5. WATER RESOURCES IN SURINAME

5.1 Surface Water

(a) River Basins. Seven first-oeder rivers drain the area of Suriname towards the Atlantic Ocean. Three main groups are distinguishable when comparing the extent and shape of the drainage areas (FIG.5.1-1).

A first group is represented by the larger Marowijne and Corantijn Rivers, with drainage areas of 68 700 and 67 600 km^2, respectively, which form the eastern and western boundaries of Suriname. Together they drain 58% of the country.

A second group is represented by the Coppename River (21 700 km^2) and the Suriname River (16 000 km^2), which drain approximately 24% of the country. The basins are elongated in a NE - SW direction located in the North-central area. They are seperated by the Saramacca basin except in the extreme headwater area, where they have a common divide.

A third group is represented by the Nickerie River (10 100 km^2), the Saramacca River (9 000 km^2), and the Commewijne River (6 600 km^2). Together they drain about 16% of the country. The centrally located Saramacca basin is elongated in a NE - SW direction. The Nickerie basin in the west is less elongated, and the Commewijne basin in the east is subtriangular.

The drainage towards the coast is such that 38% of the area drains to the extreme west (Corantijn and Nickerie Rivers) and 27% to the extreme west (Marowijne River). The remaining 35% drains to the east central area discharging at the Coppename-Saramacca rivermouth and the Suriname-Commewijne rivermouth.

The rivers are tidal generally up to the most seaward rapids about 90 to 120 km inland.

(b) River Flows. The most important river-gaugung stations are located in the basement area upstream from the tidal influence. The locations and the corresponding drainage basin areas are shown in FIG.5.1-1. The flows are listed in Tables 5.1-1 and 5.1-2 (UNDP, 1972). They compare in magnitude with the three groups of drainage basins outlined.

Flows vary seasonally, comparing with the seasonal rainfall distribution. This is illustrated by the hydrographs of the Marowijne and Corantijn Rivers (FIG.5.1-2). The highest flows are in May, June, and July, with a peak generally in May or early June, corresponding with the long wet season. The lowest flows are in November at the end of the long dry season. The short wet and short dry season are not as well defined, and at times they cannot be distinguished.

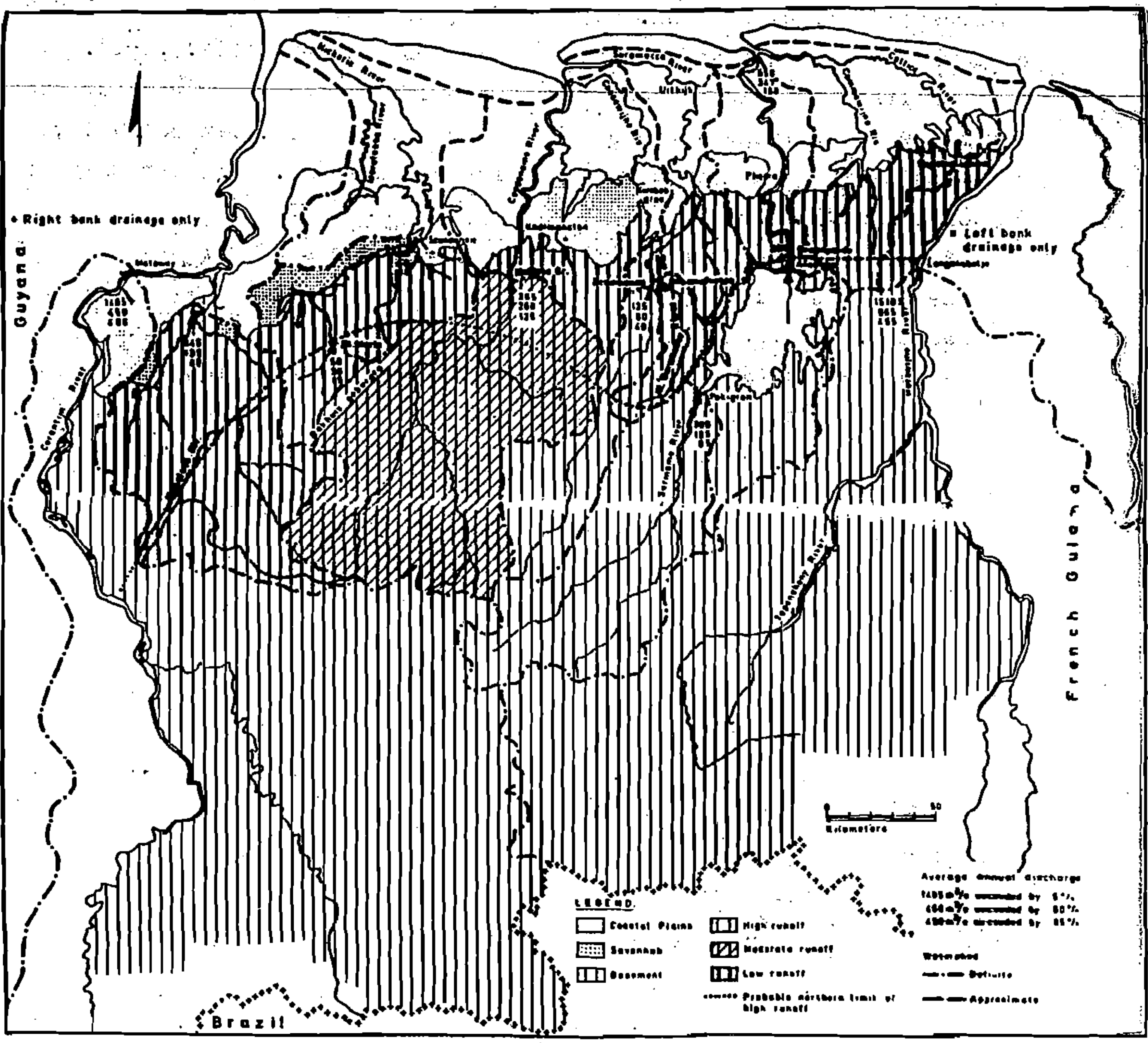


FIG.5.1-1 Drainage basins of Surinam
(From: UNDP, 1972)

TABLE 5.1-1

(From: UNDP, 1972)

RUN-OFF AND RAINFALL CHARACTERISTICS OF THE SURINAME AND MAROWIJNE RIVERS AND THEIR BASINS, 1952-1960

River, Station, and Drainage Area	Year								
	1952	1953	1954	1955	1956	1957	1958	1959	1960
Suriname River at Pokigron 7,750 km^2	+ 197 25.4 2,177	378 48.7 2,624	295 38.1 2,381	269 34.7 2,563	293 37.8 2,383	220 28.4 2,076	139 17.9 1,848	155 20.0 1,974	234 30.1 2,212
Marowijne River at Langetabbetje 63,700 km^2	1,529 24.0 -	2,088 32.8 -	1,717 26.9 2,569	1,955 30.7 2,510	1,943 30.5 2,249	1,776 27.9 2,194	1,745	2,095	1,503 23.6 2,513

\+ 197 Mean annual discharge in m^3/s

25.4 Average annual unit discharge in $l/s/km^2$

2,177 Annual rainfall total in mm

E Estimated

TABLE 5.1-2

(From: UNDP, 1972)

RUN-OFF AND RAINFALL CHARACTERISTICS OF THE SURINAM RIVERS AND THEIR BASINS, 1961-1970

River, Station, and Drainage Area	Year									
	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Corantijn River at Mataway 51,600 km^2						+ E 811 15.7 2,138	E 1,388 26.9 2,354	E 1,647 31.9 2,534	1,434 27.8 1,893	1,464 28.4 2,436
Kabalebo River at Avanavero 9,020 km^2					E 53 5.9 1,463	E 71 7.9 2,025	E 166 18.4 2,171	E 252 27.9 2,705	154 17.1 2,134	155 17.2 2,464
Nickerie River at Blanche Marie 1,260 km^2							33 26.2 2,446			
Nickerie River at Stondansie 5,160 km^2			E 141 27.3 2,714	18 3.5 1,700	38 7.4 1,947	43 8.3 1,965	86 16.7 2,408	116 22.5 2,594	83 16.1 2,083	113 21.9 2,766

+ 811 Mean annual discharge in m^3/s

15.7 Average annual unit discharge in $l/s/km^2$

2,138 Annual rainfall total in mm

E Estimated

TABLE 5.1-2 (cont.)

