	1.425	13.5.78	1.228
20.4.78	1.058	14.5.78	1.277
30.4.78	1.009		
2.5.78	0.863		

Well Description

Area : Praslin, L'Amitie
Well No : P6
Grid Ref: $^{3}548$ $^{95}225$

Location: Between Police Training School and the Airstrip

Datum: Top of casing : 2.56 m asl
Ground level : 2.01 m asl

Well Construction

Total depth : 19.5 m
Depth to screen : 0; 13.4 m
Screen length : 4.8; 2.8 m

Pump Test Details

Type	Duration
Constant discharge	1260 min

Well Characteristics

Pump rate m^3/d	Specific capacity m^2/d
263	131

Aquifer Characteristics

Transmissivity: 330; 430 m^2/d

Water Level Observations

Date	SWL(m)
23.2.78	1.158
15.3.78	1.204
20.4.78	0.867
1.5.78	0.832
7.5.78	0.872
14.5.78	1.012
15.5.78	1.041

Well Description

Area : Praslin, L'Amitie
Well No : P7
Grid ref: $^{3}544$ $^{95}224$

Location: West side of creek by Police Training School

Datum: Top of casing : 2.51 m asl
Ground level : 1.96 m asl

Well Construction

Total depth : 7.5 m
Depth to screen : 0
Screen length : 7.5 m

Pump Test Details

Not tested

Water Level Observations

Date	SWL (m)
1.5.78	1.973
2.5.78	1.849
7.5.78	2.007
14.5.78	2.106

Well Description
Area: Anse Intendance, Mahe
Well: M1
Grid Ref: $^{3}341^{94}713$

Location: adjacent to the hotel access road

Datum: Top of casing: 2.31 m asl
Ground level : 1.73 m asl

Construction Details

Total depth: 23.6 m
Depth to screen: 0
Screen length : 3.7 m

Pump Test Details

Type	Duration
Constant discharge	1050 min

Aquifer Characteristics

Storage coefficient: $7x10^{-3}$, $4x10^{-3}$

Transmissivity: 5230, 670 m^2/d

Water Level Observations

Date	SWL(m)	Date	SWL(m)
26.7.77	1.217	29.9.77	1.328
4.8.77	1.197	12.10.77	1.221
18.8.77	1.114	21.10.77	1.050
24.8.77	1.112	25.10.77	1.136
26.8.77	1.119	27.10.77	1.149
29.8.77	1.090	3.11.77	0.922
31.8.77	1.098	24.11.77	1.188
5.9.77	1.144	9.12.77	0.939
12.9.77	1.223	22.3.78	0.927
16.9.77	1.258	30.5.78	1.127
23.9.77	1.335		

Well Description
Area: Anse Intendance, Mahe
Well : M1A
Grid ref: $^{3}341^{94}712$

Location: 6.64 m from well M1

Datum : Top of casing : 2.45 m asl
Ground level : 1.70 m asl

Construction Details
Total depth: 8.5 m
Depth to screen: 2.3 m
Screen length : 5.7 m

Pump Test Details

Type	Duration
constant discharge	1050 min
step drawdown	720 min

Well Characteristics

Pump rate m^3/d	Specific capacity m^2/d	Formation loss m	Well loss m	Well efficiency %
207	692	0.32	0.01	97
302	673	0.47	0.02	95
376	652	0.58	0.04	94
438	635	0.68	0.05	93
486	620			

Aquifer Characteristics

Storage coefficient

Transmissivity : 4210 m^2/d

Water Level Observations

Date	SWL(m)
24.11.77	1.366
3.3.78	1.185
22.3.78	1.058
24.3.78	1.042
30.5.78	1.313

Well Description
Area: Anse Intendance, Mahe
Well: M2
Grid Ref: $^{3}340^{9}{}^{4}712$

Location: Adjacent to marsh outlet

Datum: Top of casing: 2.30 m asl
Ground level: 1.71 m asl

Construction Details

Total depth: 23.9 m

Depth to screen: 0

Screen length: 4.9 m

Pump Test Details

Not tested

Water Level Observations

Date	SWL(m)	Date	SWL(m)
1.8.77	1.193	16.9.77	1.281
4.8.77	1.228	23.9.77	1.363
18.8.77	1.123	29.9.77	1.370
24.8.77	1.118	25.10.77	1.181
26.8.77	1.127	27.10.77	1.188
29.8.77	1.097	3.11.77	0.923
31.8.77	1.103	9.12.77	0.956
5.9.77	1.153	21. 3.78	0.888
12.9.77	1.239	30. 5.78	1.171

Well Description

Area : Anse Intendance, Mahe
Well : M3
Grid Ref: $^{3}339^{94}713$

Location: adjacent to marsh

Datum: Top of casing : 3.90 m asl
Ground level : 3.24 m asl

Construction Details

Total depth : 20.2 m
Depth to screen : O
Screen length : 4.4 m

Pump Test Details

Type	Duration
Constant discharge	2880

Aquifer Characteristics

Storage Coefficient : 7.3×10^{-2}, 11.5×10^{-2} Transmissivity : 580, 314 m^2/d

Water Level Observations

Date	SWL(m)	Date	SWL(m)
18.8.77	2.839	30.9.77	3.058
22.8.77	2.799	9.10.77	3.078
26.8.77	2.823	25.10.77	2.617
29.8.77	2.799	27.10.77	2.650
5.9.77	2.852	3.11.77	2.569
12.9.77	2.934	2.12.77	2.876
16.9.77	2.968	9.12.77	2.592
23.9.77	3.027	3.3.78	2.462
29.9.77	3.055	27.3.78	2.412

Well Description
Area: Anse Intendance, Mahe
Well: M3A
Grid Ref: $^{3}339^{94}712$

Location: 4.92 m from well M3

Datum: Top of casing: 3.91 m asl
Ground level: 3.24 m asl

Construction Details

Total Depth: 8.0 m

Depth to screen: 2.8 m

Screen length: 5.2 m

Pump Test Details

Type	Duration
Constant Discharge	2906 min
Step drawdown	395 min

Well characteristics

Pump rate m^3/d	Specific Capacity m^2/d	Formation loss m	Well loss m	Well efficiency %
274	982	0.22	0.06	79
365	886	0.30	0.10	74
438	833	0.36	0.15	71
473	686			

Aquifer Characteristics

Storage Coefficient: Transmissivity: 530, 5400; 1170 m^2/d

Water Level Observations

Date	SWL (m)
2.12.77	2.872
3. 3.78	2.451
21.3.78	2.482
27.3.78	2.410

LA DIGUE

Generalized Borehole log Descriptions

Depth below ground level	LD1	Depth below ground level	LD4
0 - 3.0	m cal s	0 - 2.0	m cal s
3.0 - 4.0	f cal gr	2.0 - 3.0	m cal s/c cal gr
4.0 - 4.8	cl/f cal gr	3.0 - 5.0	m cal s
4.8 - 13.0	mq gr/f cal s	5.0 -12.0	m cal s/m cal gr
13.0 - 18.0	mq gr	12.0 -14.0	c cal s
18.0 - 24.4	mq gr/fel	14.0 -16.0	m cal gr/cream cl
24.4 - 25.0	mq gr/granite	16.0 -21.5	m q gr/fel
25.0	granite	21.5-22.0	mq gr/granite
		22.0	granite

	LD2		LD5
0-4.0	silt/f cal s		
4.0-5.2	f cal s	0-5.0	c cal s
5.2-10.0	f cal gr/f cal s	5.0-8.0	c cal s/m cal gr
10.0-14.0	m cal gr	8.0-11.0	c cal gr
14.0-15.0	brown cl/f cal gr	11.0-14.0	m cal gr/m cals
15.0-18.0	grey cl/f cal gr	14.0-16.0	m q gr
18.0-32.0	cream cl/mq gr	16.0-19.0	cream cl/mq gr
32.0-32.1	cream cl/mq gr granite	19.0-19.9	m q gr/granite
32.1	granite	19.9-20.0	granite

	LD3		LD6
0-3.0	m cal s	0-4.0	m cal s
3.0-13.8	m cal gr	4.0-10.0	m cal s/m cal gr
13.8-14.0	m cal gr/q gr	10.0-14.0	cream cl/ m q gr
14.0-19.0	m q gr	14.0-15.5	m q gr
19.0-28.8	cream cl/m q gr	15.5-16.0	m q gr/granite
28.8-29.0	cream cl/m q gr granite	16.0	granite
29.0	granite		

Key:

s	sand	cal	calcareous	f	fine grained
gr	gravel	q	quartzitic	m	medium grained
cl	clay	fel	feldspathic	c	coarse grained

PRASLIN

Generalized Borehole Log Descriptions

P1

Depth below ground level	
0-0.5	
0.5-2.0	m q gr
2.0-6.0	m q gr/f q s
6.0-8.0	c q gr
8.0-10.0	f q gr/orange cl
10.0-13.0	f q gr/grey cl
13.0-14.9	grey cl
14.9-15.0	syenite pebbles
15.0	syenite

P2

Depth below ground level	
0-5.0	red earth/ m q gr
5.0-7.0	m q gr/red earth
7.0-8.0	m q gr
8.0-10.0	orange fel cl/m q gr
10.0-10.3	m q gr/granite
10.3	granite

P3

Depth below ground level	
0-2.0	brown silt/m q gr
2.0-3.0	m q gr
3.0-7.0	cream cl/m q gr
7.0-8.9	cream orange fel cl/m q gr
8.9-9.0	m q gr/granite
9.0	granite

P4

Depth below ground level	
0-4.5	m cal s
4.5-6.0	m cal gr/m cal s
6.0-7.0	m cal q gr/c cal s
7.0-15.9	red earth/m q gr
15.9-16.0	m q gr/granite
16.0	granite

P5

Depth below ground level	
0-3.0	m cal s
3.0-5.0	m cal s/m cal gr
5.0-6.0	c cal gr
6.0-7.0	c cal gr/cream cl
7.0-10.0	cream cl
10.0-20.0	m q gr
20.0-20.9	m q gr/granite
20.9	granite

P6

Depth below ground level	
0-2.0	m cal s
2.0-3.0	m cal gr
3.0-7.0	m cal s
7.0-15.0	cream cl/f cal gr
15.0-15.6	black cl
15.6-18.7	m q gr
18.7-19.5	m q gr/dolerite
19.5	dolerite

P7

Depth below ground level	
0-3.0	c cal s
3.0-5.0	m cal gr
5.0-7.5	dolomitized coral/ m cal gr

MAHE

Generalized Borehole Log Descriptions

Depth below ground level	
	M1
0-0.8	silt
0.8-2.2	m cal gr/cl
2.2-3.0	coral
3.0-4.5	m cal s
4.5-6.3	coral
6.3-8.0	m cal s
8.0-10.7	coral
10.7-18.2	m cal s/c cal gr
18.2-21.6	coral
21.6-23.5	m q gr
23.5-23.6	m q gr/granite
23.6	granite
	M2
0-0.8	silt
0.8-1.0	c cal gr
1.0-5.1	coral
5.1-8.1	m cal gr
8.1-11.4	coral
11.4-15.0	m cal gr
15.0-23.6	coral
23.6-23.9	c q s/granite
23.9	granite
	M3
0-3.0	f cal s
3.0-5.0	m cal s/m cal gr
5.0-13.0	m cal gr
13.0-14.0	m cal s
14.0-20.0	m cal gr
20.0-20.2	m q gr/granite
20.2	granite

WATER LEVEL FLUCTUATIONS

LA DIGUE

Date: 5.4.1978

Time	LD4	LD6	LD6A	Tide Gauge	Time	LD4	LD6	LD6A	Tide Gauge
0943	1.735				1400				
0951		2.155	2.094		1405				
0956				3.052	1412	1.764			
1003	1.737				1432	1.762			
1010			2.092		1440		2.162	2.098	
1016				3.067	1446				2.149
1021	1.738				1452	1.764			
1029		2.156	2.092		1459		2.163	2.098	
1034				2.984	1504				2.132
1039	1.741				1510	1.764			
1048		2.157	2.092		1522		2.164	2.101	
1054				2.960	1529				2.208
1059	1.743				1534	1.765			
1107		2.156	2.092		1559		2.166	2.102	
1112				2.891	1604				2.148
1117	1.745				1609	1.759			
1126		2.157	2.093		1628		2.164	2.099	
1131				2.828	1633				2.180
1137	1.747				1640	1.757			
1151	1.749				1700		2.164	2.100	
1203		2.158	2.093		1706				2.253
1208				2.691	1724		2.166	2.102	
1214	1.752				1750	1.749			
1222		2.158	2.093		1836	1.743			
1227				2.615	1847		2.167	2.102	
1233	1.754				1852				2.612
1241		2.158	2.094						
1247				2.536					
1253	1.757								
1319	1.758								
1331		2.160	2.096						
1337				2.361					
1342	1.760								
1352	1.763								

