

WATER RESOURCES PUBLICATION NO. 2

HYDROLOGICAL REGIONS OF PENINSULAR MALAYSIA



JABATAN PENGAIRAN DAN SALIRAN
KEMENTERIAN PERTANIAN MALAYSIA

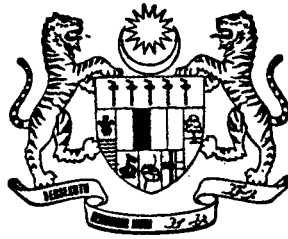
**HYDROLOGICAL REGIONS
OF
PENINSULAR MALAYSIA**

ACKNOWLEDGEMENT

This is the second of several publications of the Drainage and Irrigation Department and forms a part of the work in connection with the preparations of an inventory of water resources of Peninsular Malaysia. The work has been carried out by officers of the Water Resources Section, Hydrology Branch of the Department in association with the Engineering Export Association of New Zealand Inc. (ENEX) whilst the latter was retained as Consultants to assist the Drainage and Irrigation Department to expand its hydrological activities and upgrading its hydrological services in Peninsular Malaysia. Assistance has been received from the Soils Branch, Department of Agriculture and from the Department of Geological Survey in the preparation of this report for which we gratefully acknowledge.

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HYDROLOGICAL REGIONS OF PENINSULAR MALAYSIA

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1. Introduction

"Hydrological regions are relatively homogeneous sub-divisions of an area or a country, and in each of such regions hydrological similarity is assumed. Accurate classification of hydrological regions is extremely complex, since hydrological classification of an area with regard to one purpose or in respect of one phase or aspect of the hydrological cycle may be quite different from the classification for another purpose or aspect, classification of erosional characteristics will, for instance, involve factors such as rainfall intensity and duration, infiltration capacity, vegetative cover, erosional resistivity of the soil and sediment rating. Provided the soils are not impermeable, a low flow classification is governed mainly by the characteristics of geological strata and rainfall. Moreover, even within a small basin, small areas with different hydrological characteristics may be found. For this reason, every hydrological division is approximate only and is based on the most important factors". (Toebe and Ouryvaev, 1970).

2. Methodology

In this case of Peninsular Malaysia, the classification of hydrological regions aims at assisting in particular the assessment of water resources. For this reason the classification was based mainly on geological and climatic characteristics, both of these being significant in the assessment of water yield and low flow. The rock porosity or lithology has been selected as the main geological parameter and two important climatic factors—annual rainfall and annual potential evapotranspiration—have been lumped together to form the climatic parameter for the delineation.

Information on lithology was based on the "Preliminary Hydrogeological Map of Peninsular Malaysia" (Chong and Pfeiffer, 1971). Based on the bearing properties of the rock types shown in this map five lithological groups were identified. The boundaries of these five lithological groups provide the main boundaries for the hydrological regions.

The sub-boundaries for the classification were based on a provisional "Surface Water Resources Map of Peninsular Malaysia" (DID, 1974). This provisional map shows average annual surface water yield (W) in terms of so called "potential runoff" isolines. These isolines were obtained by deducting the average annual potential evapotranspiration (PE) from the average annual precipitation (P) according to the water balance equation $P - PE = W$. The $P - PE$ or potential runoff isolines were divided into four broad groups and the boundaries of these groups were used as sub-boundaries. As these sub-boundaries are at best only very rough demarcations, they were modified where practicable to coincide with catchment boundaries. On the map they are indicated by dotted lines.

The combination of the lithological parameter (L) and the $P - PE$ parameter (W) forms a quantitative classification system designated by combinations of the five lithological groups (L_1 to L_5) and the four $P - PE$ groups (W_1 to W_4) with a maximum of twenty possible classes. Using this system, Peninsular Malaysia was divided into 66 hydrological regions within which hydrological similarity is presumed. A number of regions have the same quantitative classification as other regions. For example, Nami region in the north has the same classification ($L_1 W_2$) as Keluang in the south, and Alor Setar in the north west has the same classification ($L_5 W_2$) as Batu Pahat in the south west. Areas of urban development have not been delineated. However, these areas cannot be considered as having characteristics hydrologically similar to any predominantly rural areas. Ideally, all areas where urban influence is felt should be classified separately.

3. Classification into Hydrological Regions

3.1 Potential Runoff or $P - PE$

Potential runoff as estimated by the annual precipitation minus potential evapotranspiration approach varies from below 500 mm to above 2,500 mm. This has been divided into 4 groups:

- W_1 — where $P - PE$ is below 500 mm per annum
- W_2 — where $P - PE$ is between 500 mm-1,000 mm per annum
- W_3 — where $P - PE$ is between 1,000 mm-1,500 mm per annum
- W_4 — where $P - PE$ is above 1,500 mm per annum

3.2. Lithology

The rock types have been grouped into 5 lithological classes based on the water bearing properties of the rocks.

- L_1 — Basically regions with massive rocks consisting mainly of undifferentiated granite with pockets of shales, schists and volcanic flows. Small pockets of porous rocks consisting of pyroclasts, tuffs and reworked tuffs are found in these regions. The massive rocks hold either no groundwater or perhaps up to $12\text{m}^3/\text{day}/\text{well}$. The porous rocks yield from between $20\text{-}50\text{m}^3/\text{day}/\text{well}$ to less than $20\text{m}^3/\text{day}/\text{well}$.
- L_2 — Basically regions with massive rocks composed of limestones, with small pockets of granite and loose clayey and sandy deposits included as well. They are regions with local or incoherent aquifers with a groundwater yield of generally over $200\text{m}^3/\text{day}/\text{well}$. In the Kuala Lumpur region, however, the yield is $50\text{-}200\text{m}^3/\text{day}/\text{well}$ while in the Pulau Langkawi and Pulau Dayang Bunting regions the yield is between $20\text{-}50\text{m}^3/\text{day}/\text{well}$.
- L_3 — Basically regions with massive rocks consisting predominantly of sandstones (including sandstones of Gagau type) with conglomerates, quartzites, grey-wackes, shales, schists and phyllites. Found also in L_3 regions are some porous rocks such as gravel, sand, clay, clayey sandstone and siltstone. The massive rocks have groundwater yields between $20\text{-}200\text{m}^3/\text{day}/\text{well}$. The porous rocks have yields varying from between $20\text{-}50\text{m}^3/\text{day}/\text{well}$ (mostly in the east and south of Peninsular Malaysia) to less than $20\text{m}^2/\text{day}/\text{well}$.
- L_4 and L_5 — These two types of regions have essentially the same lithology, namely porous rocks of loose clayey and sandy deposits. Found also in L_4 regions are some massive rocks of volcanic flows (mainly basalt). L_4 regions are located in relatively upland catchments while L_5 regions are generally located along the coastal plains. The L_4 regions have yields of between $20\text{-}50\text{m}^3/\text{day}/\text{well}$. The L_5 regions have yields varying from $> 200\text{m}^3/\text{day}/\text{well}$ along the coastal plains to between $50\text{-}200\text{m}^3/\text{day}/\text{well}$ further inland.

It can be seen, therefore, that there are in fact five distinct lithological groups—namely L_1 —Massive rocks of undifferentiated granite, L_2 —Massive limestone rocks, L_3 —Massive sandstones and porous gravel, L_4 —Porous rocks consisting of loose clayey and sandy deposits with a relatively low groundwater yield and L_5 —Same rock types as L_4 but with high groundwater yield.

3.3. General

The combination of the above groupings gives a total of 18 classes for 66 hydrological regions (Classes L_5 W_4 and L_2 W_4 do not occur). In the following, L represents the lithological groups and W represents the potential runoff groups.