(From: UNDP, 1972)

RUN-OFF AND RAINFALL CHARACTERISTICS OF THE SURINAM RIVERS AND THEIR BASINS, 1961-1970

River, Station, and Drainage Area	Year									
	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Coppename River at Maksita Kreek 12,300 km^2					+ 189 15.4 2,115	211 17.2 2,175	267 21.7 2,511	E 382 31.1 2,866	334 27.1 2,307	
K. Saramacca River at Anoemafoetoe 1,340 km^2		14.4 10.8 1,913	26.4 19.7 2,287	6.7 5.0 1,966	12.6 9.4 2,016	9.7 7.2 2,150				
Saramacca River at Dramhosso 3,520 km^2	52 14.8 1,968	82 23.3 2,053	135 38.4 2,799	32 9.1 1,765	64 18.2 2,115	64 18.2 2,202	90 25.6 2,228	119 33.8 2,817	128 36.4 2,391	96 27.3 2,605
Suriname River at Pokigron 7,750 km^2	145 18.7 2,175	181 23.4 2,153	290 37.4 2,734	86 11.1 1,772	142 18.3 2,225	142 18.3 2,468	201 25.9 2,539	293 37.8 3,180	257 33.1 2,291	199 25.7 2,604
Marowijne River at Langetabbetje 63,700 km^2	1,049 16.5 1,907	1,891	E 2,261 35.5 2,843	E 992 15.6 1,842	E 960 15.1 2,059	2,434	1,715 26.9 2,481	2,979	1,784 28.1 1,955	1,642 25.8 2,637

\+ 189 Mean annual discharge in m^3/s

15.4 Average annual unit discharge in $l/s/km^2$

2,115 Annual rainfall total in mm

E Estimated

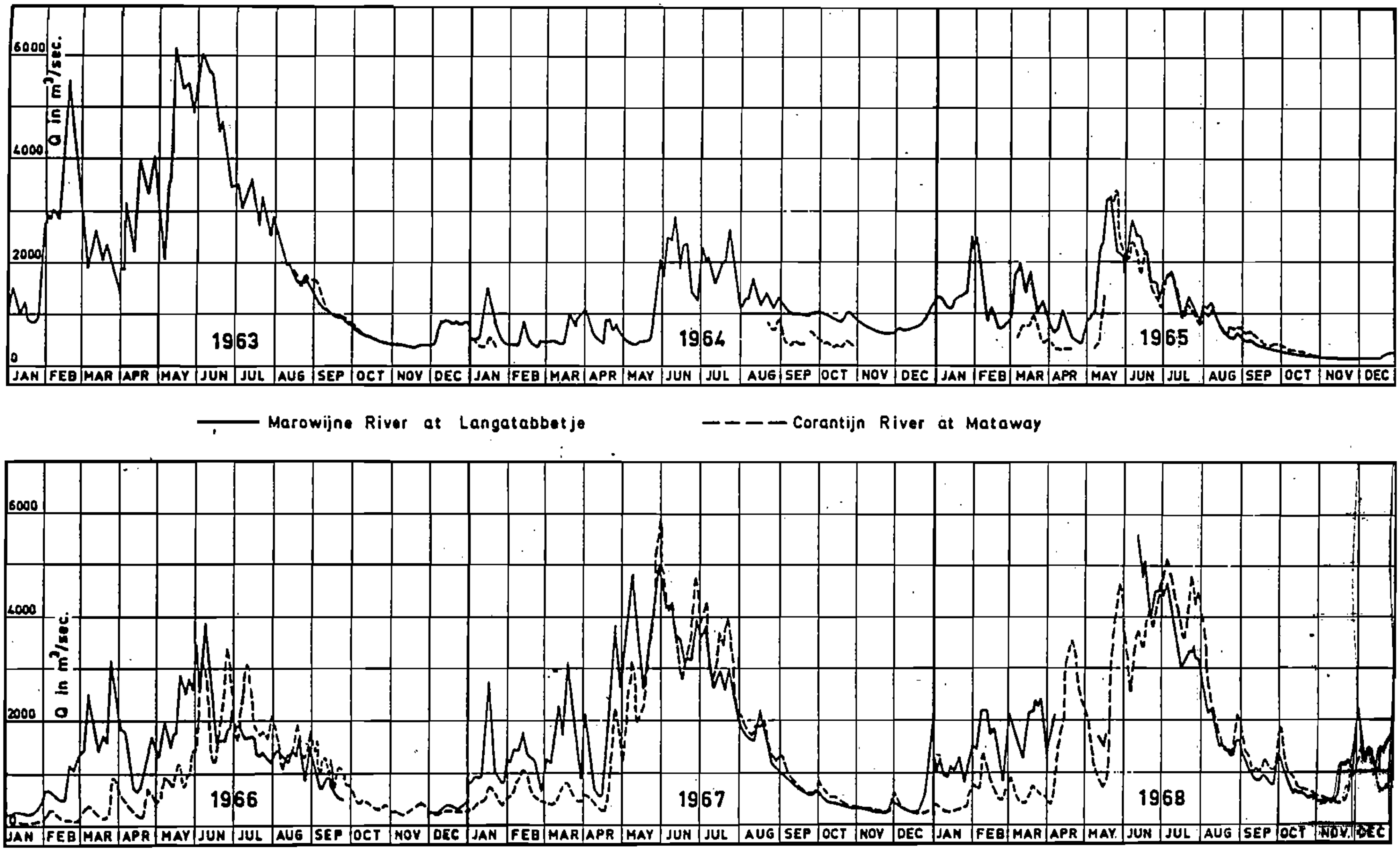


FIG.5.1-2 Hydrographs of the Marowijne and Corantijn Rivers

(From: UNDP, 1972)

(c) Unit Discharge. A wide variation of annual unit discharge is evident from the values listed in Tables 5.1-1 and 5.1-2. The parameter represents average conditions within a basin. It tends to decrease with increasing area, but in Suriname this is not necessarily the case. The values plotted against basin areas (FIG.5.1-3) show a slight decrease with increasing basin areas for most years, but this cannot be considered significant because of the variations in annual rainfall.

The frequency of average annual unit discharges for the years 1952-1970 inclusive is illustrated in FIG.5.1-4, with the basins divided into two groups. The first group represents high runoff basins for which the median unit discharge is 25 $l/s/km^2$, and the second group represents relatively low runoff basins for which the median unit discharge is 15 $l/s/km^2$.

A relationship is evident between the low and high runoff groups of basins in the form of a linear correlation between the two, which differ quatitatively (FIG.5.1-5). In the low runoff group the values of runoff are only 39 to 69% of those originating from the same rainfall depth in the high runoff group.

Altnough several factors such as the amount of intensity of rainfall, geology, topography, vegetation, and evaporation contribute to the amount of runoff and consequently the unit discharge, it is apparent that the geology in particular and the rainfall contribute most to the differences between basins.

(d) Hydrologically distinct areas. Differences in runoff as illustrated by unit discharge are evident within the drainage basins in the basement area as mapped (Fotogeologische Kaart van Suriname). Notably, the Kabalebo, Kleine Saramacca, and Nickerie (Stondansie) basins are characterized by low runoff. In addition to this, a common feature is their location along the northern fringe of the basement area on which at least a discontinuous veneer of basin sediments extends beyond the limit of the coastal basin, as shown by the Savannah area. The Nickerie and Kabalebo basins actually include part of the Savannah upstream from the gauging station.