WATER LEVEL FLUCTUATIONS

LA DIGUE

Date: 6.4.78

Time	LD2	LD3	LD4	Tide Gauge		LD2	LD3	LD4	Tide Gauge
0848				3.064	1323			1.648	
0855			1.633		1326		1.708		
0900		1.724			1328	2.032			
0905	2.048				1332			1.648	
0914				3.057	1413			1.652	
0920			1.633		1416		1.706		
0924		1.722			1419	2.030			
0927	2.047				1428				2.200
0937				3.107	1441				2.154
0943			1.633		1608			1.652	
0946		1.720			1620				1.968
0950	2.045				1640			1.649	
1000				3.103	1643		1.699		
1009			1.634		1646	2.027			
1012		1.718			1659				2.030
1015	2.043				1706			1.646	
1027				3.099	1728			1.644	
1033			1.637		1741			1.642	
1055			1.636		1754				2.176
1057		1.715			1803	2.024			
1100	2.040				1808		1.698		
1107				3.038	1841			1.638	
1117	2.038				1856			1.634	
1120		1.714			2106				2.968
1124			1.638		2118			1.629	
1135				2.958	2219			1.628	
1154				2.870	2234				3.108
1202	2.037								
1205		1.713							
1208			1.643						
1238			1.646						
1241		1.710							
1243	2.036								
1247			1.647						

WATER LEVEL FLUCTUATIONS

LA DIGUE

Date: 9.4.78

Time	LD5A	Time	LD5A
1107	1.830	1450	1.833
1115	1.831	1502	1.833
1125	1.831	1519	1.834
1135	1.831	1530	1.834
1147	1.831	1545	1.834
1157	1.831	1557	1.835
1215	1.831	1610	1.836
1230	1.832	1622	1.836
1240	1.831	1629	1.835
1252	1.832	1641	1.834
1309	1.832	1659	1.836
1320	1.832	1720	1.835
1329	1.832	1730	1.835

Victoria Tides

0542	1.59	1758	1.89
1142	0.49		

WATER LEVEL FLUCTUATIONS

PASQUIERE PRASLIN

Date: P3 3.5.78
P1 6.5.78

Time	P1	Tide Gauge	P3	Time	P1	Tide Gauge	P3
0920			1.185	1412		1.181	
0930			1.185	1415	1.175		1.188
			1.186	1430	1.174		1.188
1000			1.186	1434		1.084	
			1.186	1445	1.173		1.188
1030	1.170		1.186	1457		0.992	
1035		2.077		1500	1.172		1.188
1043		2.034		1515	1.171		1.188
1045	1.171		1.186	1519		0.870	
1100	1.172		1.186	1527		0.911	
1104		2.011		1530	1.169		1.188
1115	1.173		1.186	1545	1.168		
1120		1.983		1549		0.870	
1127		1.994		1557		0.841	
1130	1.173		1.186	1600	1.166		
1145	1.174		1.186	1615	1.165		
1149		1.834		1620		0.860	
1157		1.784		1627		0.856	
1200	1.174		1.187	1630	1.164		
1215	1.174		1.187	1645	1.162		
1230	1.175		1.187	1649		0.838	
1236		1.651		1657		0.845	
1245	1.175		1.187	1700	1.162		
1247		1.600		1715	1.162		
1300	1.175		1.188	1720		0.900	
1315	1.175		1.188	1727		0.866	
1319		1.445		1730	1.163		
1327		1.358		1745	1.163		
1330	1.175		1.188	1750		0.984	
1345	1.175		1.188	1800	1.163		
1400	1.176		1.188	1805		1.022	
1404		1.218		1815	1.164		

Tides for Victoria	6.5.78	0413	1.40	1628	1.80
		1040	0.49	2343	0.40

WATER LEVEL FLUCTUATIONS

L'AMITIE PRASLIN

Date: P4, P5 30.4.78

P6, P7 1.5.78

Time	P4	P5	P6	P7
0939		1.009		
0945	0.833	1.009		1.972
0948			0.831	
1000	0.833	1.009	0.832	1.973
	0.835	1.010	0.833	1.973
	0.837	1.011	0.835	1.973
	0.838	1.011	0.837	1.973
1100	0.839	1.012	0.837	1.973
	0.840	1.013	0.837	1.973
	0.841	1.015	0.837	1.973
	0.842	1.015	0.838	1.972
1200	0.843	1.015	0.839	1.972
	0.845	1.017	0.840	1.971
	0.847	1.017	0.828	1.969
	0.848	1.018	0.829	1.968
1300	0.849	1.019	0.830	1.968
	0.851	1.020	0.832	1.967
	0.851	1.020	0.836	1.967
	0.852	1.021	0.839	1.966
1400	0.854	1.022	0.841	1.966
		1.022	0.842	1.965
		1.022	0.844	1.966
	0.857		0.846	1.966
1500		1.024	0.847	1.967
	0.858	1.024	0.848	1.968
		1.026	0.849	1.968
		1.027	0.850	1.969
1600	0.861	1.028	0.851	1.970
		1.029	0.851	1.971
	0.866	1.030	0.851	1.972
		1.031	0.852	1.973
1700		1.031	0.852	1.974
		1.032		1.976
				1.977
1800				1.970
1815				1.971

1.5.78 rain between 12.00 and 12.30
17.30 and 17.55

Victoria tide

30.4.78	0423	0.70	1603	0.79
	1024	1.31	2238	1.49
1.5.78	0546	0.70	1800	0.90
	1204	1.30		

WATER LEVEL FLUCTUATIONS

ANSE INTENDANCE, MAHE

Date: M1A 22.3.78

M2A and M3A 21.3.78

time	M1A	M2	M3A
1000	1.056	0.888	2.482
	1.056	0.888	2.482
	1.056	0.888	2.482
	1.057	0.888	2.482
1100	1.057	0.888	2.482
	1.057	0.888	2.482
	1.057	0.888	2.482
	1.057	0.889	2.482
1200	1.057	0.889	2.482
	1.058	0.889	2.482
	1.058	0.889	2.482
	1.058	0.889	2.482
1300	1.058	0.889	2.482
	1.058	0.889	2.482
	1.059	0.890	2.482
	1.059	0.890	2.482
1400	1.059	0.890	2.482
	1.059	0.890	2.482
	1.060	0.890	2.482
	1.060	0.891	2.482
1500	1.060	0.891	2.482
	1.060	0.891	2.482
	1.060	0.891	2.482
	1.060	0.891	2.482
1600	1.061	0.891	2.482

Tides for Victoria

	HT		LT	
21.3.78	(0247	1.58	0927	0.79
	(1532	1.49	2115	0.91
	(0328	1.71	1602	1.58
	(0955	0.79	2157	0.79

APPENDIX 2

PUMPING TEST RESULTS

A total of 14 constant rate and 6 step drawdown tests were carried out at 14 sites in the 4 study areas. The drawdown data are presented in this appendix together with other relevant details.

Well No. LD1
Type of test: Constant Discharge
Elevation of datum: 3.51
Screen: 0 - 14.9 m
Observation well distance: 9.9 m
Date and time of test start: 0909 on 20th October 1977

Location: Gov't Compound La Digue
G.R. $^{3}705^{95}188$
SWL LD1 (pumped) 1.945 LD7 (obs.) 1.534
Pump set 4.6 m
Pump rate: 323 m^3/d

Time from start of test min	LD1 Drawdown m	LD7 Drawdown m
1	0.757	
2	0.926	
3	0.848	0.004
4	0.859	0.005
5	0.881	0.006
6	0.884	0.009
7	0.878	0.011
8	0.880	0.013
9	0.882	0.014
10	0.896	0.014
12	0.907	0.015
14	0.916	0.018
16	0.914	0.020
18	0.930	0.022
20	0.923	0.024
22	0.929	0.025
24	0.932	0.027
26	0.937	0.029
28	0.936	0.031
30	0.939	0.033
35	0.946	0.035
40	0.964	0.038
45	0.963	0.040
50	0.973	0.043
55	0.968	0.045
60	0.971	0.047
70	0.982	0.051
80	0.987	0.054
90	0.985	0.058
100	1.001	0.060

Note: well plugged at 6.1 m

Well No. LD1
Type of test: Stepdrawdown
Elevation of datum: 3.51 m asl
Screen: 0 - 14.9

Location: Govt. Well compound La Digue
G.R. $^{3}705^{95}188$
SWL 2.029
Pump set 4.6 m
Pump rates: 341, 415, 475 m^3/d

Date and time of test start: 1010 on 19th October 1977

Time from start of test min	Drawdown m	Time from start of test min	Drawdown m	Time from start of test min	Drawdown m
1	0.130	104	1.157	207	1.625
2	1.065	105	1.155	208	1.627
3	0.730	106	1.158	209	1.645
4	0.753	107	1.168	210	1.649
5	0.768	108	1.164	212	1.666
6	0.779	109	1.181	214	1.684
7	0.789	110	1.226	216	1.667
8	0.785	112	1.169	218	1.668
9	0.789	114	1.191	220	1.690
10	0.792	116	1.186	222	1.699
12	0.804	118	1.199	224	1.682
14	0.816	120	1.221	226	1.713
16	0.820	122	1.225	228	1.694
18	0.827	124	1.222	230	1.727
20	0.829	126	1.223	235	1.732
22	0.831	128	1.227	240	1.725
24	0.833	130	1.222	245	1.710
26	0.849	135	1.234	250	1.710
28	0.850	140	1.235	255	1.729
30	0.848	145	1.246	260	1.747
35	0.869	150	1.236	270	1.759
40	0.871	155	1.301	280	1.789
45	0.835	160	1.264	290	1.813
50	0.869	170	1.260	300	1.783
55	0.868	180	1.285		
60	0.867	190	1.283		
70	0.869	200	1.286		
80	0.867	201	1.555		
90	0.881	202	1.569		
100	0.885	203	1.602		
101	1.129	204	1.605		
102	1.148	205	1.598		
103	1.153	206	1.625		

Note: well plugged at 6.1 m

Well No. LD2
Type of test: Constant Discharge
Elevation of datum: 3.71 m asl
Screen: 0-14.7 m

Location: La Reunion, La Digue
G.R. $^{3}703^{95}188$
SWL 2.079
Pump set: 4.5 m
Pump rate: 448 m^3/d

Date and time of test start: 09.45 11 April 1978

Time from start of test	drawdown m	Time from start of test	drawdown m	Time from start of test	drawdown m	Time from start of test	drawdown m
1	0.591	165	1.745	1170	2.124	1350	0.107
2	0.659	180	1.751	1200	2.113	1365	0.100
				pump stopped - recovery			
3	0.791	210	1.791	1201	0.403	1380	0.093
4	0.899	240	1.934	1202	0.379	1395	0.090
5	0.936	270	1.923	1203	0.364	1410	0.086
6	0.979	300	1.933	1204	0.353	1425	0.081
7	1.012	330	1.932	1205	0.343	1440	0.078
8	1.039	360	1.955	1206	0.337		
9	1.058	390	2.008	1207	0.330		
10	1.079	420	2.019	1208	0.322		
12	1.099	450	2.046	1209	0.316		
14	1.136	480	2.054	1210	0.312		
16	1.160	510	2.044	1212	0.301		
18	1.171	540	2.054	1214	0.293		
20	1.192	570	2.049	1216	0.285		
22	1.221	600	2.065	1218	0.277		
24	1.242	630	2.079	1220	0.270		
26	1.245	660	2.075	1222	0.264		
28	1.253	690	2.070	1224	0.258		
30	1.283	720	2.083	1226	0.252		
35	1.316	750	2.070	1228	0.245		
40	1.342	780	2.100	1230	0.240		
45	1.372	810	2.063	1235	0.229		
50	1.393	840	2.064	1240	0.215		
55	1.409	870	2.059	1245	0.206		
60	1.430	900	2.083	1250	0.197		
70	1.448	930	2.110	1255	0.187		
80	1.492	960	2.085	1260	0.177		
90	1.542	990	2.100	1270	0.162		
100	1.561	1020	2.096	1280	0.151		
110	1.581	1050	2.090	1290	0.140		
				1300	0.133		
120	1.603	1080	2.144	1310	0.127		
135	1.683	1110	2.103	1320	0.119		
150	1.723	1140	2.111	1335	0.112		

Well No. LD2
Type of test: step drawdown
Elevation of datum: 3.71 m asl
Screen: 0 - 14.7 m

Location: La Reunion, La Digue
G.R. $^{3}703^{95}188$
SWL 2.156
Pump set 5.4 m
Pump rate: 219, 328, 419, 472 m^3/d

Date and time of test start: 10.00 on 12 April 1978

Time from start of test min	drawdown m	Time from start of test min	drawdown m	Time from start of test min	drawdown m	Time from start of test min	drawdown m
1	0.175	165	0.396	315	0.704	470	1.125
2	0.228	180	0.400	330	0.709	480	1.125
3	0.259	181	0.565	345	0.724	495	1.124
4	0.284	182	0.575	360	0.724	510	1.136
5	0.295	183	0.576	361	0.893	525	1.164
6	0.303	184	0.589	362	0.908	540	1.182
7	0.307	185	0.593	363	0.917	541	1.377
8	0.311	186	0.593	364	0.921	542	1.391
9	0.315	187	0.596	365	0.927	543	1.411
10	0.317	188	0.604	366	0.933	544	1.415
12	0.324	189	0.614	367	0.933	545	1.457
14	0.326	190	0.615	368	0.953	546	1.462
16	0.333	192	0.610	369	0.958	547	1.498
18	0.335	194	0.621	370	0.960	548	1.505
20	0.336	196	0.623	372	0.969	549	1.518
22	0.339	198	0.626	374	0.972	550	1.530
24	0.342	200	0.634	376	0.984	552	1.532
26	0.344	202	0.633	378	1.004	554	1.564
28	0.345	204	0.625	380	1.002	556	1.574
30	0.348	206	0.630	382	0.993	558	1.595
35	0.353	208	0.639	384	0.994	560	1.627
40	0.355	210	0.644	386	0.997	562	1.633
45	0.364	215	0.644	388	0.998	564	1.647
50	0.370	220	0.660	390	1.009	566	1.643
55	0.373	225	0.656	395	1.023	568	1.644
60	0.374	230	0.657	400	1.022	570	1.655
70	0.376	235	0.666	405	1.028	575	1.693
80	0.384	240	0.674	410	1.047	580	1.739
90	0.386	250	0.664	415	1.055	585	1.746
100	0.386	260	0.685	420	1.071	590	1.762
110	0.392	270	0.690	430	1.067	595	1.772
120	0.394	280	0.687	440	1.097	600	1.787
135	0.394	290	0.704	450	1.111		
150	0.396	300	0.713	460	1.124		