Region Number		Region Name				Class
1	...	P. Langkawi	Timor	...	...	L_2 W_3
2	...	P. Langkawi	Barat	...	...	L_1 W_2
3	...	P. Dayang	Bunting	...	...	L_2 W_2
4	...	Changlun	...	...	...	L_1 W_1
5	...	Bt. Pelarit	...	...	...	L_2 W_1
6	...	Kangar	...	...	...	L_5 W_1
7	...	Jitra	...	...	...	L_4 W_1
8	...	Nami	...	...	...	L_1 W_2
9	...	Alor Setar	...	...	...	L_5 W_2
10	...	Bukit Mertajam	...	...	...	L_4 W_2
11	...	Larut	...	...	...	L_5 W_2
12	...	Karangan	...	...	...	L_1 W_3

Region Number		Region Name				Class
13	...	Pulau Pinang	...	...	...	L ₁ W ₃
14	...	Temengor	...	...	...	L ₁ W ₂
15	...	Gunong Pilon	...	...	...	L ₃ W ₂
16	...	Keroh	...	...	...	L ₃ W ₂
17	...	Gerik	...	...	...	L ₁ W ₁
18	...	Selama	...	...	...	L ₁ W ₄
19	...	Lawin	...	...	...	L ₃ W ₁
20	...	Bt. Merah	...	...	...	L ₄ W ₃
21	...	Sg. Legap	...	...	...	L ₃ W ₂
22	...	Ipoh	...	...	...	L ₂ W ₃
23	...	Kuala Kangsar	...	...	...	L ₃ W ₁
24	...	Gunong Bubu	...	...	...	L ₁ W ₃
25	...	Tg. Tualang	...	...	...	L ₁ W ₂
26	...	Bidor	...	...	...	L ₁ W ₄
27	...	Telok Anson	...	...	...	L ₅ W ₂
28	...	Kuala Selangor	...	...	...	L ₅ W ₁
29	...	Sg. Bernam	...	...	...	L ₄ W ₂
30	...	Batu Tiga	...	...	...	L ₃ W ₂
31	...	Kuala Lumpur	...	...	...	L ₂ W ₃
32	...	Chuah	...	...	...	L ₄ W ₂
33	...	Kuala Pilah	...	...	...	L ₃ W ₁
34	...	Melaka	...	...	...	L ₁ W ₁
35	...	Keluang	...	...	...	L ₁ W ₂
36	...	Mersing	...	...	...	L ₁ W ₃
37	...	Kg. Semberong	...	...	...	L ₄ W ₃
38	...	Bukit Tawai	...	...	...	L ₃ W ₂
39	...	Batu Pahat	...	...	...	L ₅ W ₂
40	...	Sg. Kahang	...	...	...	L ₃ W ₂
41	...	Sg. Terbak	...	...	...	L ₃ W ₃
42	...	Mawai	...	...	...	L ₄ W ₄
43	...	Sg. Sanit	...	...	...	L ₄ W ₄
44	...	Sg. Sua	...	...	...	L ₃ W ₂
45	...	Gunong Ulu Bakar	...	...	...	L ₁ W ₃
46	...	Sg. Tekai	...	...	...	L ₃ W ₂
47	...	Sg. Lembing	...	...	...	L ₁ W ₄
48	...	Kuala Lipis	...	...	...	L ₃ W ₂
49	...	Temerloh	...	...	...	L ₁ W ₁
50	...	Kuantan	...	...	...	L ₅ W ₃
51	...	Sg. Bebar	...	...	...	L ₅ W ₂
52	...	Geret	...	...	...	L ₃ W ₂
53	...	Kg. Kachah	...	...	...	L ₃ W ₂
54	...	Bt. Batu Bertarah	...	...	...	L ₃ W ₁
55	...	Bt. Peta	...	...	...	L ₃ W ₃
56	...	Jerteh	...	...	...	L ₄ W ₄
57	...	Ulu Trengganu	...	...	...	L ₁ W ₄
58	...	Kuala Berang	...	...	...	L ₄ W ₄
59	...	Gunong Gagau	...	...	...	L ₃ W ₃
60	...	Marang	...	...	...	L ₃ W ₃
61	...	Sg. Merchang	...	...	...	L ₄ W ₄
62	...	Sg. Jabor	...	...	...	L ₃ W ₄
63	...	Kota Bahru	...	...	...	L ₅ W ₃
64	...	Tanah Merah—Ulu Selangor	...	...	...	L ₁ W ₃
65	...	Kuala Kerai—Ulu Langat	...	...	...	L ₁ W ₂
66	...	Pulau Tioman	...	...	...	L ₁ W ₃

3.4. *Names and Descriptions of Hydrological Regions*

The hydrological regions have been named after a district, a major town, river, hill or topographical feature within the region. In appendix I, qualitative as well as quantitative descriptions of the climate, potential water resources, geology, physiography, pedology, vegetation and land use are given. These characteristics have been compiled from maps and publications issued by various Government Departments. As much as practicable, the assistance of these Departments was obtained in compiling the data. In particular, the Soils Branch of the Department of Agriculture contributed the sections on pedology, physiography and land use.

3.4.1 *Explanatory notes on the description of regions*

Climate

Average annual rainfall for the region is based on the average annual rainfall isohyetal map for the period July 1950-June 1965 (DID, 1970). The rainfall region listed is based on the classification by Dale (1959) who divided Peninsular Malaysia into five rainfall regions with distinctive patterns of rainfall.

As summarised by Wycherley (1967), these are:

- North West Malaya, which has peaks in rainfall during both the post-equinoctial transition periods between monsoons, low rainfall during the North East Monsoon, and moderate precipitation during the South West Monsoon. The northern plain of Kedah and Perlis receives less rain than the Kedah Peak, as well as the mountainous parts of Penang and south Kedah.
- West Malaya, which has peaks in rainfall during the transitional periods; often the first (April) is more intense but of shorter duration than the second (October and November) during which there is more rain in total. Fair amounts of rain are received during the North East Monsoon except in February. The period of the South West Monsoon has least rain, especially in July.
- Port Dickson—Muar Coast, which sometimes has rain during the first transitional period. Usually there is a steady build-up during the South West Monsoon to a maximum during the second transitional period; followed by little rain during the North East Monsoon.
- South West Malaya, which has a rather equitable distribution of rain throughout the year. Rainfall is low inland, and increases towards the coast.
- East Malaya, which has heavy rainfall during the North East Monsoon and light rain during the rest of the year.

The potential evapotranspiration (PE) of the region is based on the "PE Map of Peninsular Malaysia" computed using Thornthwaite's method by DID (1972). The PE isolines are planimeted to give the mean potential evapotranspiration of the region.

Potential Water Resources

The potential water resources of the region is based on the provisional "Surface Water Resources Map of Peninsular Malaysia". The P-PE isolines were planimeted to give the mean P-PE (in mm depth of water) which is the potential surface water resources of the region.

Geology

The description of the general lithology of the region is based on the lithological base map used for the preparation of the "Preliminary Hydrogeological Map of Peninsular Malaysia".

Physiography

The description of the general physiography of the region is based on the "Physiographical Map of Peninsular Malaysia" (Law, 1970). The physiographical features have been described in five broad units as follows:

- (i) Hills and mountains over 500 feet above mean sea level.
- (ii) Rolling to low hills between the 100-500 feet contours.
- (iii) Intermediate and higher terraces between the 20-250 feet contours.
- (iv) Inland flood plains and low terraces below the 50 feet contour.
- (v) Coastal plains and low terraces below 50 feet contour.

Pedology

The description of the general pedology of the region is based on the "Generalised Soil Map" (Law, 1970). The data have been supplied by the Soils Branch, Department of Agriculture. The soil terminology used is based on the work by FAO/UNESCO (1968). As far as possible the parent rocks from which the soils have been derived are stated.

Vegetation and Land Use

The land use and vegetation description of the regions are based on the work by Wong (1971). The data have been supplied by the Soils Branch, Department of Agriculture. For simplicity, only where a particular type of land use in the region exceeds 1% is the type of land use recorded.

4. Discussion

The significance of the method of classification using lithology as a base can be clearly seen if one looks at it from the hydrological point of view. It is generally expected that in the L_1 regions there will be low baseflow due to low groundwater yield. However, much water can appear in the interstices of the weathered rock or in the joints which may extend to great depth. Horizontal joints systems can also increase the capacity of the water bearing capacity of the rock. Streamflow will be highly fluctuating. The soil is shallow, and when exposed, relatively unstable. In the limestone regions of L_2 , high infiltration rates can be expected. There will be little flow fluctuation. The sandstone region of L_3 will have more groundwater yield than granite; the soils are deeper and baseflow are higher. There is less fluctuation in flow than in the granite rocks. The L_4 regions will have relatively high baseflow while the L_5 regions will be either water-logged or with a high water table.

The use of the combined effect of average annual precipitation and average annual evapotranspiration (the P-PE approach) does not take account of the difference of the rainfall variability as is found in various part of the Peninsular. For instance, regions with the same W classification are found on both East and West Coasts of the Peninsular and some large regions, such as the Kuala Kerai—Ulu Langat, Tanah Merah—Ulu Selangor, span both sides of the Peninsular. This is not considered important however for water yield and low flow determination, since these hydrological characteristics correlate more highly with long term rainfall supply than with short term rainfall variability.

Physiographically, L_1 regions are dominated by steeply sloping hills and mountains together with rolling to low hilly land. Rolling to low hilly land covers the L_2 regions except in Bt. Pelarit, P. Dayang Bunting and P. Langkawi Timor where steep sloping hills are also common. For L_3 regions, physiographical features are mixed, ranging from steep hills with rugged terrain to rolling to low hills and intermediate and higher terraces. The L_4 regions are characterized mainly by riverine flood plains and low terraces with gently undulating to undulating topography. The L_5 regions consist of coastal plains as well as gently undulating low terraces.