The unit discharges represent average conditions throughout a basin, which may vary considerably. This is illustrated by differences in unit discharge for the Nickerie basin in 1967 (Table 5.1-2 and FIG.5.1-6) at Blanche Marie (26.2 $l/s/km^2$) and at Stondansie (16.72 $l/s/km^2$). Unfortu-

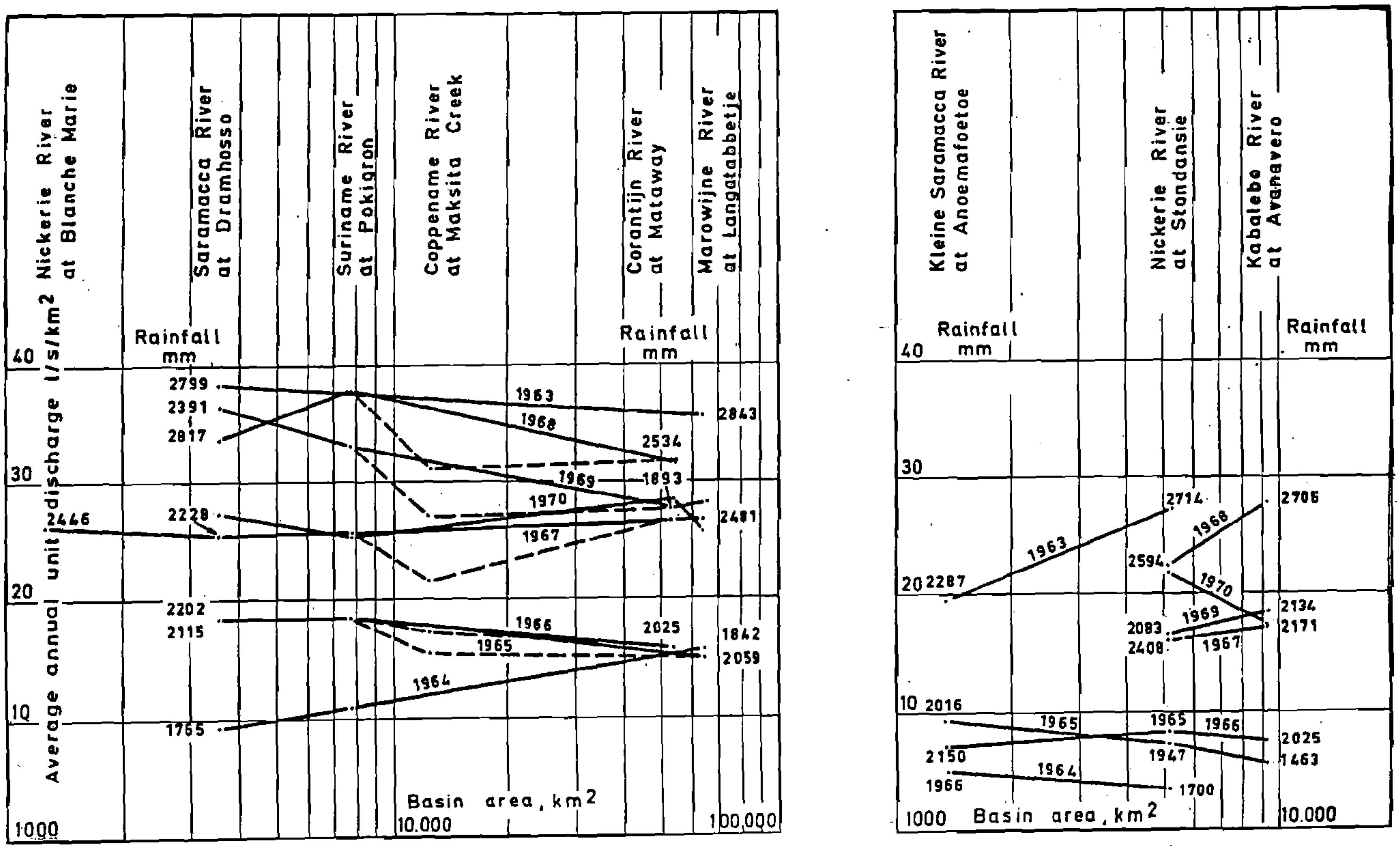


FIG.5.1-3 Average annual unit discharges and basin areas

(From: UNDP, 1972)

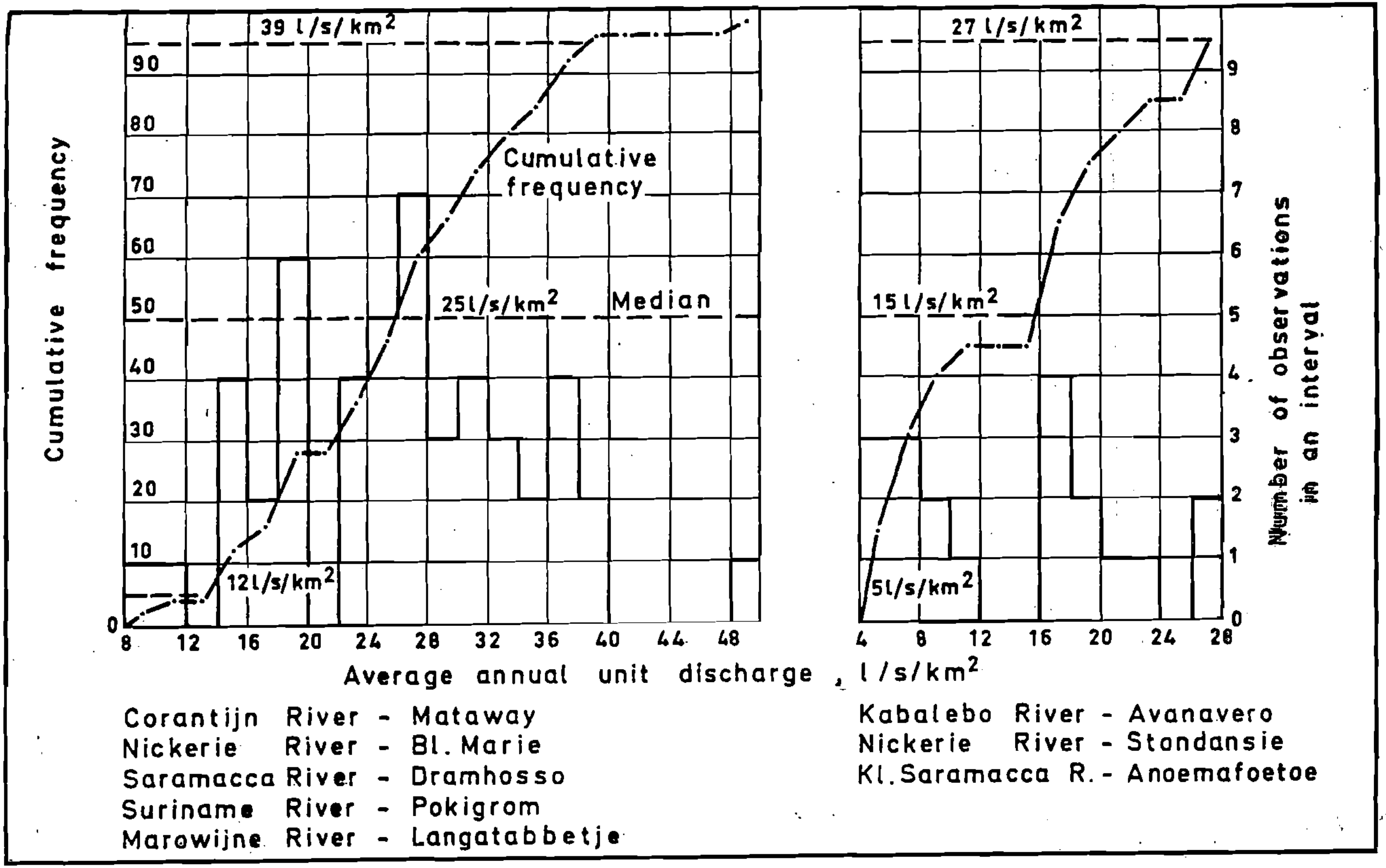


FIG. 5.1-4 , Distribution of average annual unit discharge for the years 1952 - 1970 inclusive (From: UNDP, 1972)