Well No. LD2

Time from start of test	drawdown m
610	1.776
620	1.826
630	1.839
640	1.907
650	1.840
660	1.842
675	1.951
690	1.929
705	1.952
720	1.944

Well No. LD3
Type of test: Constant Discharge
Elevation of datum: 3.27 m asl
Screen: 0 - 14.8 m

Location: La Reunion, La Digue
G.R. $^{3}701^{95}189$
SWL 1.756
Pump set 7 m
Pump rates: 430 m^3/d

Date and time of test start: 11.30 on 13th April 1978

Time from start of test min	drawdown m	Time from start of test min	drawdown m	Time from start of test min	drawdown m	Time from start of test min	drawdown m
1	0.063	150	0.524	1110	0.660	1320	0.104
2	0.096	165	0.530	1140	0.661	1330	0.096
3	0.127	180	0.535	1170	0.666	1340	0.093
4	0.164	210	0.541	1200	0.667	1350	0.086
5	0.203	240	0.572	1230	0.667	1365	0.083
				pump stopped - recovery			
6	0.237	270	0.587	1231	0.402	1380	0.077
7	0.270	300	0.596	1232	0.347	1395	0.074
8	0.303	330	0.596	1233	0.320	1410	0.071
9	0.326	360	0.597	1234	0.304	1440	0.063
10	0.344	390	0.603	1235	0.292	1470	0.057
12	0.365	420	0.597	1236	0.283	1500	0.054
14	0.383	450	0.601	1237	0.274	1530	0.052
16	0.393	480	0.608	1238	0.268		
18	0.397	510	0.619	1239	0.261		
20	0.405	540	0.631	1240	0.255		
22	0.411	570	0.643	1242	0.243		
24	0.415	600	0.645	1244	0.235		
26	0.422	630	0.652	1246	0.223		
28	0.425	660	0.656	1248	0.216		
30	0.432	690	0.658	1250	0.207		
35	0.436	720	0.633	1252	0.201		
40	0.444	750	0.638	1254	0.190		
45	0.446	780	0.640	1257	0.182		
50	0.457	810	0.640	1258	0.178		
55	0.463	840	0.647	1260	0.173		
60	0.466	870	0.657	1265	0.162		
70	0.475	900	0.656	1270	0.154		
80	0.485	930	0.661	1275	0.144		
90	0.494	960	0.652	1280	0.137		
100	0.499	990	0.651	1285	0.133		
110	0.508	1020	0.652	1290	0.126		
120	0.507	1050	0.644	1300	0.116		
135	0.512	1080	0.660	1310	0.109		

Well No. LD3
Type of test: Step drawdown
Elevation of datum: 3.27 m asl
Screen: 0 - 14.8 m

Location: La Reunion, La Digue
G.R. $^{3}701^{55}189$
SWL 1.807
Pump set 7 m
Pump rate: 276, 381, 424 m^3/d

Date and time of test start: 13.00 and 4th April 1978

Time from start of test min	drawdown m	Time from start of test min	drawdown m	Time from start of test min	drawdown m	Time from start of test min	drawdown m
1	0.053	150	0.326	290	0.471	440	0.584
2	0.072	165	0.331	300	0.476	450	0.588
3	0.104	180	0.339	315	0.479	460	0.595
4	0.123	181	0.372	330	0.480	470	0.595
5	0.145	182	0.388	345	0.489	480	0.598
6	0.163	183	0.401	360	0.491	495	0.601
7	0.175	184	0.406	361	0.504	510	0.690
8	0.189	185	0.411	362	0.509	525	0.688
9	0.201	186	0.413	363	0.512		
10	0.211	187	0.418	364	0.516		
12	0.225	188	0.421	365	0.527		
14	0.239	189	0.422	366	0.528		
16	0.246	190	0.424	367	0.529		
18	0.253	192	0.424	368	0.529		
20	0.257	194	0.430	369	0.529		
22	0.262	196	0.433	370	0.532		
24	0.264	198	0.435	372	0.538		
26	0.265	200	0.439	374	0.545		
28	0.269	202	0.441	376	0.556		
30	0.272	204	0.442	378	0.558		
35	0.275	206	0.442	380	0.561		
40	0.282	208	0.443	382	0.564		
45	0.284	210	0.443	384	0.565		
50	0.286	215	0.450	386	0.569		
55	0.290	220	0.451	388	0.571		
60	0.295	225	0.451	390	0.572		
70	0.302	230	0.457	395	0.575		
80	0.306	235	0.460	400	0.579		
90	0.311	240	0.462	405	0.581		
100	0.313	250	0.462	410	0.583		
110	0.315	260	0.466	415	0.585		
120	0.321	270	0.467	420	0.586		
135	0.324	280	0.470	430	0.590		

Well No. LD5
Type of test: Constant Discharge
Elevation of datum: 3.51 m asl
Screen: 5-10.7 m and 13.6-16.4 m
Observation well distance: 4.90 m
Date and time of test start: 16.00 on 15 April 1978

Location: L'Union, La Digue
G.R. $^{3}699^{95}180$
SWL LD5 (pumped) 2.182 LD5A (observation) 1.919
Pump set: 7 m
Pump rate: 200 m^3/d

Time from start of test	LD5 drawdown	LD5A drawdown	Time from start of test	LD5 drawdown	LD5A drawdown	Time from start of test	LD5 drawdown	LD5A drawdown
min	m	m	min	m	m	min	m	m
1	0.584	0.022	135	0.690	0.103	257	0.016	0.01
2	0.611	0.040	150	0.675	0.104	267	0.015	0.018
3	0.639	0.048	165	0.695	0.107	277	0.014	0.01
4	0.631	0.050	Pump stopped - recovery			287	0.012	0.01
5	0.624	0.052	178	0.083	0.077	297	0.011	0.015
6	0.627	0.053	179	0.062	0.064	312	0.010	0.01
7	0.636	0.056	180	0.060	0.060	327	0.007	0.010
8	0.656	0.058	181	0.058	0.058	332		0.00
9	0.634	0.059	182	0.046	0.055	357		0.009
10	0.653	0.060	183	0.044	0.054			
12	0.621	0.061	184	0.043	0.052			
14	0.637	0.065	185	0.041	0.051			
16	0.636	0.068	186	0.039	0.050			
18	0.622	0.069	187	0.038	0.049			
20	0.629	0.070	189	0.037	0.047			
22	0.624	0.072	191	0.036	0.046			
24	0.637	0.073	193	0.034	0.044			
26	0.641	0.075	195	0.023	0.041			
28	0.636	0.077	197	0.032	0.040			
30	0.648	0.079	199	0.031	0.039			
35	0.643	0.081	201	0.030	0.038			
40	0.628	0.083	203	0.030	0.037			
45	0.662	0.086	205	0.029	0.037			
50	0.628	0.088	207	0.029	0.036			
55	0.626	0.089	212	0.026	0.033			
60	0.648	0.091	218	0.025	0.030			
70	0.645	0.092	223	0.024	0.029			
80	0.667	0.093	227	0.022	0.028			
90	0.673	0.097	232	0.021	0.026			
102		0.098	237	0.020	0.025			
110	0.677	0.099	247	0.018	0.022			
120	0.674	0.101						

Well No. LD5A (Observation)
Type of test: Constant discharge
Elevation of datum : 3.24 m asl
Screen: 5.5-8.3 m
Observation well distance: 4.90 m
Date and time of test start: 22.15 on 15th April 1978
Water level readings in pumped well not taken

Location: L'Union, La Digue
G.R. $^{3}699\ ^{95}180$
SWL 1.919
Pump set: 7 m
Pump rate: 230 m^3/d

Time from start of test	drawdown	Time from start of test	drawdown	Time from start of test	drawdown
min	m	min	m	min	m
1	0.032	120	0.108	990	0.142
2	0.042	135	0.109	1020	0.141
3	0.049	150	0.110	1050	0.141
4	0.050	165	0.111	1080	0.142
5	0.051	180	0.112	1110	0.143
6	0.052	210	0.114	1140	0.125
7	0.055	240	0.117		
8	0.059	270	0.120		
9	0.060	300	0.123		
10	0.060	330	0.124		
12	0.062	360	0.125		
14	0.067	390	0.127		
16	0.069	420	0.128		
18	0.070	450	0.129		
20	0.072	480	0.131		
22	0.074	510	0.132		
24	0.076	540	0.132		
26	0.078	570	0.133		
28	0.079	600	0.133		
30	0.080	630	0.133		
35	0.083	660	0.133		
40	0.086	690	0.135		
45	0.090	720	0.134		
50	0.091	750	0.136		
55	0.092	780	0.138		
60	0.092	810	0.139		
70	0.099	840	0.139		
80	0.101	870	0.140		
90	0.106	900	0.141		
100	0.107	930	0.142		
110	0.105	960	0.141		

Well No. LD6
Type of test: constant discharge
Elevation of datum: 3.59 m asl
Screen: 4.8 - 10.6 m
Observation well distance: 4.85 m
Date and time of test start: 1800 on 17 April 1978

Location: La Passe, La Digue
G.R. $^{3}704^{95}194$
SWL LD6 (pumped) 1.861 LD6A (obs.) 1.79
Pump set 7 m
Pump rate: 280 m^3/d

Time from start of test min	LD6 drawdown m	LD6A drawdown m	Time from start of test min	LD6 drawdown m	LD6A drawdown m	Time from start of test min	LD6 drawdown m	LD6A drawdown m
1.25		0.141	35		0.234	660	0.883	0.3[illegible]
2		0.169	40		0.237	690	0.883	0.309
3		0.178	41	0.861		720	0.884	0.3[illegible]
4		0.188	45	0.853	0.240	750	0.889	0.3[illegible]
5		0.193	50	0.857	0.244	780	0.885	0.3[illegible]
6		0.197	55	0.852	0.247	810	0.896	0.3[illegible]
7		0.202	60	0.837	0.247	840	0.905	0.315
8		0.204	70	0.852	0.249	870	0.900	0.3[illegible]
9		0.205	80	0.832	0.254	900	0.900	0.319
10		0.207	90	0.868	0.255	930	0.934	0.3[illegible]
11	0.820		100	0.853	0.258	960	0.935	0.323
12		0.210	110	0.878	0.259	990	0.929	0.3[illegible]
13	0.856		120	0.867	0.264	1020	0.919	0.3[illegible]
14		0.215	135	0.851	0.269	1050	0.921	0.3[illegible]
15	0.821		150	0.872	0.273	1080	0.910	0.3[illegible]
16		0.217	175	0.873	0.275	1110	0.924	0.3[illegible]
17	0.847		180	0.874	0.275	1140	0.928	0.3[illegible]
18		0.219	210	0.887	0.280	1170	0.939	0.325
19	0.846		240	0.864	0.283	1200	0.931	0.3[illegible]
20		0.223	270	0.870	0.286	1230	0.937	0.327
21	0.856		300	0.885	0.288	1260	0.932	0.3[illegible]
22		0.225	330	0.883	0.292	1290	0.929	0.3[illegible]
23	0.852		360	0.925	0.294	1320	0.933	0.3[illegible]
24		0.226	390	0.881	0.294	1350	2.139	0.3[illegible]
25	0.846		420	0.896	0.298	1440		0.3[illegible]
26		0.228	450	0.886	0.301	1470		0.4[illegible]
27	0.849		480	0.887	0.302	1500		0.376
28		0.228	510	0.887	0.303	1530		0.3[illegible]
29	0.849		540	0.888	0.303	1560		0.377
30		0.230	570	0.879	0.304	1575		0.3[illegible]
31	0.851		600	0.879	0.305	1590		0.381
34	0.858		630	0.882	0.308	1620		0.3[illegible]

Well No: LD6
Type of test: Constant Discharge
Elevation of datum: 3.59 m asl
Screen: 4.8 - 10.6 m

Location: La Passe, La Digue
G.R. $^{3}704^{95}194$
SWL LD6 (pumped) 1.861 LD6A(Obs.) 1.794
Pump set 7m
Pump rate: 280 m^3/d

Date and time of test start: 1800 on 17th April 1978

Time from start of test	LD6A drawdown
1650	0.378
1680	0.386
1710	0.378
1740	0.378
1770	0.380
1800	0.381
1830	0.381
1860	0.379
1890	0.378
1920	0.377
1950	0.379
1980	0.381
2010	0.381
2040	0.380
2070	0.381
2100	0.382
2130	0.380
2160	0.381
2190	0.383
2220	0.377
2250	0.374
2280	0.374
2310	0.366
2340	0.383
2370	0.389