As far as soil types are concerned, there is a strong correlation between soil types and both lithology and physiography. In the L_1 regions, lithosols are found on the steeper slopes. On lower slopes, red-yellow podzolics of granitic origin are found together with red-yellow and yellow-grey podzolics and lateritic soils derived from sedimentary rocks. For the L_2 regions, lithosols are found in the steepland areas with red-yellow podzolics on lower slopes while

undifferentiated marine alluvium is found on low lying terrain. In the Kuala Lumpur and Ipoh regions, the area consists mostly of urban and mined land with occasionally pockets of subrecent alluvium. For L_3 regions, the pedology varies from lithosols on steep land to red-yellow and yellow-grey podzolics in sedimentary rocks on lower slopes. Yellow-red clays derived from andesite, riverine alluvium and subrecent alluvium are also found in these regions. The L_4 regions are dominated by riverine and marine alluvium, leached red-yellow granitic soils, red-yellow podzolics and also organic clays and mucks, peat, regosols and podsols. The L_5 regions are dominated by marine alluvium, peat, regosols and podsols, organic clays, and low humic gley soils of marine origin nearer the coast with acid sulphate soils found further inland.

As far as land use and vegetation goes, in the L_1 regions, forest lands form 80% of the area while about another 15% of it is covered with tree, palm and other permanent crops. In the L_2 regions, about 25% of the land are urban and associated areas, 20% are tree, palm and permanent crops and 30% are grasslands and forests. Over 75% of the area in the L_3 regions are forested and about 15% of the area are tree, palm and other permanent crops. In both the L_4 and L_5 regions, land use and vegetation are mixed. In L_4 , about 35% of the area is forested, 15% are tree, palm and permanent crops, 20% swamps, marshlands and wetland forests and 10% cropland. In L_5 , about 35% of the land are covered by swamps, marshlands and wetland forests, 25% are tree, palm and permanent crops, 10% are cropland while another 10% are forest lands. The rest are grasslands and horticulture etc.

The sub-boundaries as defined by the P-PE approach (W classification) are tentative and subject to revision when more data become available. The boundaries are shown in a dotted form on the map and the tentative delineation will assist meanwhile in distinguishing major differences in potential water yield.

5. Establishment of Representative and Experimental Basins

As a follow-up of the delineation, a network of representative and experimental basins (Toebe and Ouryvaev, 1970) will be established within the important hydrological regions. Representative basins sample the hydrology of natural regions while experimental basins are used to study the hydrological effects of land use changes. Theoretically, for one particular type of quantitative classification e.g. $L_1 W_1$, one representative basin should be established. In practice, some regions are just too small for any representative basin to be set up while others are so huge that more than one representative basin may be necessary. In the case of experimental basins, which are much more expensive to operate, additional factors such as soil type, vegetative cover and project objectives have to be taken into consideration.

At the time of finalising this report, a number of representative basins have been established—Sg. Lui Basin in the $L_1 W_2$ region of Kuala Kerai—Ulu Langat, and Sg. Batu (at Kg. Sg. Tua) in the $L_1 W_3$ region of Tanah Merah—Ulu Selangor. A number of representative basins are earmarked for establishment—Sg. Marang Kanan (Pasoh Forest) in the $L_3 W_1$ region of Kuala Pilah and Parit Pinggan in the $L_5 W_2$ region of Batu Pahat. An experimental basin has also been planned in Sg. Tekam in the $L_3 W_2$ region of Sg. Tekai. The studies to be conducted in the representative basins will include the water balance of natural systems; forecasting of low and mean flows within a region; studying of hydrological processes and model development. In the Sg. Tekam experimental basin, a study on the hydrological effects of land use change from a logged forest to oil palm and cocoa is contemplated.

6. Conclusions

The study reported in this paper describes the delineation of Peninsular Malaysia into 66 hydrological regions within which hydrological similarity is presumed. Water resources development and management require not only knowledge on the hydrological conditions of different regions in this country but also the relationship of human activities on the land to the natural environment. To this end, hydrological regions are useful in that they provide a logical base for the setting up of a minimum network of hydrological stations to sample the hydrology of Peninsular Malaysia. Since the classification is based on groupings of one important environmental factor influencing the hydrology, viz, lithology, and provisional estimates of one hydrological characteristic—potential

runoff rather than measured hydrological factors which were not available, the relative success of such a delineation must await the establishment of representative basins within these hydrological regions, the subsequent testing of the representativity of these basins, and comparison between them.

However, a low flow study currently in progress (Taylor et al, in press) indicates that the classification, at least the one based on the lithological features, is a reasonable one.

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APPENDIX I

REGIONAL CHARACTERISTICS OF HYDROLOGICAL REGIONS IN PENINSULAR MALAYSIA

REGIONAL CHARACTERISTICS

Name of Region: No. 1 PULAU LANGKAWI TIMOR

Classification: L₂ W₃.

Area: 110 sq. km.

Climate

Average annual rainfall — between 2,500 mm and 2,750 mm.

Rainfall region — North West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — 1,000 mm approximately.

Geology

Mainly limestone, mostly crystalline, compact, jointed and of karst type. Also includes pockets of undifferentiated granitic rocks and loose, clayey and sandy deposits.

Physiography

Most of the region is covered by steep hilly terrain with narrow stretches of beaches on the east.

Pedology

Mainly lithosols on steep land with undifferentiated marine alluvium on low-lying terrain.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	59.6%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	21.8%
Unused Land, Unclassified Land	..	..	..	..	..	..	..	8.1%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	5.1%
Grasslands	..	..	..	..	..	..	..	2.4%
Horticulture	..	..	..	..	..	..	..	1.4%
Cropland	..	..	..	..	..	..	..	1.1%

Name of Region: No. 2 PULAU LANGKAWI BARAT

Classification: L₁ W₂.

Area: 289 sq. km.

Climate

Average annual rainfall — between 2,250 mm and 2,500 mm.

Rainfall region — North West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 750 mm and 1,000 mm.

Geology

Acid and undifferentiated granitic rocks in the centre, the rest consists of sediments, such as gravel, sand, clay, clayey sandstone and siltstone.

Physiography

The northwestern and eastern portions of this region are dominated by steeply sloping hills while the rest of the region consists of rolling to low hilly land separated by wide riverine flood plains.

Pedology

Lithosols on steep land are encountered at the northwestern section of this region with red yellow podzolics on lower slopes. Some riverine alluvium are also found along rivers.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	62.7%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	11.9%
Cropland	..	..	..	..	..	..	..	9.0%
Grasslands	..	..	..	..	..	..	..	5.9%
Horticulture	..	..	..	..	..	..	..	4.1%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	3.5%
Unused Land, Unclassified Land	..	..	..	..	..	..	..	2.5%

Name of Region: No. 3 PULAU DAYANG BUNTING

Classification: L₂ W₂.

Area: 73 sq. km.

Climate

Average annual rainfall — 2,250 mm approximately.

Rainfall region — North West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 500 mm and 750 mm.

Geology

Mainly limestone, mostly crystalline, compact, jointed and of karst type. Also includes pockets of undifferentiated granite rocks and loose, clayey and sandy deposits.

Physiography

Steeply sloping hills occupy the western portion with rolling to low hilly land at lower elevations. Flat to gently undulating land covers the narrow coastal margins.

Pedology

The western part is mainly steep land with red yellow podzolics on lower slopes. Undifferentiated marine alluvium is found on low lying terrain.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	76.8%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	10.9%
Grasslands	..	..	..	..	..	..	..	4.9%
Unused Land, Unclassified Land	..	..	..	..	..	..	..	4.0%
Horticulture	..	..	..	..	..	..	..	1.5%
Cropland	..	..	..	..	..	..	..	1.3%

Name of Region: No. 4 CHANGLUN

Classification: L₁ W₁.

Area: 1,710 sq. km.

Climate

Average annual rainfall — between 1,750 mm and 2,000 mm.

Rainfall region — North West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — below 500 mm.

Geology

Mainly shales predominate with sandstones, mudstones and siltstones. Some granitic rocks and some gravel, sand, clay, clayey sandstone and siltstone are found in the north on the border between Kedah and Thailand.

Physiography

The major portion of this region consists of rolling to low hilly land; in parts the rolling to low hilly land is intermixed with intermediate and higher terraces with gently undulating to rolling topography. On the eastern border are hills and mountains with more rugged terrain.