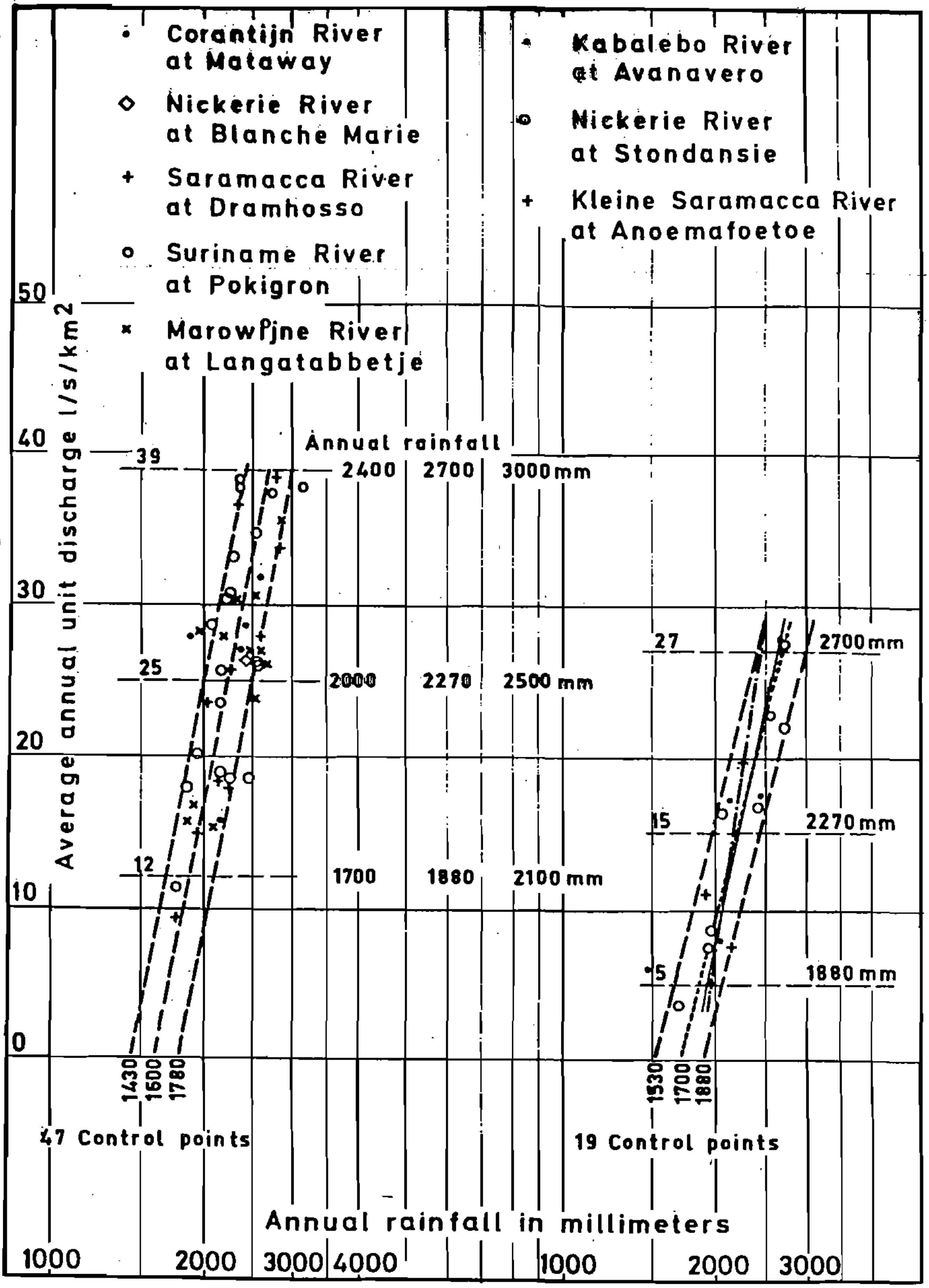
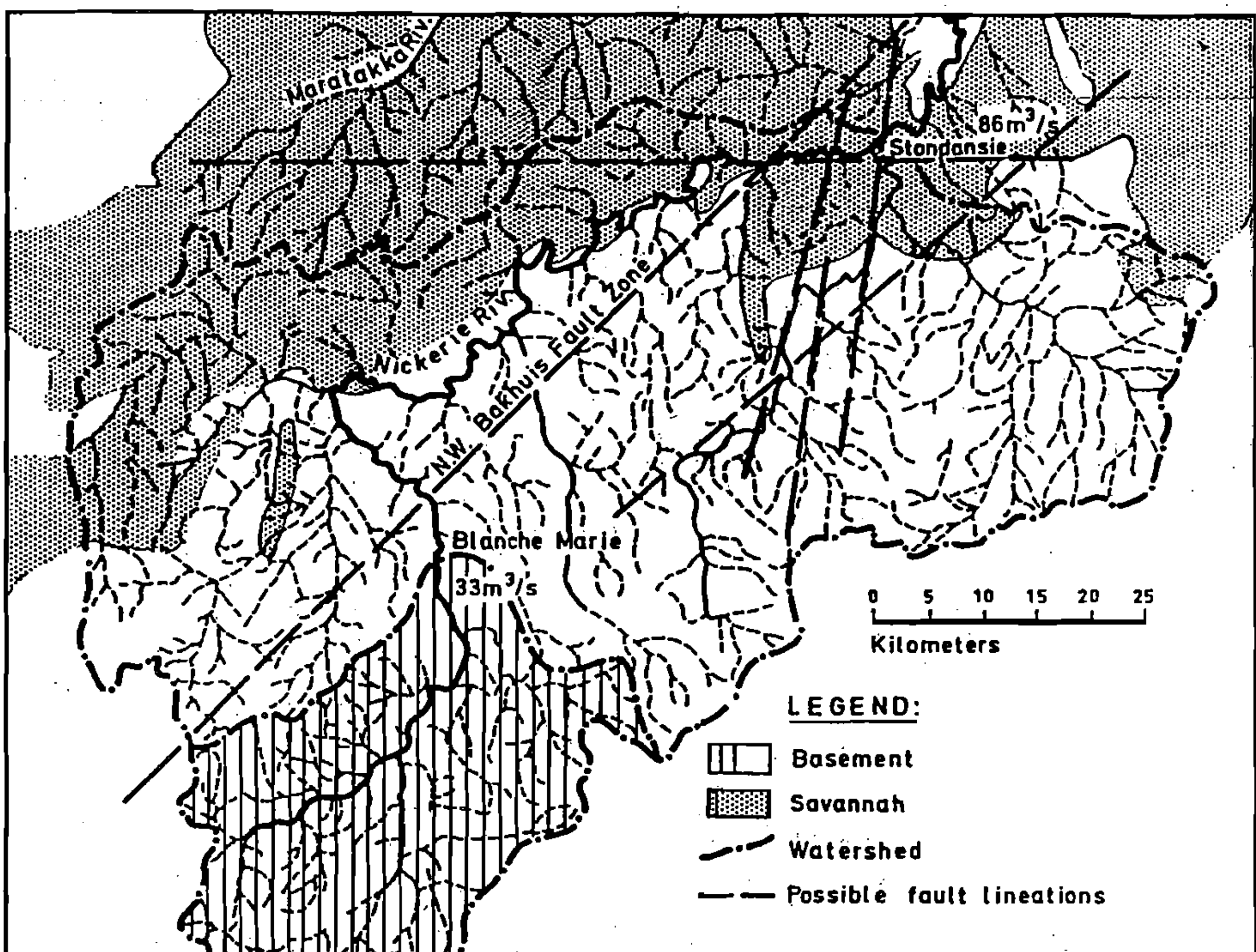


FIG.5.1-5 Relationship between annual rainfall and average annual unit discharge

(From: UNDP, 1972)



	Area km^2	1967 Discharge m^3/s	1967 Unit Discharge $l/s/km^2$
Stondansie	5160	86	16.7
Blanche Marie	1260 (24.4 %)	33	26.
Bl. Marie to Stondanie	3900 (75.6 %)	53	13.4
Savannah	980 (19 %)		

FIG. 5.1-6 The Nickerie River basin

(From: UNDP, 1972)

nately, discharge measurements at Blanche Marie are available only for the one year, and, whereas it serves to illustrate the difference, its quatitative significance is questionable. The basin received above-average rainfall in 1967, which could give an above-average runoff in the upper basin, but it followed three years of below-average rainfall and therefore runoff in the lower basin might have been lower than expected because of depleted soil moisture. The part played by the Savannah, remnants of older basin sediments, and possibly deeper weathering with less erosion in areas of low relief would be to retain water that would normally runoff a bare rock surface. Some of this may enter the zone of saturation, percolate locally to streams, and reappear as an effluent flow, while much of it would evapotranspire.

Differences in the amount of runoff probably occur in the Kabalebo basin as in the Nickerie basin with high runoff in the upstream areas; indeed, the difference likely exists in all the basins with a belt of low runoff extending along the entire northern fringe of the basement area. The possible southern limit of this low runoff belt is shown in FIG.5.1-1. The Suriname basin upstream from Pokigron falls south of it and hence high runoff is measured. The southward bulge coinciding with the Kleine Saramacca basin may represent the influence of low rainfall, in addition.

Unfortunately, there are no flow data available for the coastal area, and the runoff characteristics can be considered only indirectly. Infiltration and effluent ground water flow to streams is a feature of the Savannah area and most of the Old Coastal Plain, while natural discharge in the Young Coastal Plain is incipient and swamps abound.

(e) Hydrologically distinct seasons.

Long Wet Seaoson. The influence of the long wet season on runoff is best illustrated by runoff data from the Suriname and Marowijne Rivers, for which the longest records are available (19 years).

The volume of discharge of the Suriname River at Pokigron in the four months of the long wet season, April-July inclusive, varies between 50 and 70% (average 62%) of the annual discharge volume.