Well No. LD7
Type of test: Constant Discharge
Elevation of datum: 3.51 m asl
Screen: 0-7 m
Observation well distance: LD1 9.9 m, LD8 6.47 m
Date and time of test start: 12.00 on 26 April 1978

Location: Gov't Well Compound, La Digue
G.R. $^{3}705^{95}189$
SWL LD7(pumped)1.628 LD8(obs)1.372
LD1(obs)1.646
Pump set : 3.5 m
Pump rate: 296 m^3/d

Time from start of test	LD7 drawdown	LD8 drawdown	LD1 drawdown	Time from start of test	LD7 drawdown	LD8 drawdown	LD1 drawdown
min	m	m	m	min	m	m	m
1	0.110	0.001	0.002	135	0.451	0.158	0.096
2	0.170	0.005	0.004	150	0.454	0.160	0.097
3	0.214	0.010	0.009	165	0.457	0.165	0.100
4	0.245	0.016	0.014	180	0.460	0.168	0.102
5	0.272	0.025	0.018	210	0.464	0.173	0.106
6	0.295	0.030	0.022	240	0.470	0.178	0.108
7	0.311	0.035	0.027	270	0.472	0.181	0.112
8	0.322	0.041	0.030	300	0.475	0.187	0.114
9	0.333	0.047	0.033	330	0.479	0.191	0.116
10	0.341	0.050	0.035	360	0.481	0.194	0.117
12	0.352	0.058	0.041	390	0.483	0.195	0.121
14	0.362	0.065	0.044	420	0.485	0.199	0.123
16	0.372	0.072	0.048	450	0.487	0.202	0.124
18	0.379	0.077	0.052	480	0.490	0.204	0.125
20	0.384	0.084	0.054	510	0.491	0.205	0.127
22	0.389	0.087	0.056	540	0.492	0.207	0.129
24	0.391	0.089	0.058	570	0.493	0.208	0.131
26	0.392	0.094	0.059	600	0.495	0.211	0.132
28	0.392	0.096	0.061	630	0.500	0.213	0.133
30	0.394	0.098	0.063	660	0.500	0.214	0.134
35	0.400	0.105	0.066	690	0.500	0.215	0.135
40	0.404	0.109	0.069	720	0.502	0.217	0.136
45	0.411	0.115	0.072	750	0.504	0.217	0.138
50	0.414	0.118	0.074	780	0.500	0.219	0.139
55	0.419	0.121	0.075	810	0.500	0.220	0.139
60	0.421	0.127	0.077	840	0.502	0.221	0.140
70	0.428	0.131	0.081	870	0.503	0.222	0.141
80	0.433	0.137	0.083	900	0.504	0.222	0.142
90	0.437	0.141	0.085	930	0.505	0.224	0.144
100	0.441	0.147	0.089	960	0.506	0.225	0.144
110	0.444	0.149	0.091	990	0.508	0.227	0.146
120	0.448	0.154	0.093	1020	0.509	0.228	0.147

Well: LD7
Type of test: Constant discharge
Elevation of datum: 3.51 m asl
Screen: 0-7 m
Date and time of test start: 12.00, 26 April 1978

Location: Government Well: Compound, La Digue
G.R.: [3]705[95]189
SWL LD7 (Pumped) 1.628, LD8 (obs) 1.372
LD1 (obs) 1.646
Pumpset: 3.5 m
Pumprate: 296 m^3/d

Time from start of test min	LD7 drawdown m	LD8 drawdown m	LD1 drawdown m
1050	0.510	0.229	0.148
1070	0.512	0.231	0.150
1110	0.513	0.233	0.151
1140	0.514	0.234	0.153
1170	0.516	0.235	0.154
1200	0.517	0.237	0.156
1230	0.519	0.239	0.158
1260	0.521	0.240	0.160
1290	0.522	0.242	0.161
1320	0.522	0.243	0.162
1350	0.524	0.245	0.164
Pump stopped			
1351	0.406	0.244	0.162
1352	0.348	0.241	0.159
1353	0.304	0.235	0.155
1354	0.277	0.233	0.152
1355	0.258	0.228	0.147
1356	0.240	0.222	0.143
1357	0.226	0.218	0.141
1358	0.216	0.214	0.138
1359	0.207	0.210	0.136
1360	0.200	0.205	0.133
1362	0.185	0.198	0.128
1364	0.175	0.192	0.124
1366	0.166	0.184	0.121
1368	0.160	0.180	0.117
1370	0.153	0.174	0.115
1372	0.148	0.169	0.113
1374	0.152	0.164	0.111
1376	0.139	0.160	0.108
1378	0.134	0.155	0.105
1380	0.130	0.152	0.106
1385	0.121	0.144	0.103

Time from start of test min	LD7 drawdown m	LD8 drawdown m	LD1 drawdown m
1390	0.115	0.136	0.094
1395	0.110	0.131	0.091
1400	0.103	0.124	0.087
1405	0.100	0.120	0.084
1410	0.095	0.115	0.082
1420	0.090	0.107	0.078
1430	0.084	0.102	0.075
1440	0.081	0.095	0.072
1450	0.076	0.091	0.068
1460	0.073	0.085	0.066
1470	0.071	0.082	0.064
1485	0.067	0.076	0.061
1500	0.063	0.072	0.058
1515	0.060	0.060	0.056
1530	0.057	0.064	0.054
1560	0.053	0.058	0.050
1590	0.050	0.053	0.047
1620	0.046	0.049	0.045
1650	0.042	0.046	0.042
1680	0.041	0.042	0.041
1710	0.040	0.040	0.039

Well No: LD7
Type of Test: Step drawdown
Elevation of datum: 3.51 m asl
Screen: 0-7 m
Date and time of test start: 19.00, 25 April 1978

Location: Government Well Compound, La Digue
G.R.: $^{3}705^{95}189$
SWL: 1.688
Pumpset: 3.5 m
Pumprate: 228, 258, 315, 332 m^3/d

Time from start of test min	Drawdown m	Time from start of test min	Drawdown m	Time from start of test min	Drawdown m	Time from start of test min	Drawdown m
1	0.090	135	0.310	270	0.364	415	0.451
2	0.130	150	0.310	280	0.362	420	0.452
3	0.159	165	0.310	290	0.363	430	0.453
4	0.181	180	0.310	300	0.364	440	0.454
5	0.203	181	0.322	315	0.366	450	0.456
6	0.216	182	0.329	330	0.365	460	0.456
7	0.229	183	0.334	345	0.364	470	0.456
8	0.240	184	0.336	360	0.364	480	0.457
9	0.246	185	0.340	361	0.383	495	0.458
10	0.253	186	0.341	362	0.397	510	0.459
12	0.261	187	0.342	262	0.405	525	0.460
14	0.269	188	0.344	364	0.412	640	0.462
16	0.274	189	0.344	365	0.417	541	0.467
18	0.280	190	0.345	366	0.420	542	0.472
20	0.284	192.5	0.348	367	0.422	543	0.475
22	0.286	194	0.349	368	0.425	544	0.478
24	0.290	196	0.350	369	0.428	545	0.479
26	0.291	198	0.351	370	0.429	546	0.480
28	0.293	200	0.352	372	0.431	547	0.481
30	0.295	202	0.352	374	0.432	548	0.482
35	0.300	204	0.352	376	0.434	549	0.482
40	0.302	206	0.353	378	0.436	550	0.483
45	0.302	208	0.355	380	0.437	552	0.484
50	0.301	210	0.355	382	0.439	554	0.485
55	0.301	215	0.358	384	0.440	556	0.486
60	0.301	220	0.360	386	0.441	558	0.486
70	0.302	225	0.362	388	0.443	560	0.487
80	0.300	230	0.363	390	0.445	562	0.487
90	0.301	235	0.364	395	0.446	564	0.488
100	0.307	240	0.364	400	0.447	566	0.489
110	0.309	250	0.364	405	0.448	568	0.490
120	0.310	260	0.364	410	0.450	570	0.491

Well No: LD7
Type of test: Stepdrawdown
Elevation of datum: 3.51 m
Screen: 0-7 m
Date and time of test start: 19.00, 25 April 1978

Location: Government well compound, La Digue
G.R.: $^{3}705^{95}189$
SWL: 1.688

Time from start of test min	Drawdown m
575	0.492
580	0.493
585	0.494
590	0.495
595	0.496
600	0.497
610	0.498
620	0.498
630	0.499
640	0.498
650	0.499
660	0.500
675	0.501
690	0.502
705	0.503
720	0.503

Well No: LD8
Type of test: Constant discharge
Elevation of datum:
Screen: 2-4 m
Observation well distance: LD1 11.37 m, LD7 6.47 m
Date and time of test start: 16.45, 27 April 1978

Location: Government Well Compound, La Digue
G.R.: $^{3}705^{95}187$
SWL: LD8(pumped)1.406, LD7(obs)1.66
LD1(obs)1.685
Pump set: 4 m
Pump rate: 331 m^3/d

Time from start of test min	LD8 drawdown m	LD1 drawdown m	LD7 drawdown m	Time from start of test min	LD8 drawdown m	LD1 drawdown m	LD7 drawdown m
1	0.350	0.002	0.003	135	1.645	0.082	0.162
2	0.488	0.002	0.007	150	1.744	0.086	0.166
3	0.604	0.003	0.014	165	1.802	0.088	0.172
4	0.655	0.004	0.021	180	1.862	0.093	0.175
5	0.683	0.006	0.027	210	2.074	0.098	0.183
				pump stopped - recovery			
6	0.702	0.008	0.033	211		0.098	0.183
7	0.716	0.009	0.037	212		0.097	0.183
8	0.728	0.011	0.041	213		0.097	0.182
9	0.739	0.013	0.044	214		0.097	0.181
10	0.754	0.014	0.047	215		0.097	0.179
12	0.780	0.016	0.054	216		0.096	0.176
14	0.803	0.018	0.060	216.5	0.818		
16	0.820	0.022	0.064	217		0.096	0.174
18	0.836	0.024	0.068	217.5	0.767		
20	0.855	0.026	0.073	218		0.096	0.173
22	0.876	0.028	0.076	218.5	0.728		
24	0.903	0.030	0.081	219		0.095	0.172
26	0.925	0.032	0.083	219.5	0.686		
28	0.946	0.034	0.086	220		0.095	0.168
30	0.974	0.036	0.090	220.5	0.645		
35	1.014	0.040	0.096	222		0.094	0.164
40	1.038	0.044	0.103	222.5	0.575		
45	1.063	0.048	0.106	224		0.092	0.160
50	1.085	0.050	0.112	224.5	0.523		
55	1.103	0.053	0.116	226		0.092	0.156
60	1.139	0.055	0.122	226.5	0.486		
70	1.177	0.061	0.127	228		0.091	0.153
80	1.250	0.064	0.134	228.5	0.455		
90	1.304	0.067	0.139	230		0.090	0.148
100	1.362	0.072	0.146	230.5	0.427		
110	1.436	0.076	0.151	232		0.088	0.145
120	1.522	0.077	0.154	232.5	0.406		

Well No: LD8
Type of test: Constant Discharge
Elevation of datum:
Screen:
Date and time of test start: 16.45, 27 April 1978

SDL: LD8 (pumped) 1.406, LD7 (obs) 1.666
LD1 (obs) 1.685
Pumprate: 331 m /d

Time from start of test min	LD8 drawdown m	LD1 drawdown m	LD7 drawdown m	Time from start of test min	LD8 drawdown m	LD1 drawdown m	LD7 drawdown m
234		0.086	0.142	420	0.043	0.018	0.024
234.5	0.387			435	0.037	0.016	0.022
236		0.085	0.137	450	0.034	0.015	0.020
236.5	0.368						
238		0.084	0.135				
238.5	0.355						
240		0.082	0.132				
240.5	0.340						
245		0.079	0.123				
245.5	0.309						
250		0.075	0.116				
250.5	0.283						
255		0.073	0.110				
255.5	0.257						
260		0.069	0.103				
260.5	0.235						
265		0.066	0.096				
265.5	0.216						
270		0.064	0.092				
270.5	0.198						
280	0.174	0.059					
281			0.081				
290	0.151	0.054					
291			0.074				
300	0.132	0.049	0.066				
310	0.116	0.045	0.060				
320	0.104	0.042	0.054				
330	0.095	0.037	0.050				
345	0.083	0.034	0.044				
360	0.072	0.030	0.038				
375	0.063	0 026	0.035				
390	0.056	0.024	0.029				
405	0.049	0.022	0.027				

Well No: LD8
Type of test: Constant discharge
Elevation of datum:
Screen: 2-4 m
Observation well distance: LD1, 11.37 m, LD7, 6.47 m
Date and time of test start: 00.15, 28 April 1978

Location: Government Well Compound,
La Digue
G.R.: $^{3}705^{95}187$
SWL: LD8(pumped1.440, LD7(obs)1.686
LD1(obs)1.700
Pumpset: 4 m
Pumprate: 306 m^3/d