Pedology

Lithosols of the Bt. Koh Mai Range are dominant at the eastern portion of this region. Red yellow podzolics of granitic origin are also found on lower slopes within this region. Further west, soils derived from sedimentary origin are prominent with the majority being lateritic. Some red yellow podzolics of granitic origin are again encountered in the north and these are associated with some subrecent alluvium.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	72.7%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	14.5%
Cropland	..	..	..	..	..	..	..	5.1%
Grasslands	..	..	..	..	..	..	..	3.9%
Horticulture	..	..	..	..	..	..	..	2.0%
Swamps, Marshlands Wetland Forests	..	..	..	..	..	..	..	1.1%

Name of Region: No. 5 BT. PELARIT

Classification: L₂ W₁.

Area: 110 sq. km.

Climate

Average annual rainfall 1,750 mm approximately.

Rainfall region—North West Malaya.

Annual potential evapotranspiration—between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff below 500 mm.

Geology

Limestone, mostly crystalline, compact, jointed and of karst-type, mainly springs.

Physiography

This region consists mainly of mountain ridges with pockets of low hilly land.

Pedology

Mainly lithosols of steepland with occasional patches of subrecent alluvium on flatter terrain.

Vegetation and Land Use

Unused Land, Unclassified Land	..	..	..	..	42.6%
Forest Lands	..	..	..	..	37.9%
Cropland	..	..	..	..	6.2%
Tree, Palm, Permanent Crops	..	..	..	..	5.4%
Swamps, Marshlands, Wetland Forests	..	..	..	..	2.9%
Horticulture	..	..	..	..	2.6%
Grasslands	..	..	..	..	2.1%

Name of Region: No. 6 KANGAR

Classification: L₅ W₁.

Area: 427 sq. km.

Climate

Average annual rainfall — between 2,000 mm and 2,250 mm.

Rainfall region — North West Malaya.

Annual potential evapotranspiration — between 1,500 and 1,750 mm.

Potential Water Resources

Potential runoff — 500 mm. approximately.

Geology

Mainly loose clayey and sandy deposits.

Physiography

The whole region is part of the western coastal plain.

Pedology

Low humic gley soils of marine origin are found nearer the coast while further inland acid sulphate soil is dominant.

Vegetation and Land Use

Cropland	..	..	..	..	..	..	81.6%
Horticulture	..	..	..	..	..	..	12.3%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	1.8%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	1.8%
Forest Lands	..	..	..	..	..	..	1.5%

Name of Region: No. 7 JITRA

Classification: L₄ W₁.

Area: 1,150 sq. km.

Climate

Average annual rainfall — between 2,000 mm and 2,250 mm.

Rainfall region — North West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — 500 mm approximately.

Name of Region No. 9 ALOR SETAR

Classification: L₅ W₂.

Area 516: sq. km.

Climate

Average annual rainfall — between 2,250 mm and 2,500 mm.

Rainfall region — North West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — 750 mm approximately.

Geology

Loose, clayey and sandy deposits.

Physiography

The whole region is in the western coastal plain.

Pedology

Mainly low humic gley soils of marine origin and undifferentiated recent marine alluvium along the coast.

Vegetation and Land Use

Cropland	73.8%
Horticulture	13.1%
Swamps, Marshlands, Wetland Forests	5.7%
Tree, Palm, Permanent Crops	2.9%
Urban and Associated Areas	2.6%
Unused Land, Unclassified Land	1.4%

Name of Region: No. 10 BUKIT MERTAJAM

Classification: L₄ W₂.

Area: 436 sq. km.

Climate

Average annual rainfall — 2,500 mm approximately.

Rainfall region — North West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 750 mm and 1,000 mm.

Geology

Except for some minor pockets of shales, the rest consists of loose, clayey and sandy deposits.

Physiography

The northern portion is part of the western coastal plain. Gently undulating low terraces occupy the northeastern portion while the rest of the region consists of rolling to low hilly land.

Pedology

Undifferentiated recent marine alluvium is found in the north at the mouth of the Sg. Merbok. This extends southwards into subrecent alluvial soils. Further south, leached red yellow soils of granitic origin are encountered.

Vegetation and Land Use

Tree, Palm, Permanent Crops	50.7%
Cropland	22.2%
Swamps, Marshlands, Wetland Forests	9.2%
Horticulture	6.4%
Forest Lands	5.1%
Unused Land Unclassified Land	2.7%
Grasslands	2.6%
Urban and Associated Areas	1.1%

Name of Region: No. 11 LARUT

Classification: L₅ W₂.

Area: 2,090 sq. km.

Climate

Average annual rainfall — between 2,250 mm and 2,500 mm.

Rainfall region — North West Malaya and West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 750 mm and 1,000 mm.

Geology

Mainly loose, clayey and sandy deposits.

Physiography

This region is part of the western coastal plain with a peat swamp at the centre and at the south.

Pedology

Undifferentiated recent marine alluvium dominates the coastline and extends inland as well. In the south, peat swamps are found.

Vegetation and Land Use

Swamps, Marshlands, Wetland Forests	33.8%
Tree, Palm, Permanent Crops	25.6%
Cropland	15.6%
Forest Lands	7.6%
Unused Land, Unclassified Land	5.9%
Horticulture	5.0%
Grasslands	4.3%
Urban and Associated Areas	2.3%

Name of Region: No. 12 KARANGAN

Classification: L₁ W₃.

Area: 992 sq. km.

Climate

Average annual rainfall — between 2,500 mm and 2,750 mm.

Rainfall region — North West Malaya.

Annual potential evapotranspiration — 1,250 mm and 1,500 mm.

Potential Water Resources

Potential runoff — between 1,000 mm and 1,250 mm.

Geology

On the north, mainly shales predominate with sandstones, mudstones and siltstones. The rest of the region consists of undifferentiated granitic rocks.

Physiography

The eastern and southern portions are occupied by hills and mountains. The rest of the region is composed of rolling to low hilly land.

Pedology

Most of the eastern strip of this region is on steepland. This is separated from the leached red yellow soils of granitic origin in the west by concretionary soils of sedimentary origin.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	62.4%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	27.3%
Grasslands	..	..	..	..	..	..	..	4.0%
Cropland	..	..	..	..	..	..	..	2.3%
Horticulture	..	..	..	..	..	..	..	1.9%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	1.4%

Name of Region: No. 13 PULAU PINANG

Classification: L₁ W₃.

Area: 313 sq. km.

Climate

Average annual rainfall — between 2,750 mm and 3,000 mm.

Rainfall region — North West Malaya.

Annual potential evapotranspiration — 1,500 mm approximately.

Potential Water Resources

Potential runoff — 1,250 mm approximately.

Geology

Mainly acid and undifferentiated granitic rocks with a pocket each of loose clayey and sandy deposits on the east and on the west.

Physiography

A hill and mountain complex dominates the central portion of the island. Rolling to low hilly land surrounds the highlands while the narrow coastal fringes are flat to gently undulating.

Pedology

The central part is mainly steepland and bordered by red yellow podzolics of granitic origin. Undifferentiated marine alluvium is found along western and southern coastline.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	30.5%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	27.1%
Horticulture	..	..	..	..	..	..	..	14.4%
Cropland	..	..	..	..	..	..	..	11.6%
Urban and Associated Areas	..	..	..	..	..	..	..	10.4%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	3.2%
Grasslands	..	..	..	..	..	..	..	2.6%

Name of Region: No. 14 TEMENGOR

Classification: L₁ W₂.

Area: 4,060 sq. km.

Climate

Average annual rainfall — 2,250 mm approximately.

Rainfall region — West Malaya.

Annual potential evapotranspiration — 1,250 mm approximately.

Potential Water Resources

Potential runoff — between 750 mm and 1,000 mm.

Geology

Mainly acid and undifferentiated granitic rocks in the central and southern portions of the regions. On the eastern and western parts, mainly shales predominate with sandstones, mudstones and siltstones.

Physiography

The whole region consists of hills and mountains with rugged terrain.

Pedology

This is almost entirely consisting of lithosols on steep land.

Vegetation and Land Use

Forest Lands	99%
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Name of Region: No. 15 GULONG PILONG

Classification: L₃ W₂.

Area: 292 sq.: km.

Climate

Average annual rainfall — 2,250 mm approximately.

Rainfall region — West Malaya.

Annual potential evapotranspiration — between 1,250 mm and 1,500 mm.

Potential Water Resources

Potential runoff — between 750 and 1,000 mm.

Geology

In the northern half are gravel, sand, clay, clayey sandstones and siltstones while in the southern half mainly sandstones predominate with conglomerates, quartzites, greywackes, shales, schists and phyllites.

Physiography

Hills and mountains cover the entire region.