The weight of the long wet season in contributing to the annual runoff of the Marowijne River basin is lower than for the Suriname River basin. It amounts to between 45 and 64%, for an average of 56%.

Long Dry Season. The discharge of the Suriname River at Pokigron during the four-month long dry season (August-November, inclusive) for the 19-year observation period varies between 10 and 28%, for an average of 17% of the total discharge. Thus, the average volume of the long wet season runoff is 3.65 times larger than that of the long dry season.

A parallel situation occurs in the Marowijne River basin, with the seasonal flows varying between 10 and 32 for an average of 17% of the annual flow.

5.2 Ground water

(a) Precambrian basement as an aquifer. The rocks of the basement are for the most part granites, gneiss and similar rock-types, known as crystalline rocks which generally are impervious. They are deeply weathered, but the process involves the decomposition of feldspars and ferromagnesian minerals into clay minerals; although the weathered rocks may become more porous, the hydraulic conductivity would be too low to consider them as aquifer material. Clayey and micaceous sands were intersected locally above the hard basement by tests drilled in the Savannah area.

Widespread faulting of the basement is part of the tectonic history of the region, the most notably of which being the Bakhuis fault zone. However, a series of evidences indicate that it seems unlikely that significant quantities of water flow through fractures in the basement at the present time.

(b) Cretaceous aquifers. The Nickerie formation of Cretaceous age is confined deep in the coastal area (FIG.5.2-1). There is a dominance of sand and gravel, but water is brackish. Because of its water quality and depth, the formation is not considered further.

(c) Onverdacht aquifers. The Onverdacht aquifers include the sand members of the Onverdacht formation. It has not been as widely explored for ground water as the overlying formations.

Onverdacht formations occur as an almost continuous downfaulted coastel unit, confined beneath younger Tertiary sediments; it ends against the rising basement immediately north of the Bauxite Belt. In the Paramaribo area the top is at depths of 120 to 450 m. The sand horizons are 30 to 50 m thick, and the aquifers constitute between 30 and 50% of

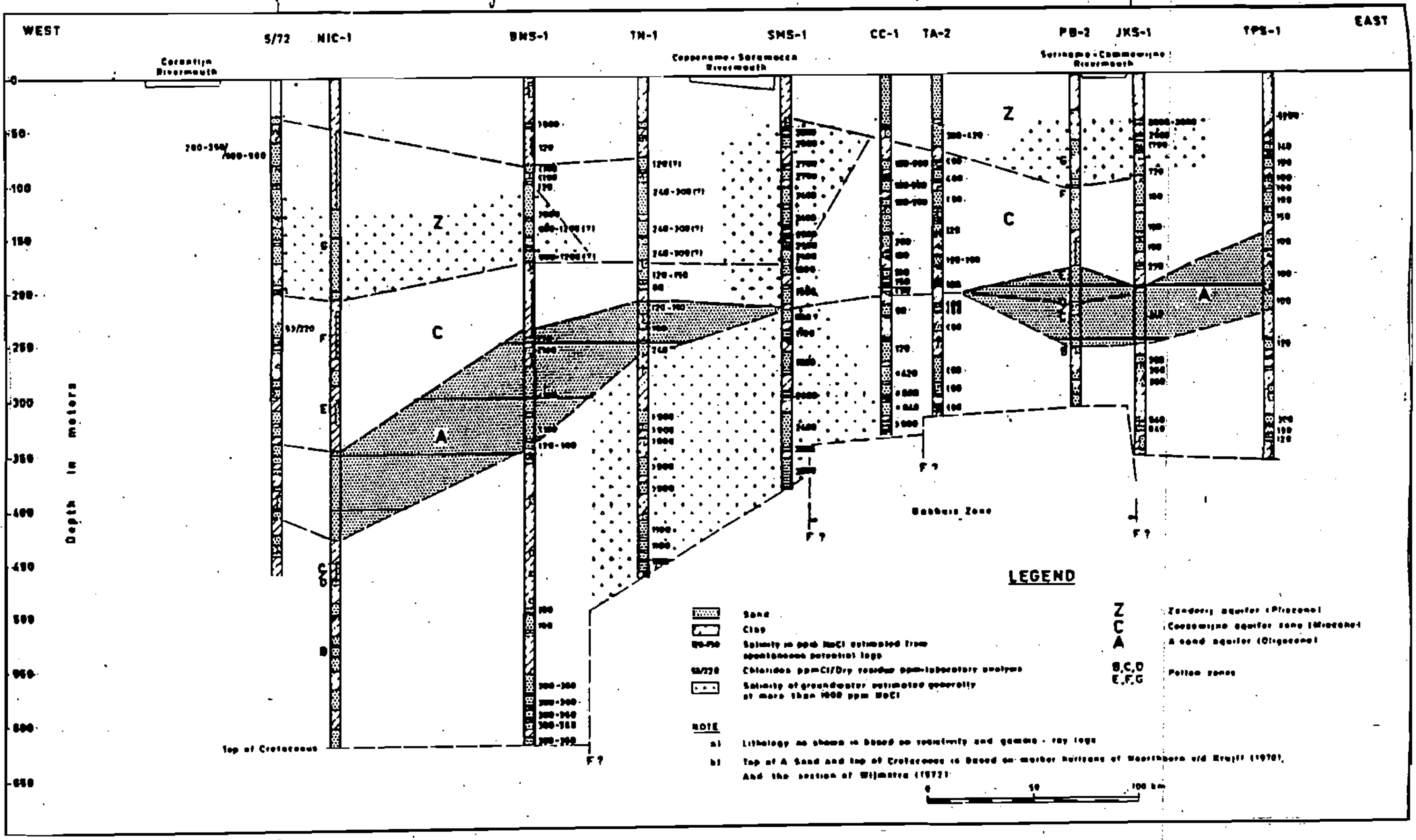


FIG.5.2-1 Section Nickerie to Alliance showing lithology and groundwater salinity of Tertiery and Quaternary sediments as deduced from well logs (From: UNDP, 1972)

the formation in most areas (FIG.5.2-1). A more or less discontinuous unit is present at higher levels in the Bauxite Belt.

The only aquifer test under leaky artesian conditions rendered a transmissivity of 75 m^2/day and corresponding hydraulic conductivity of 8 m/day, and storativity in the order of 10^{-3} to 10^{-4}. At other places, incomplete tests indicated hydraulic conductivity values from 5 to 40 m/day. It is assumed that non-leaky confined conditions prevail throughout the coastal area.

The chemical quality is variable according to the occurrence. At Onverdacht (Bauxite Belt) wells yield water low in dissolved solid: dry residue of 75 ppm and chloride of 19 ppm. Close to the north brackish water is reported (chloride content 4065 and 3672 ppm). In the coastal area east and northeast of Paramaribo the water is mainly brackish (chlorides generally in excess of 1500 ppm). At Meerzorg, the chlorides in the interval 161 to 188 m increase with depth from 323 to 590 ppm. At Livorno, chloride content is 111 ppm. A similar condition with A-Sand aquifer containing fresh water overlying directly the Onverdacht formation appears to exist north of Jarikaba.

Historical water levels in the coastal area indicated the highest level in the test well at Nieuw Amsterdam (3.9 m ACL or about 5 m NSP). The level is lower farther inland at Jagtlust (0.97 m ACL or about 3 m NSP), Meerzorg (0.75 mACL or about 2.7 m NSP), and at Tamanredjo (0.2 m BCL or about 2.0 m NSP). This an evidence of an apparent inland flow of ground water.

Since in the coastal areas the Onverdacht aquifers are everywhere confined to the inland slope of the piezometric surface, and water levels are higher than in the overlying aquifers, such conditions rule out the possibility of modern recharge. In the Bauxite Belt, the possibility of local recharge is present.

(d) A-Sand aquifer. The unit corresponds with the A-Sand formation, probably of Oligocene age, consisting of coarse- and fine-grained angular sand and in places of coarse angular sand and fine-rounded gravel. The aquifer is present in the coastal plain north of the Bauxite Belt. It thins inland ending against the rising basement or intervening eocene sediments. It is confined beneath Coesewijne clays and above the Onverdacht formation. Locally it is in contact with the lowest Coesewijne aquifer, which is also confined, and with sands of the Onverdacht formation below. The roof is relatively uniform, sloping gently with a gradient of about 0.003 m/m to the north, but the floor is irregular, conforming with the topography of the post-Eocene surface (FIG.5.2-2).

Along the coastal area an eastern and a western unit are evident, seperated by an area coinciding with the Bakhuis zone, where the floor is higher and the aquifer is thinner or missing.