Time of start of test min	LD8 drawdown m	LD7 drawdown m	LD1 drawdown m	Time of start of test min	LD8 drawdown m	LD7 drawdown m	LD1 drawdown m
1	0.280	0.003		135	1.248	0.134	0.066
2	0.431	0.007		150	1.294	0.139	0.069
3	0.523	0.009	0.001	165	1.275	0.145	0.072
4	0.582	0.016	0.002	180	1.343	0.151	0.074
5	0.614	0.021	0.003	210	1.421	0.163	0.076
6	0.640	0.025	0.004	240	1.660	0.153	0.075
7	0.659	0.030	0.006	270	1.592	0.154	0.075
8	0.672	0.033	0.007	300	1.680	0.155	0.074
9	0.685	0.036	0.008	330	1.668	0.155	0.074
10	0.694	0.039	0.009	360	1.670	0.155	0.074
12	0.713	0.044	0.011	390	1.680	0.154	0.073
14	0.730	0.049	0.013	420	1.740	0.156	0.072
16	0.743	0.053	0.015	450	1.743	0.155	0.072
18	0.756	0.057	0.018	480	1.749	0.154	0.070
20	0.772	0.060	0.019	510	1.810	0.153	0.069
22	0.785	0.064	0.021	540	1.857	0.153	0.067
24	0.798	0.067	0.023	570	1.823	0.151	0.L66
26	0.813	0.069	0.024	600	1.781	0.149	0.063
28	0.829	0.072	0.025	630	1.744	0.144	0.060
30	0.846	0.074	0.027	660	1.772	0.143	0.058
35	0.881	0.080	0.030	690	1.845	0.141	0.056
40	0.926	0.086	0.034	720	1.830	0.141	0.052
				pump stopped - recovery			
45	0.960	0.091	0.037	721	1.366	0.141	0.052
50	0.978	0.094	0.039	722	1.197	0.140	0.052
55	0.991	0.099	0.042	723	1.059	0.140	0.052
60	1.007	0.103	0.043	724	0.936	0.138	0.051
70	1.029	0.109	0.048	725	0.851	0.136	0.051
80	1.073	0.114	0.051	726	0.795	0.134	0.050
90	1.102	0.118	0.054	727	0.750	0.132	0.049
100	1.125	0.123	0.058	728	0.705	0.130	0.048
110	1.155	0.128	0.060	729	0.667	0.127	0.047
120	1.194	0.130	0.062	730	0.631	0.125	0.047

Well No: LD8
Type of test: Constant discharge
Elevation of datum:
Screen: 2-4 m
Date and time of test start: 00.15, 28 April 1978

Location: Goverment Well Compound, La Digue
G.R.: $^{3}705^{95}187$
SWL: LD8(pumped)1.440, LD7(obs)1.686, LD1(obs)1.700
Pumprates: 306 m^3/d

Time of start of test min	LD8 drawdown m	LD7 drawdown m	LD1 drawdown m
732	0.560	0.121	0.046
734	0.513	0.116	0.044
736	0.474	0.113	0.042
738	0.441	0.108	0.041
740	0.415	0.105	0.039
742	0.391	0.102	0.038
744	0.371	0.097	0.036
746	0.353	0.094	0.033
748	0.337	0.090	0.032
750	0.322	0.087	0.031
755	0.289	0.075	0.027
760	0.263	0.068	0.022
765	0.239	0.063	0.020
770	0.217	0.056	0.017
775	0.197	0.051	0.014
780	0.179	0.044	0.011
790	0.141	0.032	0.004
800	0.117	0.023	0.001
810	0.097	0.014	0.007
820	0.077	0.005	0.012
830	0.062	0.002	0.017
840	0.048	0.007	0.021

Well No: P1
Type of test: constant discharge
Elevation of datum: 1.71 m asl
Screen: 2.8 - 8.0 m
Time & date of test start: 1546 on 16 May 1978

Location: Baie Pasquiere, Praslin
GR: $^{3}581^{95}234$
SWL: 1.310 m
Pump set: 5.0 m
Pump rate: 309 m^3/d

Time from start of test	Drawdown	Time from start of test	Drawdown	Time from start of test	Drawdown
min	m	min	m	min	m
1	0.071	180	2.115	805	1.232
4	1.319	210	2.137	807	1.197
5	1.454	240	2.358	809	1.142
6	1.509	270	2.302	811	1.114
7	1.550	300	2.556	813	1.084
8	1.589	330	2.568	815	1.060
9	1.606	360	2.614	817	1.033
10	1.630	390	2.643	819	1.007
12	1.644	420	2.688	821	0.978
14	1.685	450	2.718	823	0.960
16	1.700	480	2.866	825	0.938
18	1.704	510	2.759	830	0.885
20	1.720	540	2.868	835	0.842
22	1.714	570	2.842	840	0.791
24	1.708	600	2.873	845	0.747
26	1.734	630	2.944	850	0.710
28	1.759	670	2.996	855	0.679
30	1.775	690	3.045	865	0.631
35	1.819	720	3.081	875	0.584
40	1.843	750	3.092	885	0.580
45	1.849	780	3.121	895	0.522
50	1.843	795	3.216	905	0.495
55	1.865	Pump stopped-recovery		915	0.469
60	1.896	795.5	1.898	930	0.432
70	1.933	796	1.774	945	0.406
80	1.953	797	1.641	960	0.379
90	1.971	798	1.536	975	0.360
100	2.071	799	1.463	1005	0.324
110	2.036	800	1.401	1035	0.300
120	2.043	801	1.359	1065	0.279
135	2.027	802	1.318	1095	0.260
150	2.040	803	-	1125	0.247
165	2.077	804	1.261	1155	0.239

Well No: P2
Type of test: Constant discharge
Elevation of datum: 112.16 m asl
Screen: 0-8.0 m
Time & date of test start: 1500 m 18 May 1978

Location: Plaine Hollandaise, Praslin
GR: $^{3}585^{95}223$
SWL: 3.507 m
Pump set: 6.2 m
Pump rate: 131 m^3/d

Time from start of test min	Drawdown m	Time from start of test min	Drawdown m	Time from start of test min	Drawdown m
1	0.224	150	1.102	405	0.276
2	0.288	165	1.099	410	0.269
3	0.243	180	1.175	415	0.260
4	0.347	210	1.165	420	0.253
5	0.486	240	1.205	425	0.246
6	0.573	270	1.202		
7	0.636	300	1.223		
8	0.675	330	1.245		
9	0.696	360	1.250		
10	0.722	Pumped stopped-recovery			
12	0.759	360.5	0.678		
14	0.772	361	0.561		
16	0.789	362	0.465		
18	0.796	363	0.436		
20	0.803	364	0.422		
22	0.797	365	0.410		
24	0.799	366	0.404		
26	0.836	367	0.394		
28	0.833	368	0.387		
30	0.855	369	0.381		
35	0.883	370	0.374		
40	0.885	372	0.365		
45	0.920	374	0.356		
50	0.940	376	0.347		
55	0.941	378	0.341		
60	0.971	380	0.333		
70	0.963	382	0.327		
80	0.995	384	0.321		
90	1.023	386	0.316		
100	1.034	388	0.311		
110	1.061	390	0.306		
120	1.077	395	0.295		
135	1.099	400	0.286		

Well No: P4
Type of test: constant discharge
Elevation of datum: 2.10 m asl
Screen: 0 - 7.5; 13.2 - 16.0 m
Time & start of test: 1400 on 13 May 1978

Location: L'Amitie, Praslin
GR: $^{3}552^{95}228$
SWL: 1.100 m
Pump set: 7.5m
Pump rate: 367 m^3/d

Time from start of test min	Drawdown m	Time from start of test min	Drawdown m	Time from start of test min	Drawdown m
01	0.012	150	1.434	392	0.098
2	0.051	165	1.446	397	0.092
3	0.592	180	1.450	402	0.087
4	0.917	210	1.467	407	0.083
5	0.921	240	1.458	412	0.080
6	0.943	270	1.486†	422	0.074
7	0.972	300	1.210	432	0.068
8	0.981	330	1.282	442	0.063
9	0.994	352	1.270	452	0.058
10	0.998	†pump started to suck air		462	0.054
12	1.002	Pump stopped-recovery		472	0.050
14	1.024			487	0.046
16	1.028	353	0.280	502	0.042
18	1.033	354	0.202	522	0.037
20	1.061	355	0.192	532	0.034
22	1.057	356	0.184	552	0.032
24	1.077	357	0.176		
26	1.090	358	0.171		
28	1.089	359	0.167		
30	1.094	360	0.163		
35	1.107	361	0.161		
40	1.144	362	0.154		
45	1.174	364	0.150		
50	1.189	366	0.143		
55	1.181	368	0.138		
60	1.189	371	0.131		
70	1.225	372	0.129		
80	1.282	374	0.125		
90	1.318	376	0.121		
100	1.305	378	0.118		
110	1.337	380	0.114		
120	1.382	382	0.109		
135	1.424	387	0.103		

Well No: P4
Type of test: Constant discharge
Elevation of datum: 2.10 m asl
Screen: 0 - 7.5; 13.2 - 16.0 m
Time and date of test: 2300 on 13 May 1978

Location: L'Amitie, Praslin
GR: $^{3}552$ $^{95}228$
SWL: 1.132 m
Pump set: 7.5 m
Pump rate: 344 m^3/d

Time from start of test min	Drawdown m	Time for start of test min	Drawdown m
1	0.957	150	1.394
2	1.010	165	1.399
3	1.028	180	1.416
4	1.055	210	1.476
5	1.058	240	1.510
6	1.083	270	1.585
7	1.089	pump started to suck air	
8	1.095	pump stopped-recovery	
9	1.098	270.5	0.224
10	1.109	271	0.209
12	1.122	271.5	0.195
14	1.126	272	0.186
16	1.147	273	0.171
18	1.171	274	0.162
20	1.165	275	0.156
22	1.172	276	0.150
24	1.176	277	0.145
26	1.184	278	0.140
28	1.182	279	0.136
30	1.216	280	0.131
35	1.195	282	0.127
40	1.216	284	0.120
45	1.229	286	0.115
50	1.230	288	0.110
55	1.269	290	0.107
60	1.289	292.5	0.101
70	1.300	294	0.098
80	1.319	296	0.095
90	1.366	298	0.092
100	1.373	300	0.089
110	1.362		
120	1.350		
135	1.373		

Well No: P5
Type of test: Constant discharge
Elevation of datum: 2.33 m asl
Screen: 0-5.1; 13.7-19.4 m
Time and date of test start:
1230 on 14 May 1978

Location: L'Amitie, Praslin
G.R.: ^{3}550 ^{95}226
SWL: 1.277 m
Pumpset: 7.5 m
Pumprate: 262 m^3/d

Time from start of test	Drawdown	Time from start of test	Drawdown	Time from start of test	Drawdown	Time from start of test	Drawdown
min	m	min	m	min	m	min	m
1	0.639	150	1.968	1110	2.712	1330	0.340
2	1.234	165	1.994	1140	2.662	1340	0.325
3	1.331	180	1.978	1170	2.689	1350	0.315
4	1.367	210	2.001	1200	2.691	1360	0.304
5	1.372	240	2.005	1230	2.690	1370	0.293
6	1.399	270	1.977	1260	2.673	1380	0.279
7	1.447	300	2.193	Pump stopped - recovery		1395	0.265
8	1.446	330	2.250	1261	0.733	1410	0.252
9	1.447	360	2.290	1262	0.689	1425	0.241
10	1.473	390	2.266	1263	0.656	1440	0.231
12	1.555	420	2.316	1264	0.624	1470	0.215
14	1.606	450	2.334	1265	0.608	1500	0.199
16	1.617	480	2.355	1266	0.588	1550	0.178
18	1.590	510	2.369	1267	0.575	1560	0.171
20	1.621	540	2.377	1268	0.567		
22	1.598	570	2.376	1269	0.556		
24	1.597	600	2.391	1270	0.546		
26	1.659	630	2.457	1272	0.526		
28	1.659	660	2.509	1274	0.513		
30	1.674	690	2.497	1276	0.503		
35	1.704	720	2.494	1278	0.489		
40	1.741	750	2.607	1280	0.478		
45	1.754	780	2.555	1282	0.464		
50	1.730	810	2.644	1284	0.452		
55	1.755	840	2.602	1286	0.447		
60	1.853	870	2.670	1288	0.439		
70	1.868	900	2.642	1290	0.433		
80	1.829	930	2.623	1295	0.417		
90	1.900	960	2.676	1300	0.412		
100	1.977	990	2.689	1305	0.394		
110	2.029	1020	2.708	1310	0.379		
120	1.902	1050	2.695	1315	0.370		
135	1.883	1080	2.724	1320	0.361		

Well: P6
Type of test: Constant discharge
Elevation of datum: 2.56 m asl
Screen: 0-48; 13.4-16.2 m
Time and date of test start: 1530 on 15 May 1978

Location: L'Amitie, Praslin
G.R.: ^{3}548 ^{95}225
SWL: 1.041 m
Pumpset: 7.5 m
Pumprate: 263 m^3/d