Pedology

Consisting entirely of lithosols on steep land.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	98.7%
Unused Land, Unclassified Land	..	..	..	..	..	..	..	1.2%

Name of Region: No. 16 KEROH

Classification: L₃ W₂.

Area: 653 sq. km.

Climate

Average annual rainfall — between 2,000 mm. and 2,250 mm.

Rainfall region — North West Malaya.

Annual potential evapotranspiration — between 1,250 mm. and 1,500 mm.

Potential Water Resources

Potential runoff — 750 mm approximately.

Geology

Except for very minor pockets of limestone and shales the rest comprises mainly gravel, sand, clay, clayey sandstones, siltstones.

Physiography

This region is covered by hills and mountains except for parts of the northern portion where more subdued topography composed of rolling to low hill occurs.

Pedology

Dominated by lithosols on steepland with red yellow ultisols derived from sedimentary rocks on lower slopes. Some limestone soils are found in the vicinity of Baling town.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	77.7%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	12.0%
Cropland	..	..	..	..	..	..	..	3.6%
Grasslands	..	..	..	..	..	..	..	3.4%
Horticulture	..	..	..	..	..	..	..	1.8%

Name of Region: No. 17 GERIK

Classification: L₁ W₁.

Area: 2,100 sq. km.

Climate

Average annual rainfall — between 1,750 mm and 2,000 mm.

Rainfall region — West Malaya.

Annual potential evapotranspiration — 1,500 mm approximately.

Potential Water Resources

Potential runoff — below 500 mm.

Geology

Except for some pyroclastics, tuffs and reworked tuffs in the north the rest consists mainly of undifferentiated granitic rocks.

Physiography

The eastern portion is chiefly composed of hills and mountains while the northern, western, central and southern portions are occupied by rolling to low hilly land. Narrow riverine flood plains also occur in the central portion.

Pedology

Dominated by steepland of the Gunong Ulu Soh and Gunong Peninjau ranges. Granite derived red yellow podzolics separate these two ranges. Red yellow podzolics derived from sedimentary rocks are found in the north. Some riverine alluvium is encountered along the Perak river.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	69.5%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	16.0%
Grasslands	..	..	..	..	..	..	..	6.6%
Cropland	..	..	..	..	..	..	..	2.5%
Unused Land, Unclassified Land..	..	..	..	..	..	..	..	1.6%
Urban and Associated Areas	..	..	..	..	..	..	..	1.5%
Swamps, Marsh Lands, Wetland Forests	..	..	..	..	..	..	..	1.4%

Name of Region: No. 18 SELAMA

Classification: L₁ W₄.

Area: 1,340 sq. km.

Climate

Average annual rainfall — between 3,000 mm. and 3,250 mm.

Rainfall region — North West Malaya.

Annual potential evapotranspiration — 1,500 mm approximately.

Potential Water Resources

Potential runoff — 1,750 mm. approximately.

Geology

Mainly acid and undifferentiated granitic rocks on the eastern half of the region, the rest consists of mainly shales predominate with sandstones, mudstones and siltstones.

Physiography

The northern and southern portions are occupied by hills and mountains. Rolling to low hilly lands cover the rest of the region the hills being separated by wide riverine flood plains and low terraces which are most extensive in the south.

Pedology

Steepland of the G. Bintang range is found in the north and of Maxwell Hill in the south. The central part is dominated by sedentary soil, mainly red yellow podzolics derived from granite and sedimentary rocks. Pockets of subrecent alluvium are also encountered.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	59.4%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	23.8%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	5.1%
Cropland	..	..	..	..	..	..	..	4.7%
Grasslands	..	..	..	..	..	..	..	3.0%
Horticulture	..	..	..	..	..	..	..	2.9%

Name of Region: No. 19 Lawin

Classification: L₃ W₁.

Area: 179 sq. km.

Climate

Average annual rainfall — between 1,750 mm and 2,000 mm.

Rainfall region — West Malaya.

Annual Potential evapotranspiration — 1,500 mm approximately.

Potential Water Resources

Potential runoff — below 500 mm.

Geology

Mainly gravel, sand, clay, clayey sandstone and siltstone.

Physiography

This is a region of hills and mountains with rolling to low hilly land on the western and southern portions.

Pedology

Mainly steep land with some granite derived red yellow soils at lower slopes.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	90.7%
Grasslands	..	..	..	..	..	..	..	4.3%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	2.5%
Unused Land, Unclassified Land	..	..	..	..	..	..	..	1.5%

Name of Region: No. 20 BT. MERAH

Classification: L₄ W₃.

Area: 444 sq. km.

Climate

Average annual rainfall — 3,000 mm approximately.

Rainfall region — North West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 1,250 mm-1,500 mm.

Geology

Mainly loose, clayey and sandy deposits. Some gravel, sand, clay, clayey sandstone and siltstone in the north and some pockets of shales in the south.

Physiography

The northern part is made up of rolling to low hilly land. The central portion consists of a wide riverine flood plain with low terraces while the southern portion is part of the coastal plain. On the southeastern border a peat swamp is present.

Pedology

A patch of peat is found in the middle of this region. Recent riverine alluvium is found bordering the peat. In the north and south of this region, red yellow podzolics of sedimentary origin is encountered.

Vegetation and Land Use

Tree, Palm, Permanent Crops	..	..	..	..	..	33.7%
Swamps, Marshlands, Wetland Forests	..		..	..	..	33.1%
Cropland	..	..	..	..	..	12.6%
Forest Lands	..	..	..	..	..	8.3%
Unused Land, Unclassified Land			..	..	..	4.5%
Horticulture	..	..	..	..	..	3.6%
Grasslands	..	..	..	..	..	3.3%

Name of Region: No. 21 SG. LEGAP

Classification: L₃ W₂.

Area: 258 sq. km.

Climate

Average annual rainfall — 2,250 mm approximately.

Rainfall region — West Malaya.

Annual potential evapotranspiration — between 1,250 mm-1,500 mm.

Potential Water Resources

Potential runoff — between 750 mm and 1,000 mm.

Geology

Mainly gravel, sand, clay, clayey sandstone and siltstone.

Physiography

This is a hill and mountain region with steep slopes being predominant. On the western edge gentler slopes on more subdued hills are present.

Pedology

Dominated by steep land with some red yellow podzolics of sedimentary origin at the western fringe.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	93.8%
Cropland	..	..	..	..	..	3.0%
Grasslands	..	..	..	..	..	2.0%

Name of Region: No. 22 IPOH

Classification: L₂ W₃.

Area: 974 sq. km.

Climate

Average annual rainfall — 2,750 mm approximately.

Rainfall region — West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 1,000 mm and 1,250 mm.

Geology

Mainly limestone, mostly crystalline, compact, jointed and of karst-type, mainly springs. The northern tip of the region consists of limestones with no springs.

Physiography

Rolling to low hilly land is predominant in this region with many mining pools dotting the flat areas.

Pedology

Almost entirely consisting of mined land with occasionally pockets of subrecent alluvium.

Vegetation and Land Use

Tree, Palm, Permanent Crops	..	..	..	..	..	28.5%
Urban and Associated Areas	..	..	..	..	..	25.2%
Grasslands	..	..	..	..	..	22.9%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	6.0%
Cropland	..	..	..	..	..	5.4%
Unused Land, Unclassified Land	..	..	..	..	..	5.1%
Forest Lands	..	..	..	..	..	3.7%
Horticulture	..	..	..	..	..	3.2%

Name of Region: No. 23 KUALA KANGSAR

Classification: L₃ W₁.

Area: 877 sq. km.

Climate

Average annual rainfall — 2,000 mm approximately.

Rainfall region — West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — 500 mm approximately.

Geology

Mainly gravel, sand, clay, clayey sandstone and siltstone.

Physiography

Flat to gently undulating riverine flood plains stretch along the length of this region with rolling to low hilly land on either side.

Pedology

Riverine alluvium bordering Perak river is prominent. Sedentary soils are mainly derived from sedimentary rocks and are of the red yellow podzolics groups. Some subrecent alluvium is also encountered towards the southern tip of this region.

Vegetation and Land Use

Tree, Palm, Permanent Crops	..	..	..	..	..	32.1%
Forest Lands	..	..	..	..	..	26.0%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	17.4%
Cropland	..	..	..	..	..	8.6%
Grasslands	..	..	..	..	..	6.9%
Horticulture	..	..	..	..	..	4.9%
Unused Land, Unclassified Land	..	..	..	..	..	2.5%
Urban and Associated Areas	..	..	..	..	..	1.6%

Name of Region: No. 24 G. BUBU

Classification: L₁ W₃.

Area: 518 sq. km.