The eastern unit extends inland south of Paramaribo to the northern edge of the Bauxite Belt. It does not continue east beyond the Suriname River in areas south and east of Meerzorg. The aquifer is at a depth of 120 m in the south and 160 m near the coast, with corresponding thicknesses of a few meter to 60 m, respectively. A relatively thick section of aquifer extends inland following the SE Bakhuis fault, likely as an infilled burried valley.

The western unit is not exploited for water supplies, but it is known from oil tests. It extends inland from 30 to 50 km. In the Nickerie area the top is at a depth of 350 m and the aquifer is up to 80 m thick.

The eastern and western unit connect in the coastal strip by the Saramacca River near Calcutta and Tambaredjo. How far offshore the aquifer continues is unknown, but almost 100 km offshore sediments of the same age consists of sand and limestone, at depths of 1400 to 1450 m; thus, the aquifer as it is known onshore is not in open contact with the ocean.

The aquifer is everywhere confined. Flowing artesian conditions existed in Paramaribo before withdrawals and probably exist in the western unit at the present time.

Storage coefficients in the range of 10^{-4} to 10^{-5} have been determined from pumping tests in Paramaribo, and in the range of 10^{-3} to 10^{-4} from tests on the Leysweg wells. Hydraulic conductivities estimated for the Zorg and Hoop well field are from 80 to 190 m/day for an average of 116 m/day. At Leysweg the transmissivity has been estimated at between 2300 and 4100 m^2/day (rounded average of 3200 m^2/day); the hydraulic conductivity at 320 m/day. Hydraulic conductivities estimated from old incomplete data are mainly between 30 and 80 m/day, with a very high value of 370 m/day at Koewarasan.

Water levels are known only in the eastern basin in the area surrounding Paramaribo where, before withdrawals, the piezometric surface was lower than in the underlying Onverdacht aquifers, but higher than in the overlying aquifers (FIG.5.2-3).

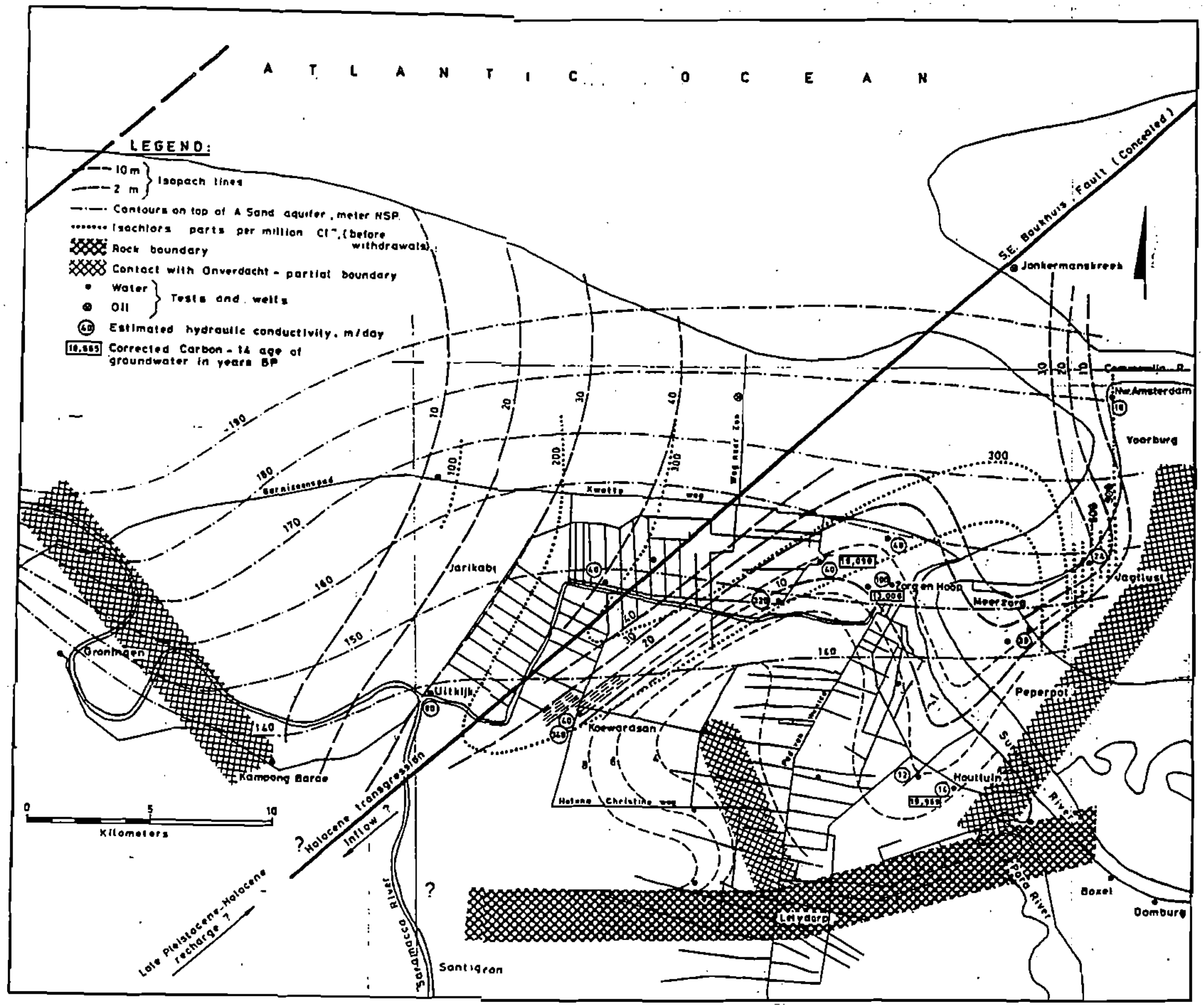


FIG.5.2-2 Hydrogeological features of the A Sand Aquifer

(From: UNDP, 1972)