Time from start of test	Drawdown	Time from start of test	Drawdown	Time from start of test	Drawdown	Time from start of test	Drawdown
min	m	min	m	min	m	min	m
1	0.444	150	2.046	1022	0.268	1185	0.093
2	1.723	165	2.017	1023	0.253	1200	0.089
3	1.750	180	2.027	1024	0.245	1230	0.083
4	1.758	210	2.083	1025	0.243	1260	0.077
5	1.787	240	2.072	1026	0.239		
6	1.819	270	2.095	1027	0.231		
7	1.801	300	2.127	1028	0.225		
8	1.800	330	2.143	1029	0.220		
9	1.807	360	2.201	1030	0.217		
10	1.811	390	2.205	1032	0.209		
12	1.828	420	2.253	1034	0.202		
14	1.847	450	2.246	1036	0.200		
16	1.865	480	2.209	1038	0.196		
18	1.834	510	2.216	1040	0.191		
20	1.853	540	2.195	1042	0.183		
22	1.839	570	2.167	1044	0.182		
24	1.835	600	2.198	1046	0.179		
26	1.837	630	2.230	1048	0.176		
28	1.874	660	2.217	1050	0.172		
30	1.980	690	2.247	1055	0.165		
35	1.873	720	2.223	1060	0.159		
40	1.873	750	2.191	1065	0.154		
45	1.867	780	2.256	1070	0.149		
50	1.933	810	2.225	1075	0.144		
55	1.946	840	2.281	1080	0.140		
60	1.949	870	2.214	1090	0.133		
70	1.966	900	2.237	1100	0.126		
85	2.013	930	2.264	1110	0.121		
90	1.982	960	2.244	1120	0.116		
100	1.963	990	2.253	1130	0.112		
110	1.943	1020	2.272	1140	0.107		
120	1.992	Pump stopped - recovery		1155	0.102		
135	2.031	1021	0.296	1170	0.097		

Well No: M1A
Type of test: constant discharge
Elevation of datum : 2.45 m asl
Screen : 2.3-8.0 m
Observation well distance : 6.64 m
Date & time of start of test :
1845 on 22 March 1978

Location: Anse Intendance, Mahe
GR : [3]341 [94]712
SWL : M1A (Pumped) 1.058 m; M1 (observation) 0.927 m
Pump set : 3.3 m
Pump rate: 486 m^3/d

Time from start of test	M1A drawdown	M1 drawdown	Time from start of test	M1A drawdown	M1 drawdown	Time from start of test	M1A drawdown	M1 drawdown
min	m	m	min	m	m	min	m	m
1	0.675	0.098	120	0.780	0.205	990	0.799	0.211
2	0.719	0.131	135	0.767	0.210	1020	0.793	0.212
3	0.731	0.146	150	0.788	0.212	1050	0.794	0.214
4	0.754	0.155	165	0.778	0.211			
5	0.762	0.168	180	0.781	0.214			
6	0.784	0.171	210	0.790	0.208			
7	0.770	0.176	240	0.796	0.218			
8	0.766	0.178	270	0.802	0.219			
9	0.751	0.180	300	0.791	0.219			
10	0.743	0.181	330	0.790	0.217			
12	0.759	0.185	360	0.808	0.222			
14	0.764	0.189	390	0.813	0.217			
16	0.768	0.193	420	0.809	0.217			
18	0.768	0.194	450	0.810	0.216			
20	0.773	0.197	480	0.782	0.211			
22	0.746	0.196	510	0.789	0.222			
24	0.764	0.196	540	0.805	0.221			
26	0.760	0.198	570	0.782	0.210			
28	0.765	0.200	600	0.799	0.211			
30	0.769	0.201	630	0.780	0.211			
35	0.803	0.202	660	0.775	0.219			
40	0.791	0.205	690	0.799	0.211			
45	0.749	0.201	720	0.789	0.213			
50	0.777	0.205	750	0.799	0.213			
55	0.782	0.206	780	0.790	0.211			
60	0.781	0.210	810	0.813	0.213			
70	0.779	0.210	840	0.779	0.210			
80	0.777	0.210	870	0.799	0.214			
90	0.780	0.213	900	0.787	0.220			
100	0.788	0.214	930	0.811	0.213			
110	0.791	0.212	960	0.767	0.210			

Pump rate varied. Test abandoned

Well No: M1A
Type of test: Step drawdown
Elevation of datum: 2.45 m asl
Screen: 2.3 - 8.0 m
Date & time of test:
0930 on 24 March 1978

Location: Anse Intendance, Mahe
GR : [3]341 [94]713
SWL: 1.042 m
Pump set: 3.3 m
Pump rates: 207 m^3/d 376 m^3/d
302 m^3/d 438 m^3/d

Time from start of test	Drawdown	Time from start of test	Drawdown	Time from start of test	Drawdown	Time from start of test	Drawdown
min	m	min	m	min	m	min	m
1	0.295	135	0.297	270	0.449	415	0.578
2	0.280	150	0.298	280	0.446	420	0.586
3	0.281	165	0.295	290	0.448	430	0.587
4	0.284	180	0.297	300	0.449	440	0.571
5	0.299	181	0.420	315	0.449	450	0.579
6	0.285	182	0.429	330	0.458	460	0.572
7	0.280	183	0.437	345	0.447	470	0.584
8	0.281	184	0.461	360	0.445	480	0.583
9	0.286	185	0.438	361	0.562	495	0.568
10	0.288	186	0.439	362	0.565	510	0.566
12	0.290	187	0.438	363	0.570	525	0.575
14	0.290	188	0.439	364	0.563	540	0.570
16	0.290	189	0.442	365	0.564	541	0.665
18	0.290	190	0.440	366	0.544	542	0.677
20	0.290	192	0.442	367	0.565	543	0.679
22	0.291	194	0.448	368	0.570	544	0.680
24	0.290	196	0.442	369	0.568	545	0.674
26	0.291	198	0.446	370	0.571	546	0.678
28	0.291	200	0.443	372	0.576	547	0.678
30	0.291	202	0.445	374	0.594	548	0.678
35	0.292	204	0.443	376	0.572	549	0.676
40	0.294	206	0.441	378	0.573	550	0.673
45	0.294	208	0.442	380	0.571	552	0.680
50	0.295	210	0.442	382	0.570	554	0.679
55	0.295	215	0.463	384	0.549	556	0.681
60	0.295	220	0.446	386	0.567	558	0.686
70	0.295	225	0.463	388	0.576	560	0.686
80	0.296	230	0.440	390	0.580	562	0.682
90	0.305	235	0.442	395	0.572	564	0.683
100	0.297	240	0.443	400	0.576	566	0.688
110	0.297	250	0.443	405	0.572	568	0.681
120	0.300	260	0.444	410	0.579	570	0.679

Well no: M1A
Type of test: Step drawdown

Location: Anse Intendance, Mahe
SWL : 1.042 m

Time from start of test	Drawdown
min	m
575	0.690
580	0.678
585	0.683
590	0.689
595	0.685
600	0.687
610	0.689
620	0.689
630	0.685
640	0.686
650	0.690
660	0.681
675	0.684
690	0.670
705	0.668
720	0.679

Well No: M3A
Type of test: Constant Discharge
Elevation of datum: 3.91 m asl
Screen 0-8.0 m
Observation well distance: 4.92 m
Date and time of start of test:
1245 on 27 March 1978

Location: Anse Intendance, Mahe
Gr: $^{3}339$ $^{94}712$
SWL: M3A (pumped) 2.410 m M3 (Observation) 2.412 m
Pump set: 3.3 m
Pump rate: 473 m^3/d

Time from start of test min	M3A Drawdown m	M3 Drawdown m	Time from start of test min	M3A Drawdown m	M3 Drawdown m	Time from start of test min	M3A Drawdown m	M3 Drawdown m
1	0.370	0.034	135	0.661	0.331	1050	0.743	0.416
2	0.425	0.051	150	0.670	0.360	1080	0.739	0.416
3	0.436	0.073	165	0.677	0.347	1110	0.753	0.418
4	0.454	0.088	180	0.687	0.354	1140	0.741	0.418
5	0.463	0.090	210	0.692	0.363	1170	0.751	0.419
6	0.473	0.110	240	0.692	0.370	1200	0.752	0.420
7	0.479	0.117	270	0.710	0.390	1230	0.748	0.418
8	0.488	0.123	300	0.710	0.385	1260	0.750	0.419
9	0.502	0.130	330	0.710	0.390	1290	0.757	0.420
10	0.503	0.136	360	0.727	0.393	1320	0.749	0.419
12	0.500	0.146	390	0.735	0.398	1350	0.750	0.421
14	0.510	0.155	420	0.731	0.400	1380	0.748	0.419
16	0.512	0.161	450	0.732	0.402	1410	0.753	0.420
18	0.505	0.168	480	0.735	0.405	1440	0.746	0.418
20	0.502	0.188	510	0.732	0.406	1470	0.745	0.418
22	0.517	0.185	540	0.737	0.407	1500	0.742	0.416
24	0.538	0.194	570	0.740	0.410	1530	0.743	0.420
26	0.540	0.198	600	0.738	0.410	1560	0.738	0.418
28	0.541	0.203	630	0.744	0.413	1590	0.741	0.417
30	0.555	0.208	660	0.746	0.414	1620	0.747	0.419
35	0.566	0.221	690	0.752	0.413	1650	0.745	0.419
40	0.577	0.231	720	0.753	0.416	1680	0.749	0.420
45	0.590	0.239	750	0.747	0.418	1710	0.740	0.419
50	0.590	0.249	780	0.740	0.417	1740	0.747	0.418
55	0.590	0.257	810	0.757	0.419	1770	0.745	0.418
60	0.596	0.264	840	0.737	0.416	1800	0.745	0.419
70	0.622	0.278	870	0.746	0.416	1830	0.745	0.419
80	0.631	0.300	900	0.744	0.416	1860	0.745	0.418
90	0.641	0.310	930	0.744	0.414	1890	0.739	0.417
100	0.650	0.317	960	0.737	0.415	1920	0.746	0.418
110	0.650	0.320	990	0.738	0.415	1950	0.749	0.417
120	0.661	0.324	1020	0.746	0.416	1980	0.745	0.416

Well No: M3A
Type of test: Constant discharge

Location: Anse Intendance, Mahe'
SWL: M3A 2.410 m; M3 2.412 m

Time from start of test	M3A Drawdown	M3 Drawdown
min	m	m
2010	0.748	0.417
2040	0.747	0.416
2070	0.749	0.416
2100	0.753	0.418
2130	0.741	0.416
2160	0.748	0.415
2190	0.747	0.416
2220	0.743	0.416
2250	0.748	0.417
2280	0.757	0.417
2310	0.749	0.417
2340	0.749	0.417
2370	0.748	0.417
2400	0.750	0.417
2430	0.751	0.418
2460	0.749	0.417
2490	0.755	0.418
2520	0.749	0.418
2550	0.750	0.417
2580	0.749	0.417
2610	0.746	0.416
2640	0.750	0.417
2670	0.751	0.417
2700	0.743	0.416
2730	0.748	0.418
2760	0.743	0.416
2790	0.748	0.417
2820	0.740	0.415
2850	0.739	0.407
2880	0.729	0.396
Pumped stopped; recovery		
2881	0.275	0.348
2882	0.253	0.336
2883	0.240	0.325
2884	0.229	0.314
2885	0.222	0.305
2886	0.217	0.298
2887	0.211	0.289
2888	0.206	0.282
2889	0.202	0.276
2890	0.198	0.270
2892	0.193	0.260
2894	0.185	0.249
2896	0.177	0.240
2898	0.172	0.231
2900	0.167	0.225
2902	0.161	0.217
2904	0.157	0.209
2906	0.152	0.203

Well: M3A
Type of test: step drawdown
Elevation of datum: 3.91 m asl
Screen: 0 - 8.0 m
Date & time of test start: 1100 on 30 march 1978

Location: Anse Intendance, Mahe
G.R. ^{3}339^{94}712
SWL: 2.271 m
Pump set: 3.3 m
Pump rates: 170 m^3/d 252 m^3/d 346 m^3/d

Time from start of test	Drawdown	Time from start of test	Drawdown	Time from start of test	Drawdown
min	m	min	m	min	m
1	0.187	135	0.271	270	0.402
2	0.196	150	0.272	280	0.402
3	0.202	165	0.275	290	0.408
4	0.206	180	0.275	300	0.408
5	0.210	181	0.362	315	0.408
6	0.213	182	0.366	330	0.409
7	0.216	183	0.368	345	0.409
8	0.219	184	0.369	360	0.411
9	0.222	185	0.369	361	0.483
10	0.225	186	0.370	362	0.486
12	0.227	187	0.371	363	0.488
14	0.230	188	0.371	364	0.489
16	0.232	189	0.372	365	0.490
18	0.234	190	0.373	366	0.492
20	0.237	192	0.374	367	0.492
22	0.238	194	0.377	368	0.493
24	0.240	196	0.379	369	0.494
26	0.241	198	0.380	370	0.496
28	0.243	200	0.381	372	0.496
30	0.243	202	0.381	374	0.501
35	0.247	204	0.382	376	0.502
40	0.250	206	0.383	378	0.502
45	0.252	208	0.386	380	0.502
50	0.255	210	0.387	382	0.502
55	0.258	215	0.389	384	0.504
60	0.259	220	0.390	386	0.507
70	0.261	225	0.391	388	0.508
80	0.262	230	0.391	390	0.509
90	0.265	235	0.396	395	0.516
100	0.267	240	0.398		
110	0.269	250	0.400	pump stopped	
120	0.270	260	0.401		