Climate

Average annual rainfall — 2,500 mm approximately.

Rainfall region — West Malaya.

Annual potential evapotranspiration — between 1,250 mm and 1,500 mm.

Potential Water Resources

Potential runoff — between 1,000 mm and 1,250 mm.

Geology

Mainly acid and undifferentiated granitic rocks.

Physiography

This region consists of a mountain complex with steep slopes being predominant.

Pedology

The major part of this region is steepland except for some granite derived red yellow podzolics bordering the western fringe.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	77.4%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	15.9%
Grasslands	..	..	..	..	..	..	..	1.4%
Gropland	..	..	..	..	..	..	..	1.3%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	1.2%
Horticulture..	..	..	..	..	..	..	..	1.1%
Unused Land, Unclassified Land	..	..	..	..	..	..	..	1.1%

Name of Region: No. 25 TG. TUALANG

Classification: L₁ W₂.

Area: 152 sq. km.

Climate

Average annual rainfall — between 2,250 mm and 2,500 mm.

Rainfall region — West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 750 mm and 1,000 mm.

Geology

In the northern half, mainly shales predominate with sandstones, mudstones and siltstones. In the south, mainly acid and undifferentiated granitic rocks.

Physiography

Mainly rolling to low hilly land.

Pedology

Mainly mined land in the north with some granite derived red yellow podzolics towards the south.

Vegetation and Land Use

Tree, Palm, Permanent Crops	..	..	..	..	..	38.4%
Forest Lands	..	..	..	..	..	19.9%
Grasslands	..	..	..	..	..	13.7%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	13.4%
Urban and Associated Areas	..	..	..	..	..	13.2%

Name of Region: No. 26 BIDOR

Classification: L₁ W₄.

Area: 1,699 sq. km.

Climate

Average annual rainfall — 3,000 mm approximately.

Rainfall region — West Malaya.

Annual potential evapotranspiration — between 1,250 mm and 1,500 mm.

Potential Water Resources

Potential runoff — between 1,500 mm and 1,750 mm.

Geology

The south western portion comprises mainly shales predominate with sandstones, mudstones and siltstones. The remaining part of the region consists mainly of acid and undifferentiated granitic rocks.

Physiography

Hills and mountains occupy the eastern half of this region. Rolling to low hilly lands occur in the centre while on the western edge intermediate terraces on gently undulating surfaces are present.

Pedology

The entire eastern half is steepland. The foothills around Tapah town are mainly of red yellow podzolics derived from sedimentary rocks. This grades into subrecent alluvium towards the western border of this region. Mined lands are also found north and south of Tapah town.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	68.4%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	16.4%
Grasslands	..	..	..	..	..	..	6.6%
Urban and Associated Areas	..	..	..	..	..	..	3.8%
Cropland	..	..	..	..	..	..	1.9%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	1.7%

Name of Region: No. 27 TELOK ANSON

Classification: L₅ W₂.

Area: 1,120 sq. km.

Climate

Average annual rainfall — approx. 2,500 mm.

Rainfall region — West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 750 mm and 1,000 mm.

Geology

Mainly loose, clayey and sandy deposits.

Physiography

Flat to undulating riverine flood plains and low terraces occur in the north while in the south peat swamps are present.

Pedology

The southern part is dominated by peat while the northern region is dominated by riverine alluvium. Some subrecent alluvium are also found within this region.

Vegetation and Land Use

Swamps, Marshlands, Wetland Forests	50.3%
Tree, Palm, Permanent Crops	18.0%
Cropland	10.9%
Forest Lands	10.1%
Grasslands	5.7%
Unused Land, Unclassified Land	2.5%
Horticulture.. .. .	1.6%

Name of Region: No. 28 KUALA SELANGOR

Classification: L₅ W₁.

Area: 5,340 sq. km.

Climate

Average annual rainfall — between 2,000 mm and 2,250 mm.

Rainfall region — West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — 500 mm approximately.

Geology

Mainly loose, clayey and sandy deposits.

Physiography

This region is part of the western coastal plain and consists of coastal alluvial flats with two large peat swamps, one in the north and the other in the south.

Pedology

Major portion of this region is occupied by marine alluvium from Morib to Bagan Datoh. The coastline is lined with undifferentiated recent marine alluvium and the interior is usually occupied by peat. The Dindings area is dominated by subrecent and recent alluvium with some occurrence of recent marine alluvium along the coast and peat towards the interior.

Vegetation and Land Use

Swamps, Marshlands, Wetland Forests	41.0%
Tree, Palm, Permanent Crops	37.4%
Cropland	5.7%
Forest Lands	3.9%
Grasslands	3.9%
Horticulture	1.1%

Name of Region: No. 29 SG. BERNAM

Classification: L₄ W₂.

Area: 185 sq. km.

Climate

Average annual rainfall — between 2,500 mm and 2,750 mm.

Rainfall region — West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — 1,000 mm approximately.

Geology

Mainly loose, clayey and sandy deposits.

Physiography

This region straddles the boundary between the coastal plain and the hills so that it consists of alluvial plains and peat swamps separated by low hilly land.

Pedology

Mainly peat and riverine alluvium especially along the Sg. Bernam. Pockets of sedentary soils are also found.

Vegetation and Land Use

Swamps, Marshlands, Wetland Forests	53.5%
Forest Lands	31.7%
Tree, Palm, Permanent Crops	12.40%
Grasslands	1.1%
Unused Land, Unclassified Land	1.1%

Name of Region: No. 30 BATU TIGA

Classification: L₃ W₂.

Area: 2,200 sq. km.

Climate

Average annual rainfall — 2,500 mm approximately.

Rainfall region — West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 750 mm and 1,000 mm.

Geology

Except for small pockets of undifferentiated granitic rocks in the south and some shales in the centre, the rest of the region consists of gravel, sand, clay, clayey sandstone and siltstone.

Physiography

Rolling to low hilly land occupies this region.

Pedology

Except for the area near Kuala Lumpur where some red yellow podzolics derived from granites are found, the majority of the remaining area is occupied by red yellow podzolics derived from sedimentary rocks.

Vegetation and Land Use

Tree, Palm, Permanent Crops	..	..	..	..	..	38.8%
Forest Lands	..	..	..	..	..	34.9%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	13.1%
Grasslands	..	..	..	..	..	7.0%
Urban and Associated Areas	..	..	..	..	..	4.3%
Horticulture..	..	..	..	..	..	1.1%

Name of Region: No. 31 KUALA LUMPUR**Classification:** L₂ W₃.**Area:** 160 sq. km.**Climate**

Average annual rainfall — between 2,500 mm and 2,750 mm.

Rainfall region — West Malaya.

Annual potential evapotranspiration — between 1,500 and 1,750 mm.

Potential Water Resources

Potential runoff — between 1,000 mm and 1,250 mm.

Geology

Limestones, mainly crystalline, compact, jointed and of karst-type, mainly springs.

Physiography

Mainly rolling to low hilly land.

Pedology

Dominated by urban and mined land.

Vegetation and Land Use

Urban and Associated Areas	..	..	..	..	..	67.7%
Grasslands	..	..	..	..	..	9.8%
Tree, Palm, Permanent Crops	..	..	..	..	..	8.0%
Forest Lands	..	..	..	..	..	7.7%
Horticulture..	..	..	..	..	..	3.1%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	2.1%

Name of Region: No. 32 CHUAH**Classification:** L₄ W₂.**Area:** 244 sq. km.**Climate**

Average annual rainfall — 2,250 approximately.

Rainfall region — West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 500 mm and 750 mm.

Geology

Mainly loose, clayey and sandy deposits.

Physiography

Most of this region is on west coastal plain with flat land being predominant. Only on the east are rolling to low hilly lands evident.

Pedology

Peat is dominant except for some brown grey soil derived from marine alluvium. Sedentary soils are mainly red yellow podzolics of sedimentary parent materials.

Vegetation and Land Use

Swamps, Marshlands, Wetland Forests	45.2%
Tree, Palm, Permanent Crops	36.6%
Unused Land, Unclassified Land	10.5%
Urban and Associated Land	2.0%
Cropland	1.9%
Grasslands	1.8%
Forest Lands	1.1%

Name of Region: No. 33 KUALA PILAH

Classification: L₃ W₁.

Area: 2,600 sq. km.

Climate

Average annual rainfall — between 1,750 and 2,000 mm.

Rainfall region — South West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — below 500 mm.

Geology

Except for one small pocket of undifferentiated granitic rocks and one small pocket of shales, the rest of the region consists of gravel, sand, clay, clayey sandstone and siltstone.

Physiography

Steeply sloping hills and mountains occur in the south of this region. In the rest of the region, low hilly land is predominant with riverine flood plains in the broad valleys between the low hills.