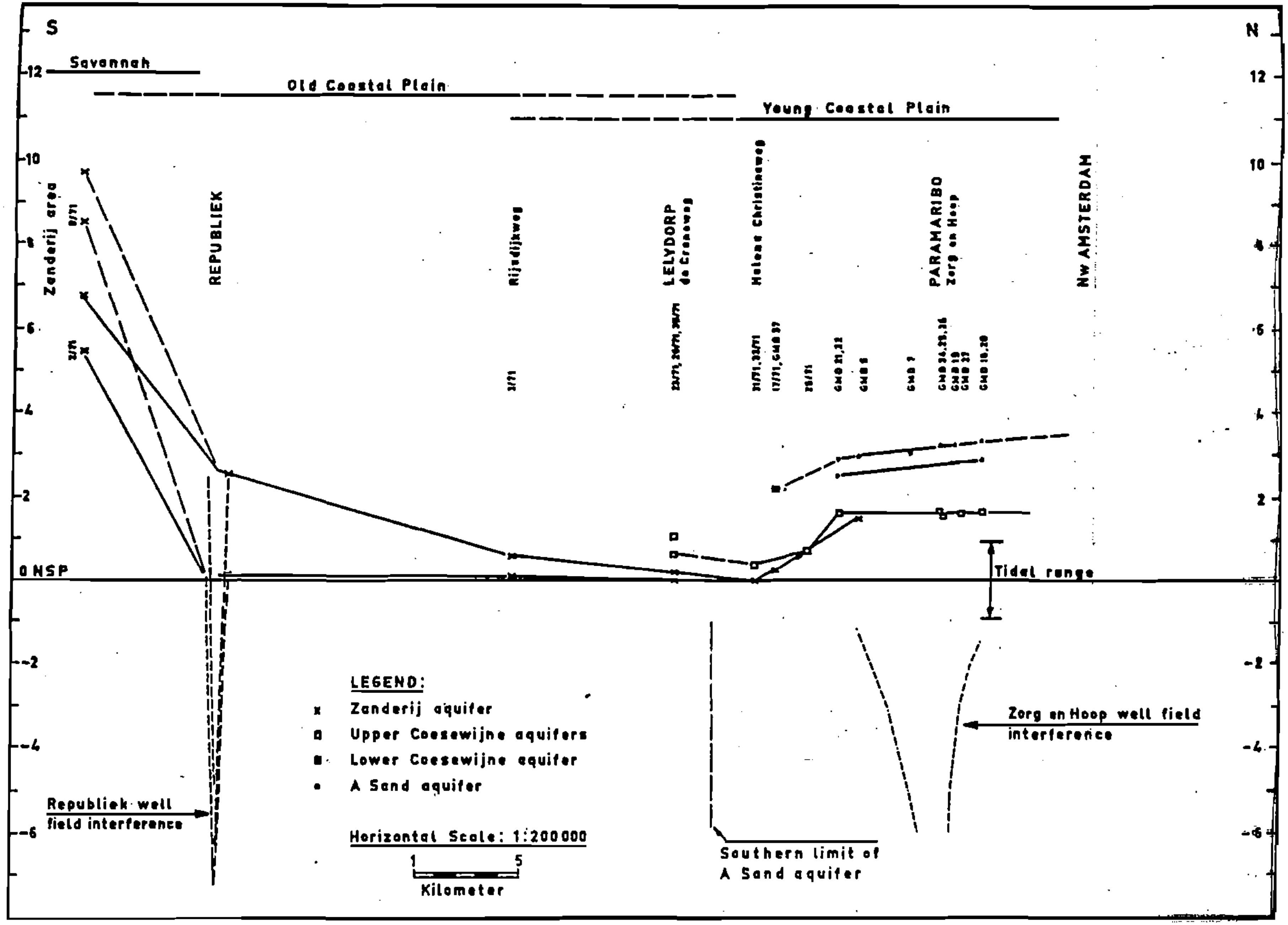


FIG. 5.2-3 Water levels of aquifers in the coastal basin from the Savannah area near Zanderij to the Young Coastal Plain near Paramaribo

(From: UNDP, 1972)

The water contains mainly sodium chloride in solution, with dissolved solid concentrations ranging from 340 to 2100 ppm. The dissolved solid content increases northward towards the coast. This is illustrated by the isochlorides in FIG.5.2-2. In western Suriname relatively fresh water is indicated, as deduced from the logs of tests drilled for oil. An exception may the area at the mouth of the Saramacca River (well SMS-1, FIG.5.2-1).

There is no evidence of modern recharge to the aquifer, at least in the eastern basin.

(e) <u>Coesewijne aquifer</u>. The unit is composed largely of clay and sandy clay with interbedded sand aquifers, which appear to be hydraulically interconnected. The zone is up to 100 m thick in the Saramacca and Suriname Rivers area and up to 120 m in the Nickerie area, where the top is about 230 m below ground surface.

The zone is covered by the Zanderij aquifer. There are no known outcrops of the formation.

The aquifers generally make up from 30 to 50% of the entire zone and in the east appear most frequently in the upper section. Individual aquifers are normally up to 10 m thick, but locally they form complexes of two or more sand bodies seperated by only thin partings.

The NNW dip of the zone is greater than that of the Zanderij aquifer, and thus there is contact between them in the Bauxite Belt and immediately to the north where water in the Zanderij aquifer contains brackish water and subsurface outcrops of the Coesewijne aquifers along the sides of the burried valley are in contact with it. The lowest aquifer is in contact with the A-Sand aquifer at places in the coastal area.

The zone is everywhere confined. Local exceptions may exist in the extreme south of the basin, where there is contact with the Zanderij aquifer at locations where it is unconfined. The confined condition of the aquifers is reflected by the storage coefficient ($S=10^{-4}$ to 10^{-5}). Hydraulic conductivities estimated fall within the range of 10 to 130 m/day. The highest value was estimated for the supply well of the DWV Kwatta water supply plant. Averages of all hydraulic conductivities estimated are 43 m/day for the lower aquifers and 70 m/day for the upper aquifers. In general, values decrease west of the Saramacca River. In western Suriname, hydraulic conductivities of 10 and 42 m/day have been estimated. Effective porosities of the Coesewijne aquifer vary from 8 to 13%(overall value = 10%).

Ground water in the Coesewijne aquifer is relatively low in dissolved solids throughout the coastal area except at locations near the coastline in the eastern part of the country. The dissolved solids are generally less than 800 ppm. The lowest values was determined for a well at Rijsdijkweg (164 ppm) and the highest value for the aquifer at Nieuw Amsterdam (907 ppm). The salinity increases northward towards the coast in the Saramacca - Suriname Rivers area.

The piezometric surface in the coastal area near Paramaribo is 1.0 to 2.0 m NSP or close to ground level. This condition continues inland for about 24 km to the vicinity of Uitkijk and Koewarasan (FIG.5.2-3). Immediately to the south the level is lower. The lowest levels were measured at Helena Christinaweg (less than 0.5 m NSP). Farther to the south, the aquifers are in contact with the overlying Zanderij aquifer.

There are no known outcrops of the zone, and therefor recharge by the direct infiltration of rainfall may be discounted. Since the rivers and streams are effluent under natural conditions, recharge as an influent flow from surface water is also doubtful.

(f) <u>Zanderij aquifer</u>. The Zanderij aquifer is equivalent to the sandy facies of the Zanderij formation. It crops out, forming the Savannah Belt, and continues northward, dipping gently in that direction confined beneath the Coropina clays and above the Coesewijne formation. It is not known how far the coarse sand aquifer extends offshore. At about 100 km offshore its equivalent is silty and sandy clay and clay.

In the Savannah Belt the distribution of aquifers is very irregular. In places there are no clean sands. Where present the sands are normally highly kaolinitic. Conditions improve northward, and in the Bauxite Belt the aquifer appears to be present everywhere except locally, where buried bauxite hills rise to higher elevations.
The base is irregular, corresponding to the post-middle Miocene erosion surface (FIG.5.2-4). The upper limit of the aquifer is taken as the top of the main sandbody, but in places this is difficult to define due to overlying Quaternary sands.

Thicknesses vary up to 20 m in the Savannah Belt and are generally between 10 and 20m in the Bauxite Belt. In the coastal area of eastern Suriname the aquifer begins at a depth of about 30 to 40 m and the thickness attains 40 to 50 m in the burried valleys. At Nickerie in western Suriname, it begins at about 5o m and the thickness is appoximately 169 m, but this may include some overlying Coropina sands.