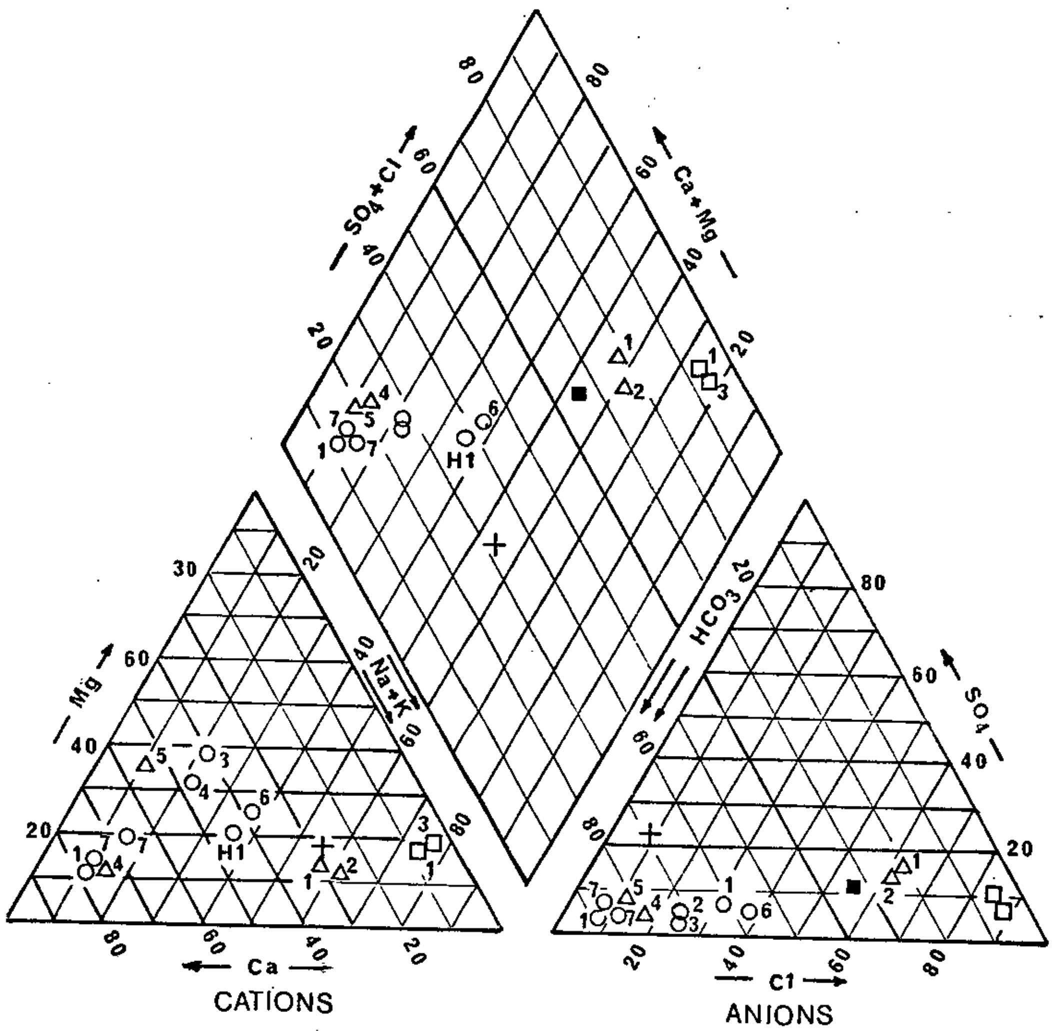
APPENDIX 3

WATER CHEMISTRY

Water samples were collected during this study from groundwater sources and of river water and rainfall for chemical analysis. The results are presented in Tables A.1 to A.3.

Heavy metal and ammoniacal nitrogen concentrations of less than 0.03 mg/l and fluoride concentrations of less than 0.1 mg/l are indicated by the symbol, Tr.

Although cadmium was included in the analyses, its presence was not detected in any of the samples and this constituent has not been included in each table.



O La Digue

□ Mahe Anse Intendance

■ Intendance River

\+ Salazie Rainfall

Δ Praslin

TRILINEAR DIAGRAM

Figure A.3.1

TABLE A 3 1

MAHE (ANSE INTENDANCE)

Sample		M1A	M3A		Rainfall at Salazie	Intenance River
Date		23/3/78	28/3/78	29/3/78	31/10/77	30/5/78
Period of Pumping		6 hours	24 hours	48 hours	-	-
EC (umhos)		5700	10000	9800	45	78
pH		8.1	7.9	8.4	7.8	7.2
TDS		3900	7810	6630	30	64
Total Hardness		860	1610	1440	10	20
Non-carb "	mg/l	680	1225	1220	0	5
CO_2					0.5	2
H_2S		0.5	1.86	1.74		
SiO_2		18	14	14	2	15
Ca		5.3	5.6	7.5	0.12	0.25
Mg		11.9	26.6	21.3	0.08	0.15
Na		50	102.2	84.8	0.22	0.43
K	me/l	1.0	1.5	1.6	0.02	0.02
HCO_3		3.6	7.7	4.4	0.30	0.29
SO_4		6.2	10.4	9.4	0.10	0.10
Cl		57.2	118.6	101.4	0.03	0.45
NO_3		0		0	0.01	0.01
NO_2 as N		Tr	0.01	0.01	0	0.02
Ammon. N		0.14	Tr	Tr	0.05	Tr
F		0.26	0.35	0.30	Tr	
Fe		0.19	0.07	0.10	0.03	1.00
Mn	mg/l	Tr	0.10	Tr	0	0.05
Zn		0.04	0.10	0.10		0.05
Cu		Tr	0.05	0.05	0	Tr
Pb		Tr	Tr	Tr	0	0.04
r Cl : HCO_3		15.9	15.40	23.04		

TABLE A 3 2

LA DIGUE

Sample		LD1		LD7		LD2	LD3	LD6	LDH1
Date	19/10/77	19/10/77	19/10/77	2/6/77	10/1/78	12/4/78	14/4/78	19/4/78	23/6/77
Period of Pumping	95 mins	195 mins	295 mins	40 mins	2 months	20 hours	20 hours	40 hours	
EC (umhos)	405	400	435	585	460	740	780	930	710
pH	7.9	8.1	8.1	7.7	8.0	7.9	8.0	7.9	8.0
TDS	270	280	290	390	320	520	510	650	510
Total Hardness	210	222	232	310	270	390	385	375	290
Non-carb "	20	7	2	0	10	40	25	55	15
CO_2	5	4	4	15	6	8			5
H_2S				10			0.32		
SiO_2	16	16	18	14	12	18	14	18	22
Ca	3.5	3.83	4.07	4.81	4.62	4.68	3.93	4.55	4.00
Mg	0.70	0.61	0.57	1.39	0.78	3.12	3.77	2.95	1.80
Na	0.54	0.62	0.54	1.09	0.61	2.04	2.07	4.35	3.04
K	0.04	0.04	0.05	0.03	0.05	0.09	0.08	0.14	0.13
HCO_3	3.80	4.30	4.60	6.20	5.20	7.20	7.10	6.80	5.50
SO_4	0.50	0.31	0.15	0.27	0.29	0.28	0.15	0.54	0.66
Cl	0.48	0.48	0.48	0.82	0.54	2.39	2.59	4.65	2.81
NO_3	0	0.01	0	0.03	0.03	0.06	0.01	0	0
NO_2 as N	0	0	0	0	0	0.01	Tr	0.01	0
Ammon. N	0.03	0.04	0.03	0.02	0.03	Tr	Tr	Tr	0.02
F	0.50	0.47	0.38	0.50	0.47	0.88	0.92	0.99	0.43
Fe	0.41	0.25	0.39	0.94	0.11	0.14	0.10	0.10	0.06
Mn	0	0	0	0.03	0	Tr	Tr	Tr	0
Zn	0.10	0.14	0.10	0.04	0.23	Tr	Tr	Tr	0.10
Cu	0	0	0	0	0	Tr	Tr	Tr	0
Pb	0	0	0	0	0	Tr	Tr	Tr	0
r Cl : HCO_3	0.13	0.11	0.10	0.13	0.10	0.33	0.36	0.68	0.51

TABLE A 3 3

PRASLIN

ample		P1	P2	P4	P5
ate		17/5/78	18/5/78	14/5/78	15/5/78
eriod of Pumping		12.5 hours	6 hours	5 hours	10 hours
EC (umhos)		48	49	520	510
I		6.3	6.6	7.8	7.8
TDS		46	49	380	380
otal Hardness		10	10	310	325
Non-carb "	mg/l	5	4	40	35
O_2		5	3	8	9
H_2S					0.32
iO_2		18	18	6	16
a		0.14	0.13	5.29	3.96
Mg		0.06	0.07	0.91	2.54
a	me/l	0.22	0.26	0.89	0.70
K		0.05	0.05	0.03	0.04
CO_3		0.10	0.12	5.60	5.80
SO_4		0.08	0.07	0.28	0.54
l		0.28	0.31	1.18	0.87
NO_3		0.01	0.01	0.06	0.03
O_2 as N		0.01	0.01	0.02	0.02
Ammon. N		0.04	0.03	Tr	Tr
		Tr	0.11	0.44	0.92
re	mg/l	3.25	0.03	0.13	0.06
n		Tr	Tr	Tr	Tr
l		0.04	0.03	Tr	0.05
Cu		Tr	Tr	Tr	Tr
)		Tr	Tr	Tr	Tr
Cl : HCO_3		2.80	2.58	0.21	0.15

ANNEX A

SALINE INTRUSION

1. The depth to saline water in an aquifer is related to the hydrostatic equilibrium between fluids of differing densities. This relationship is known as the Ghyben-Hertzberg relationship and is expressed as follows:

$$hs = \frac{pf}{ps - pf} hf$$

where ps and pf are the densities of saline and fresh water respectively, hs the depth below sea level of the saline interface, and hf is the water level height above sea level. Normal sea water gives a relationship of hs = 40 hf. Because of a dynamic equilibrium between the fresh water-salt water at their interface the depth to salt water computed from the Ghyben-Hertzberg relationship is usually less than the actual depth.

2. Usually fresh water escapes along the top of the saline wedge. From Darcy's Law the seaward flow of fresh water for a confined aquifer is expressed as follows:

$$q = \frac{1}{2} \frac{ps - pf}{pf} \frac{Tm}{L}$$

where q is the fresh water flow per unit of vertical contact at the front between the sea and fresh water, T is the transmissivity m the aquifer thickness, and L the length of the intruded wedge. As the length of the intruded wedge is inversely proportional to the amount of fresh water outflow any decrease in the outflow by groundwater abstraction causes the saline wedge to move landwards.

ANNEX B

STABLE ISOTOPE DETERMINATIONS

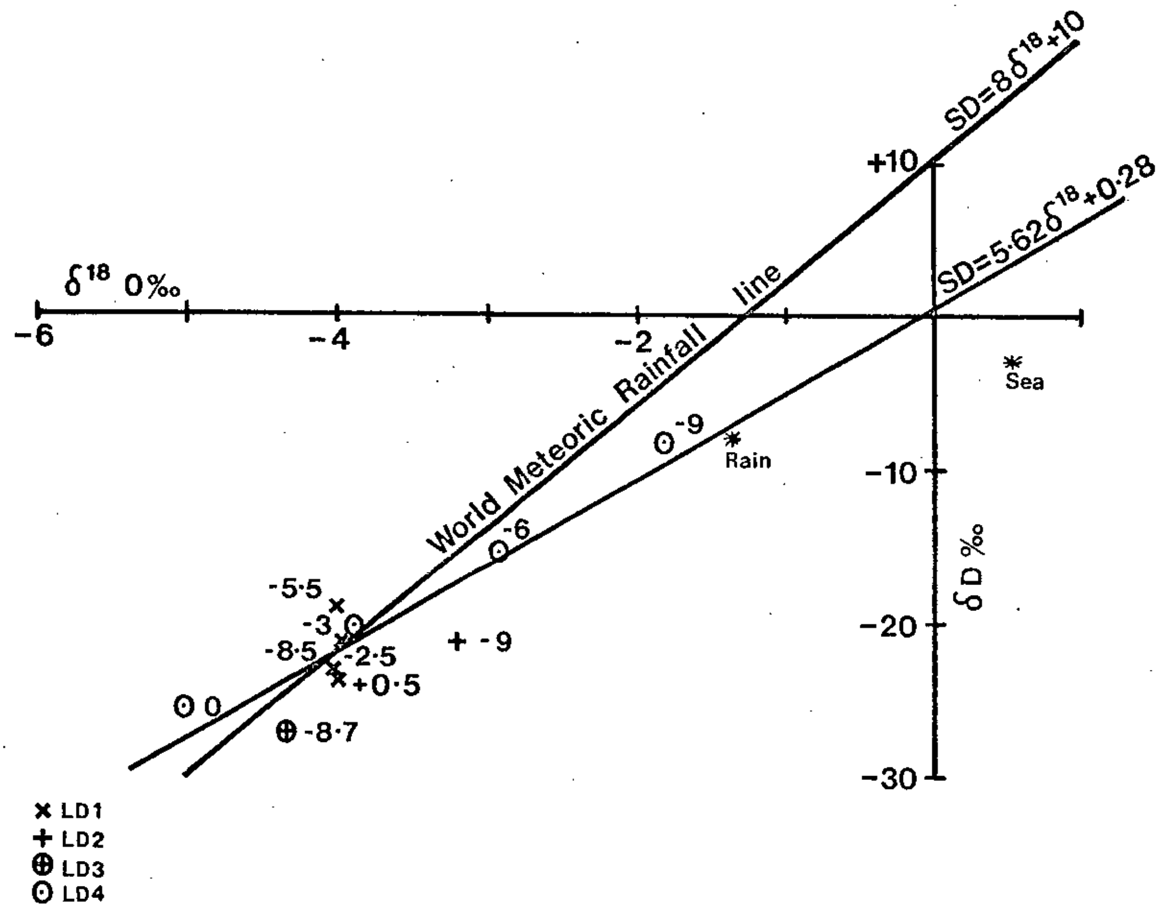
Deuterium (D) and oxygen-18 (^{18}O) occur in small quantities in all natural waters as $HD^{16}O$ and $H^2\,^{18}O$. Their concentrations depend upon the history of the water whilst in contact with the atmosphere with evaporation tending to control the concentrations of the stable isotopes. Groundwater recharged from rainfall without any evaporation concentration will retain the isotopic characteristics of the rainfall and can be related areally to the location of the recharge by comparing the relative concentrations of D and ^{18}O. A limited study of isotopic composition has therefore been carried out and the results compared to the routine monitoring of isotopes in rainfall at a low elevation at Mahe undertaken by the International Atomic Energy Agency for 1961-63[1].