Pedology

The Mt. Ophir massif is found towards the south and is surrounded by red-yellow podzolics of granite origin. The rest of the area is occupied mainly by red yellow, yellow grey podzolics derived from sedimentary rocks.

Vegetation and Land Use

Forest Lands	48.4%
Tree, Palm, Permanent Crops	39.3%
Grasslands	5.1%
Swamps, Marshlands, Wetland Forests	2.7%
Horticulture.. .. .	2.0%
Cropland	1.8%

Name of Region: No. 34 MELAKA

Classification: L₁ W₁.

Area: 3,880 sq. km.

Climate

Average annual rainfall — 2,000 mm approximately.

Rainfall region — Port Dickson–Muar Coast.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — 500 mm approximately.

Geology

The western and south western parts of the region comprise mainly shales, predominate with sandstones, mudstones and siltstones. The remaining part of the region consists mainly of acid and undifferentiated granitic rocks.

Physiography

This is principally a region of rolling to low hilly land with hills and mountains at its northern border. At its extreme southern edge narrow strips of coastal plains are evident and narrow riverine flood plains and isolated patches of peat swamps occur within this region.

Pedology

Steepland which forms part of the main range is found in the north of this region. Red yellow podzolics derived from granite extend from the steep land southwards. Towards the west up to the coast, most of the soils are red yellow and yellow grey podzolics. Much of this soils are associated with lateritic soils. Small patches of peat and riverine alluvium are also found within this region.

Vegetation and Land Use

Tree, Palm, Permanent Crops	..	..	..	..	..	47.6%
Forest Lands	..	..	..	..	..	36.4%
Cropland	..	..	..	..	..	5.4%
Horticulture	..	..	..	..	..	3.9%
Grasslands	..	..	..	..	..	2.5%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	2.1%
Urban and Associated Areas	..	..	..	..	..	1.5%

Name of Region: No. 35 KELUANG

Classification: L₁ W₂.

Area: 6,220 sq. km.

Climate

Average annual rainfall — between 2,250 mm and 2,500 mm.

Rainfall region — South West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — 750 mm approximately.

Geology

The western portion consists mainly of shales predominate with sandstones, mudstones and siltstones. In the north, both undifferentiated granitic rocks and volcanic rocks (rhyolite and dacite) are found. In the rest of the region, both granites and shales predominate except for some recent alluvium (loose and clayey and sandy deposits).

Physiography

The northern portion is covered by a complex of rolling to steep hills and mountains. Towards the eastern boundary the topography is also made up of a complex of hills some of which are single hills with steep slopes. Another hill complex occurs on the west with steep slopes also being predominant. Except for two minor occurrences of peat swamps, one in the centre and the other towards the east, the rest of the region, particularly the central portion, consists of rolling to low hilly land.

Pedology

The Gunong Beremban range occupies the northern part of this region. Red yellow podzolics of granitic origin extends from this range southwards and is bordered by yellow grey podzolics and older alluvium in the west, Riverine alluvium are found along most rivers in this region.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	59.9%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	29.3%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	5.8%
Grasslands	..	..	..	..	..	..	..	3.6%

Name of Region: No. 36 MERSING

Classification: L₁ W₃.

Area: 4,780 sq. km.

Climate

Average annual rainfall — between 3,000 mm and 3,250 mm.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 1,250 mm and 1,500 mm.

Geology

The northern and eastern parts of the region consist mainly of shales, predominate with sandstones, mudstones and siltstones. There are some pockets of pyroclastics, tuffs and reworked tuffs on the west. The rest of the region consists of undifferentiated granitic rocks.

Physiography

Rolling to low hilly land is predominant in this region. Hill complexes with more rugged terrain occur in an arc from Kota Tinggi to Tg. Tenggara. The hills on the east coast are low but often steeply sloping; where they have been eroded along the coast sandy beaches are now evident. In the south "higher terraces" occur with the low hills.

Pedology

Red yellow podzolics and lithosols derived from granite occupy the major portion of the interior of this region. This is separated from the coastal podsols by red yellow, yellow grey and light grey ultisols derived from sedimentary rocks.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	79.4%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	10.0%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	6.1%
Grasslands	..	..	..	..	..	..	..	2.5%
Unused Land, Unclassified Land	..	..	..	..	..	..	..	1.1%

Name of Region: No. 37 KG. SEMBERONG

Classification: L₄ W₃.

Area: 706 sq. km.

Climate

Average annual rainfall — between 2,500 mm and 2,750 mm.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — 1,000 mm approximately.

Geology

Mainly loose, clayey and sandy deposits except for minor pockets of granite in the south.

Physiography

This region consists of rolling to low hilly land surrounded by riverine flood plains and low terraces.

Pedology

This region is occupied mainly by red yellow and yellow grey podzolics derived from sedimentary rocks. A patch of granite derived red yellow podzolics is found in the middle.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	61.7%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	30.3%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	4.1%
Grasslands	..	..	..	..	..	..	..	1.9%
Unused Land, Unclassified Land	..	..	..	..	..	..	..	1.5%

Name of Region: No. 38 BUKIT TAWAI

Classification: L₃ W₂.

Area: 202 sq. km.

Climate

Average annual rainfall — 2,250 mm approximately.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 500 mm and 750 mm.

Geology

Mainly sandstones (Gagau type).

Physiography

This is a region of hill complexes with rugged terrain being common. Only in the south is rolling to low hilly land evident.

Pedology

More than half the region is occupied by lithosols on steepland while the rest is mainly red-yellow podzolics derived from sedimentary rocks.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	97.3%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	2.7%

Name of Region: No. 39 BATU PAHAT

Classification: L₅ W₂.

Area: 4,420 sq. km.

Climate

Average annual rainfall — between 2,500 mm and 2,750 mm.

Rainfall region — South West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 750 mm and 1,000 mm.

Geology

Mainly loose, clayey and sandy deposits except for a granite outcrop at Batu Pahat.

Physiography

This is part of the western coastal plain with flat to very gently undulating land predominating. In the southern half of this region, a peat swamp occupies approximately the whole of the eastern portion. Similarly, in the north, more than half the interior consists of peat swamps. Isolated hills also occur in the plains with the largest single complex of hills in the Batu Pahat area.

Pedology

In the northern tip, the soil is predominantly organic clay and muck with some riverine alluvium and also some sedentary soils of sedimentary origin. The major portion of the region is occupied by marine and riverine alluvium and peat. Soils developed from marine alluvium range from slightly acid to very acid and are towards the coast. These marine alluvium grade into peat further inland. Some sandy grey yellow sedentary soils are found around Batu Pahat town.

Vegetation and Land Use

Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	60.5%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	14.5%
Forest Lands	..	..	..	..	..	..	..	11.6%
Grasslands	..	..	..	..	..	..	..	4.8%
Horticulture	..	..	..	..	..	..	..	3.0%
Unused Land, Unclassified Land	..	..	..	..	..	..	..	2.7%
Urban and Associated Areas	..	..	..	..	..	..	..	1.8%
Cropland	..	..	..	..	..	..	..	1.2%

Name of Region: No. 40 SG. KAHANG

Classification: L₃ W₂.

Area: 121 sq. km.

Climate

Average annual rainfall — 2,250 mm approximately.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm

Potential Water Resources

Potential runoff — between 500 mm and 750 mm.

Geology

Mainly sandstones (Gagau type).

Physiography

This region consists of steep-sided low hill ranges separated by undulating riverine flood plains and low terraces.

Pedology

Dominated by red yellow and yellow grey podzolics derived from sedimentary rocks with some riverine alluvium along rivers.

Vegetation and Land Use

Tree, Palm, Permanent Crops	..	..	..	..	..	85.7%
Forest Lands	..	..	..	..	..	8.0%
Grasslands	..	..	..	..	..	3.0%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	2.6%

Name of Region: No. 41 SG. TEBAK

Classification: L₃ W₃.

Area: 284 sq. km.

Climate

Average annual rainfall — 2,750 mm approximately.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 1,000 mm and 1,250 mm.

Geology

Mainly sandstones (Gagau type).

Physiography

Steep hills occur in the northern half with a range of steep hills cutting through the centre of this region. In the south the topography is more subdued.

Pedology

Dominated by red yellow podzolics and lithosols derived from granites.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	97.1%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	1.6%

Name of Region: No. 42 MAWAI

Classification: L₄ W₄.

Area: 408 sq. km.

Climate

Average annual rainfall — 3,250 mm approximately.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 1,500 mm and 1,750 mm.

Geology

Mainly loose clayey and sandy deposits.