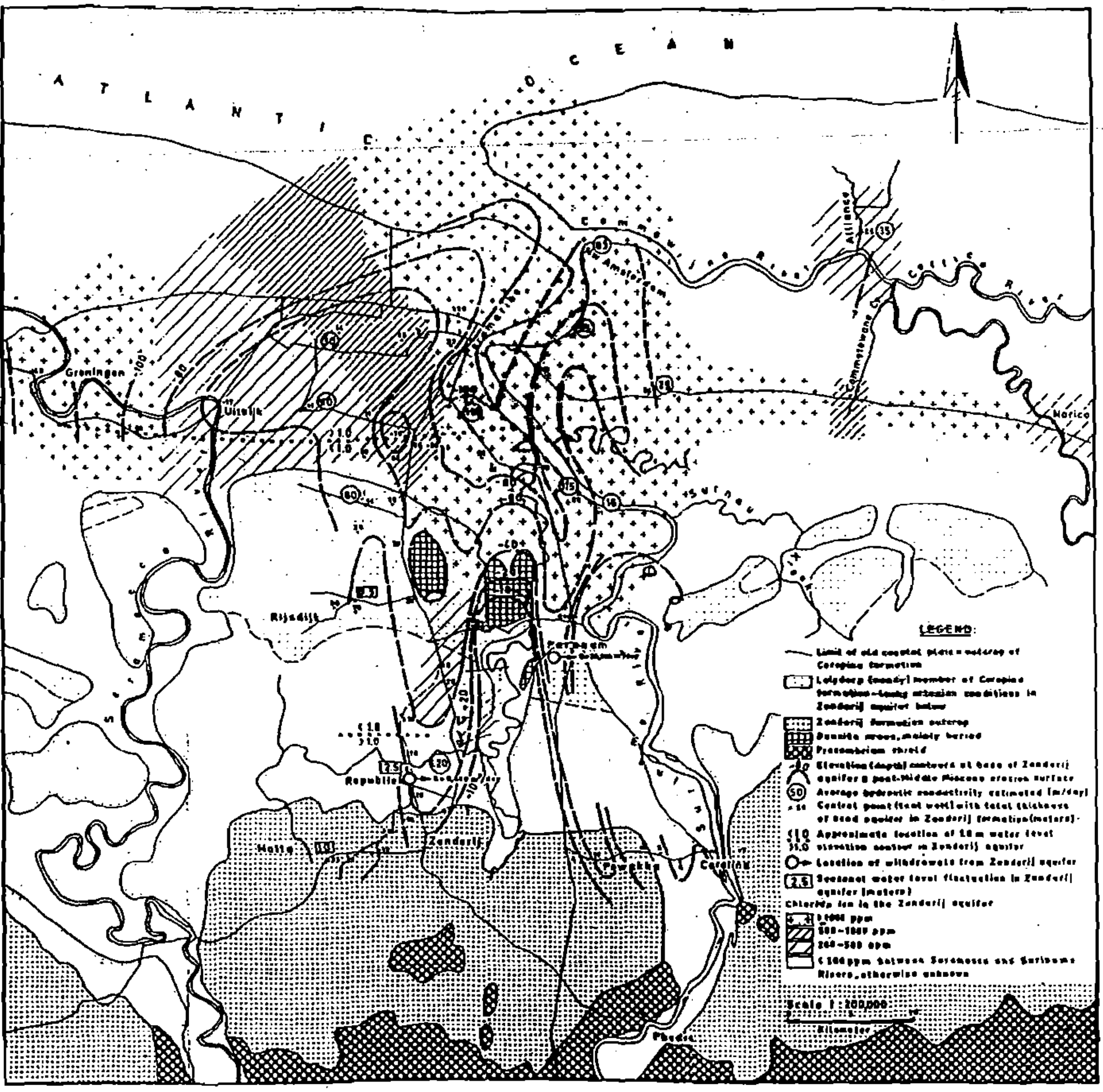


FIG.5.2-4 Hydrogeological features and salinity distribution in the Zanderij aquifer in the vicinity of Paramaribo and Zanderij

(From: UNDP, 1972)

In the coastal area the aquifer is confined beneath Coropina and Demerara clays, whereas southward the overlying Coropina sediments locally become more arenaceous and leaky artesian and unconfined conditions exist.

The hydraulic conductivity is low in the Savannah Belt and adjacent areas to the north, limited mainly by the presence of kaolin. At Republiek, transmissivities between 24 and 126 m^2/day have been calculated for an average of 82 m^2/day. The equivalent hydraulic conductivity probably is in the order of 15 to 20 m/day. At Rijsdijk an average transmissivity of 880 m^2/day was calculated, which, with an aquifer thickness of 20 m, gives an average hydraulic conductivity of 44 m/day. A specific yield of 13% was estimated for the aquifer at Republiek.

The ground water is fresh in the Savannah and Bauxite Belt, but the salinity increases northward towards the coast. In the Savannah area the water is very low in dissolved material. Dissolved solids of 46 to 86 ppm have been determined for samples taken in the Zanderij-Matta area. The northern limit of fresh ground water varies considerably (FIG.5.2-4) and the change to brackish water may be quite sharp. Fresh ground water near the northern limit for fresh water contains dissolved solids between 50 and 250 ppm. The salinity is highest in the thickest parts of the aquifer, where the dissolved solids are between 2000 and 5000 ppm. In the southern coastal area the thickest parts of the aquifer aproximate the locations of the present Suriname and Saramacca Rivers, suggesting deposition in the form of deltas.

Water levels are highest in the Savannah area (10m NSP). At Republiek, the water level fluctuates between 0 and 2.5 m NSP (average 1.25 m NSP). The level declines northward to the area of Helena Christinaweg (about sealevel), then it increases again (FIG.5.2-3).

The Zanderij aquifer is probably the only aquifer in the basin that receives recharge directly by infiltration of rainfall. This takes place mainly in the Savannah area and immediately to the north.

(g) Coropina and Demerara aquifers. The Demerara and Coropina are essentially clay formations confining the Zanderij aquifer below. Interbedded sand aquifers occur locally mainly in the form of lenses (FIG.5.2-5). In the coastal area the Coropina aquifers are difficult to distinguish from the Zanderij aquifer below. They probably are all interconnected.

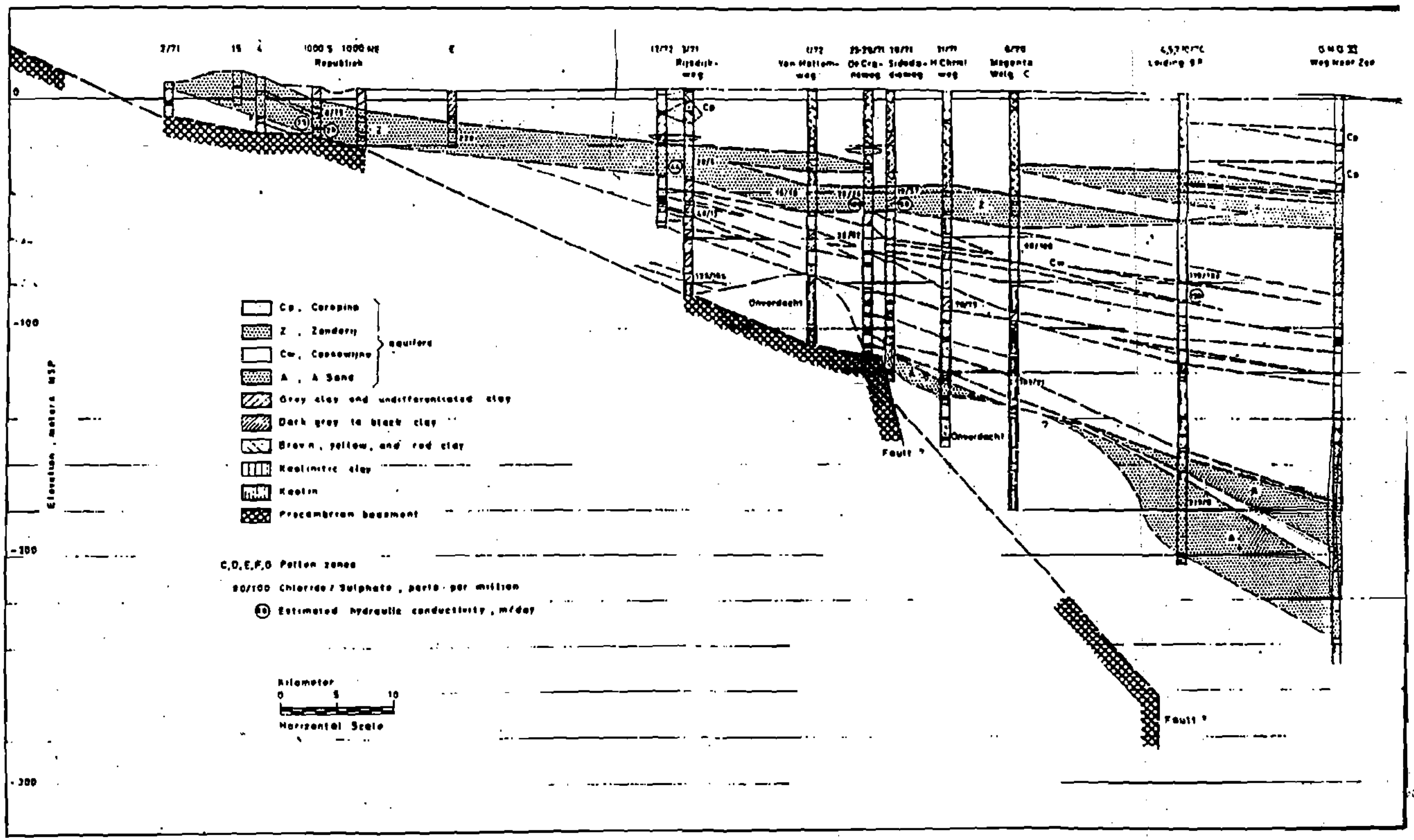


FIG.5.2-5 Section Republiek to Weg Naar Zee

(From: UNDP, 1972)

In the Bauxite Belt, the Coropina sands are connected hydraulically with the underlying Zanderij aquifer at least locally(FIG.5.2-6). In this area the sand formations are exploited for small individual water supplies by means of dug wells. On a regional scale, the formation may be regarded as an aquitard above the Zanderij aquifer.

At Wageningen in the west, a relatively thin sand layer extends throughout an area of several kilometers in the depth interval from 23 to 40 m.

The only aquifer parameters known are from a test in Wageningen ($K = 75$ to 50 m/day and $S = 1.4 \times 10^{-4}$).

The salinity distribution appears to follow the same pattern as in the Zanderij aquifer below, with mainly brackish water in the coastal area and fresh water in the Bauxite Belt and river valley areas to the south.

Water levels are known only locally and therefore it is not possible to construct a regional flow pattern. It appears that the levels are similar throughout the coastal basin and that very little flow can be expected.

The seasonal fluctuations in the Zanderij aquifer at Rijsdijk must be a result of recharge entering the Lelydorp (Upper Coropina) aquifer above.