Ten groundwater samples were collected on La Digue, together with one rainfall sample and seawater. These were analysed at the Carbon14/Tritium Measurement Laboratory of the Atomic Energy Research Establishment, Harwell. The results are shown in Table B1 and Figure B1 where they are presented in a conventional δD-$\delta^{18}O$ diagram.

The isotopic composition of normal groundwater on La Digue is low ranging in composition from $\delta^{18}O$ = $-5.0‰$ to $-3.0‰$ and D = $-25.7‰$ to $-19‰$. The samples collected at site LD4 (60 m from the sea) through a saline water transition zone show increasing isotopic concentrations with depth and confirm a mixing of fresh groundwater with sea water as the source of the salinity.

Generally, the isotopic compositions of the groundwater samples are sufficiently similar to suggest a common origin and post-recharge history. There is little indication of isotopic concentration due to long residence times and direct evaporation from shallow aquifers.

[1] *1969, Environment Isotope Data: World survey of Isotope Concentractions in Precipitation. IAEA Tech. Rep. Ser. No. 96*



ISOTOPIC COMPOSITION OF GROUNDWATER

Figure B. 1

ISOTOPIC COMPOSITION OF WATER SAMPLES

Sample No[1]	Well	Depth (relative to sea level) (m)	$\delta^{18}O$ ‰	δD ‰
LD1 - 3 m	LD1	+0.5	-3.98	-23.6
LD1 - 6 m		-2.5	-4.01	-23.2
LD1 - 9 m		-5.5	-4.00	-19.0
LD1 - 12 m		-8.5	-3.96	-21.3
LD2 - 12 m	LD2	-9.0	-3.20	-21.2
LD3 - 12 m	LD3	-8.7	-4.33	-27.4
LD4 - 3 m	LD4	0	-5.01	-25.7
LD4 - 6 m		-3.0	-3.89	-20.4
LD4 - 9 m		-6.0	-2.92	-15.4
LD4 - 12 m		- 9.0	- 1.81	- 8.2
	sea[2]		+0.52	- 3.0
	rain[3]		-1.37	- 7.9

Notes: [1] *Samples taken on 20 May 1978*

[2] *Sample taken at Anse Forbans, Mahe on 30 May 1978*

[3] *Sample taken at the International Airport on 27 May 1978*

The isotopic concentrations in the rainfall samples taken in 1961-63 are lower than in the rainfall sample collected in May 1978 from a similar elevation but are higher than in the samples of groundwater. Low isotopic concentrations are likely to be associated with storms of higher magnitude as well as high elevation rainfall. Consequently, with the limited data available, it is not possible to distinguish whether the low isotopic concentrations in the groundwater reflect recharges of wet season storm rainfall on the plateau or recharge of runoff from high elevation rainfall.

ANNEX C

SURFACE WATER HYDROLOGY

Data availability

The principal island of Mahe has an extensive network of over 30 raingauges although the smaller islands have a less comprehensive coverage. Mean monthly rainfall data are available for the islands included in the study area and to assess the variability of rainfall, we have used the monthly rainfall data from Long Pier, Victoria, which has the longest period of record (62 years).

Six years of data are available from the meteorological station at the International Airport on Mahe to estimate, by use of the Penman method, open water evaporation and potential evapotranspiration from a 'green' crop. The meteorological record at this site is the most comprehensive available.

A number of rivers and streams are now being gauged. The data from these stations with the longest and most reliable record were used to estimate the flow of ungauged streams.

Rainfall variability

Analysis of the record of rainfall from Long Pier, Victoria found no significant serial correlation between annual rainfall totals. This would indicate that periods of exceptionally low rainfall are unlikely to extend over many years.

We have also used the rainfall record from Long Pier to estimate the minimum annual rainfall to be expected to occur on average

TABLE C.1

DRY YEAR RAINFALL AT LONG PIER, VICTORIA

Return period (years)	2	5	10	20
Annual rainfall (mm)	2328	1950	1730	1550
Proportion of mean annual rainfall	100%	84%	74%	67%

once in a 5, 10 or 20 year period. In our estimate, we have necessarily assumed that the rainfall distribution at Long Pier (see Figure C.1) is representative of the islands in general. In this way, the minimum annual rainfall can be expressed as a percentage of the mean annual rainfall as given in Table C.1.

Evapotranspiration

Where water is freely available for crop use, actual evaporation approaches the potential evaporation, which can be estimated from meteorological data using the Penman approach.

We have assumed an albedo of 0.25 which is an appropriate value for green vegetation to estimate a potential transpiration of 1600 mm/year. This value is assumed to apply to all the study areas.

Surface runoff

The available streamflow data were examined and six stations were selected for further study. The stations were Baie Lazare, Anse Poules Bleues, Le Niol, Mamelles and Mare aux Cochons on Mahe, and Maurice Payet on La Digue. The mean annual runoff recorded at these stations varied from 1000 to 1500 mm/year for the Mahe stations, with the Maurice Payet catchment yielding 330 mm/year, as shown in Table C.2.

Analysis of the monthly rainfall and runoff was severely hampered by the lack of concurrent rainfall and runoff records. Those that were available showed a considerable contrast between stations. We cannot therefore substantiate the measured runoff data without further field studies, which are not strictly justified in the context of the current groundwater project.

Thus, in order to estimate the potential recharge available to the plateau areas, we have derived runoff estimates by a water balance approach. Data from the gauged catchments suggest that the average year losses are, in general, close to potential transpiration, 1600 mm/year (see Table C.2). The deviation from this figure for the Anse aux Poules Bleues catchment can, perhaps, be the result of poor stream gauging practice, or inaccurate catchment rainfall

GAUGED CATCHMENTS MEAN ANNUAL WATER BALANCE

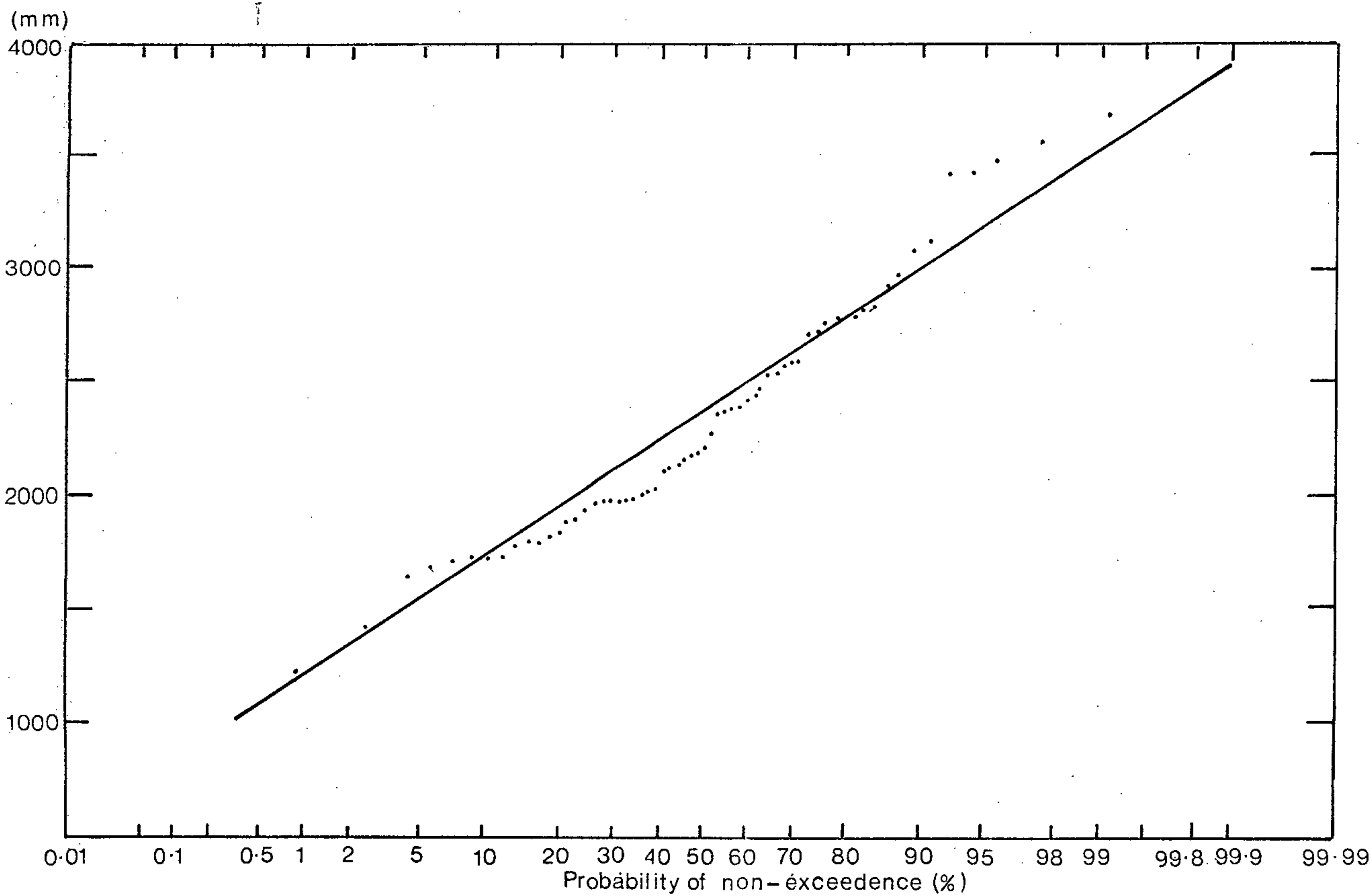
Catchment	Estimated mean annual catchment rainfall (mm)	Mean annual runoff (mm)	Mean annual losses (mm)
MAHE			
Le Niol	3000	1400	1600
Mare aux Cochons	2600	1000	1600
Mamelles	3000	1330	1670
Anse aux Poules Bleues	2400	1500	900
Baie Lazare	2400	1100	1300
LA DIGUE			
Maurice Payet	1750	330	1420

TABLE C.3

SURFACE RUNOFF BEHIND PLATEAU AREAS
(mm)

Area	Catchment area (km^2)	Return period (years) Mean	5	10	20
La Digue	2.81	330	100	50	25
Praslin - Pasquiere	2.15	700	360	150	50
L'Amitie	0.68	700	360	150	50
Mahe - Intendance	2.08	900	530	300	140

Figure C.1



ANNUAL RAINFALL-LONG PIER, VICTORIA

estimation. For the ungauged catchments of interest in this study, it is assumed that the potential transpiration losses will not quite be attained, an average annual catchment loss estimate of 1400 mm/year seems reasonable.

This approach can be extended to produce runoff estimates for the 5, 10 and 20 year return period dry years. However, interpretation of the results requires care. The assumption, implicit in this approach, that all vegetation within the catchment remains transpiring throughout the year at its potential rate might well be violated for the longer return period droughts. A number of alternative methods were examined to attempt to quantify the expected dry year runoff, but none produced estimates in which we had any great confidence. The estimates of runoff finally adopted, Table C.3, were made by use of the water balance model, assuming potential evapotranspiration losses. When the runoff estimate dropped to an unrealistically low value, a subjective estimate was made of the possible drop in evapotranspiration losses due to the drought, and the runoff increased accordingly.

Water potentially available for recharge

The availability of direct rainfall or indirect rainfall from surface water runoff from the upland catchments to each study area is shown in Table C.4 for return periods of 5, 10 and 20 years.

TABLE C.4

POTENTIAL AVAILABILITY OF WATER FOR RECHARGE

Return period (years)	Plateau area (km^2)	Rain (R) (mm)	Evapotranspiration (E) (mm)	(R)-(E) (m^3x10^3)	Surface runoff(I) (m^3x10^3)	(I)+(R)-(E) (m^3x10^3)
LA DIGUE	1.87					
2		1640	1600	75	925	1002
5		1380			280	0
10		1210			140	
20		1100			70	
PRASLIN-PASQUIERE	0.10					
2		2020	1600	59	1505	1560
5		1695	1600	13	775	790
10		1490	1600	-15	320	300
20		1350	1600	-35	110	75
PRASLIN - L'AMITIE	1.27					
2		2040	1600	559	475	1035
5		1715	1600	146	245	390
10		1510			100	
20		1370			35	
MAHE - INTENDANCE	0.22					
2		1800	1600	44	1870	1915
5		1510	1600	-20	1100	1080
10		1330	1600	-59	625	565
20		1210	1600	-86	290	200