Physiography

This is part of the coastal lowlands which has been covered by peat swamps. Isolated low hills rise above this swamp in the north and south while on the east the swamp is succeeded by coastal sand beaches.

Pedology

This region is mainly covered with peat except for a narrow coastal strip of podzols and regosols derived from dune and beach sands.

Vegetation and Land Use

Swamps, Marshlands, Wetland Forests ..	..	..	..	49.5%
Forest Lands ..	..	..	..	39.2%
Unused Land, Unclassified Land ..	..	..	..	4.5%
Tree, Palm, Permanent Crops ..	..	..	..	4.1%
Grasslands ..	..	..	..	1.7%

Name of Region: No. 43 SG. SANIT

Classification: L₄ W₄.

Area: 445 sq. km.

Climate

Average annual rainfall — between 3,000 mm and 3,250 mm.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — 1,500 mm approximately.

Geology

Northern portion consists of acid and undifferentiated granitic rocks. Eastern portion consists of loose, clayey and sandy deposits. The rest consists of volcanic rocks of acid to intermediate fragments and flows, mainly tuffs of predominantly rhyolic to dacitic composition.

Physiography

Low hills with gentle slopes occur in the northern and central parts of this region. The coastal lowlands in the immediate vicinity of the hills are usually covered by peat swamps which give way to sandy beaches on the eastern and southern sides; on the western portion river deltas with mangrove swamps are common.

Pedology

Red yellow and yellow grey podzolics are predominant inland. This is separated from the coastal strip consisting mainly of podzols by peat. Dark grey marine alluvial soils border the two large rivers in the region.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	38.4%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	26.1%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	16.3%
Grasslands	..	..	..	..	..	..	..	8.5%
Unused Land, Unclassified Land	..	..	..	..	..	..	..	8.5%
Urban and Associated Areas	..	..	..	..	..	..	..	1.4%

Name of Region: No. 44 SG. SUA

Classification: L₃ W₂.

Area: 1,660 sq. km.

Climate

Average annual rainfall — 2,250 mm approximately.

Rainfall region — West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 500 mm and 750 mm.

Geology

Mainly gravel, sand, clay, clayey sandstone and siltstone.

Physiography

The whole region consists of hills and mountains with rugged terrain.

Pedology

This region is mainly lithosols on steep-land complexes except for a patch of yellowish red clay soil developed from schists at the confluence of the Sg. Tekai and Sg. Telom.

Vegetation and Land Use

Forest Lands	98.4%
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Name of Region: No. 45 GUNONG ULU BAKAR

Classification: L₁ W₃.

Area: 1,460 sq. km.

Climate

Average annual rainfall — between 2,500 mm and 2,750 mm.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,250 mm and 1,500 mm.

Potential Water Resources

Potential runoff — 1,250 mm approximately.

Geology

Mainly acid and undifferentiated granitic rocks. A minor pocket of shales, predominate with sandstones, mudstones and siltstones in the northern tip.

Physiography

The whole region consists of steeply sloping hills and mountains separated by narrow river valleys.

Pedology

The entire region is on steep land.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	97.4%
Grasslands	..	..	..	..	..	..	..	1.7%

Name of Region: No. 46 SG. TEKAI

Classification: L₃ W₂.

Area: 5,500 sq. km.

Climate

Average annual rainfall — 2,250 mm approximately.

Rainfall Region — East Malaya.

Annual potential evapotranspiration — 1,500 mm approximately.

Potential Water Resources

Potential runoff — 750 mm approximately.

Geology

In the north and south, mainly sandstones predominate with conglomerate, quartzites, greywackes, shales, schists and phyllites. In the centre, mainly gravel, sand, clay, clayey sandstone and siltstone with very minor pockets of volcanic rocks. East of Bt. Bertangga, shales, sandstones of Gagau type are found.

Physiography

In the north, the steep sloping hills and mountains are separated by narrow river valleys with minor occurrences of low hilly land. The central portion is dominated by steep rugged mountain ranges with some portions more subdued and having undulating to rolling topography. The south portion is also an area of hills and mountains producing a rugged terrain; some rolling to hilly land is also found.

Pedology

Lithosols on steep land occupy the major portion of this region with red yellow podzolics on sedimentary rocks on lower slopes along river valleys. In the western portion, friable reddish clay soils derived from andesite are dominant. In the southeast, red yellow podzolics of sedimentary origin are found with some red brown clay.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	95%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	1.8%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	1.1%

Name of Region: No. 47 SG. LEMBING

Classification: L₁ W₄.

Area: 1,300 sq. km.

Climate

Average annual rainfall — 3,250 mm approximately.

Rainfall region — East Malaya.

Annual potential evapotranspiration — 1,500 mm approximately.

Potential Water Resources

Potential runoff — 1,750 mm approximately.

Geology

In the eastern central and south western portions are mainly shales, predominate with sandstones, mudstones and siltstones. The rest of the region consists of undifferentiated granitic rocks.

Physiography

Hills and mountains occupy the western half of this region while rolling to low hilly land is present on the eastern half.

Pedology

The western portion of this region is on steepland while the rest of the region is occupied by red yellow and yellow grey podzolics of sedimentary origin.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	94.8%
Grasslands	..	..	..	..	..	..	..	2.7%
Unused Land, Unclassified Land				..	..	..	..	1.3%

Name of Region: No. 48 KUALA LIPIS

Classification: L₃ W₂.

Area: 263 sq. km.

Climate

Average annual rainfall — 2,250 mm approximately.

Rainfall region — West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 500 mm and 750 mm.

Geology

Mainly gravels, sand, clay, clayey sandstones and siltstones.

Physiography

Hilly land separated by gently sloping and moderately wide riverine flood plains cover this region.

Pedology

Premominately yellow red podzolics derived from sedimentary rocks with riverine alluvium along the major rivers.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	48.8%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	36.3%
Grasslands	..	..	..	..	..	..	..	6.1%
Cropland	..	..	..	..	..	..	..	2.7%
Horticulture	..	..	..	..	..	..	..	2.4%
Unused Land, Unclassified Land	..	..	..	..	..	..	..	1.7%
Urban and Associated Areas	..	..	..	..	..	..	..	1.2%

Name of Region: No. 49 TEMERLOH

Classification: L₁ W₁.

Area: 11,800 sq. km.

Climate

Average annual rainfall — 2,000 mm approximately.

Rainfall region — West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — 500 mm approximately.

Geology

In the north, pocket of pyroclastics, tuffs and reworked tuffs are found. Small pockets of volcanic rocks are found in the east. Undifferentiated granitic rocks are found to the west. The rest of about two thirds of the region are mainly shales predominate with sandstones, mudstones and siltstones.

Physiography

The major portion of the region consists of rolling to low hilly land, some of the hills being, however, steeply sloping. Along the northern, western and southeastern borders of this region the topography is more rugged as hill complexes are more prominent. River flood plains and low terraces are narrow. An inland swamp, the Tasek Bera Swamp, occurs in the central part of this region.

Pedology

An extensive tract of granite derived red yellow podzolics extends from the south eastern to southern part of this region. The rest of the region is dominated by yellow grey podzolics intermixed with red yellow podzolics both of which are derived from sedimentary rocks. Lateritic soils are also frequently encountered within this region.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	74.3%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	15.1%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	3.7%
Grasslands	..	..	..	..	..	..	..	2.9%
Cropland	..	..	..	..	..	..	..	1.6%
Horticulture	..	..	..	..	..	..	..	1.2%

Name of Region: No. 50 KUANTAN

Classification: L₅ W₃.

Area: 3,740 sq. km.

Climate

Average annual rainfall — between 2,750 mm and 3,000 mm.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 1,250 mm and 1,500 mm.

Geology

Mainly loose, clayey and sandy deposits.

Physiography

Flat to gently undulating coastal plains covered by peat swamps and minor sand beaches occupy approximately 2/3 of the southern portion of this region. In the north the land consists of rolling to low hilly land.

Pedology

The central portion is predominantly peat with some organic soils but towards the south organic soils are dominant. Podzolics are found only along the coast. In the north, a large area of Dark brown soils of basaltic origin is found. Smaller areas of red yellow podzolics of granite parent material are also present.

Vegetation and Land Use

Swamps, Marshlands, Wetland Forests	62.3%
Forest Lands	18.9%
Tree, Palm, Permanent Crops	6.4%
Grasslands	5.9%
Unused Land, Unclassified Land.. .. .	3.5%
Horticulture.. .. .	1.5%
Cropland	1.1%

Name of Region: No. 51 SG. BEBAR

Classification: L₅ W₂.

Area: 1,230 sq. km.

Climate

Average annual rainfall — between 2,500 mm and 2,750 mm.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — 1,000 mm approximately.

Geology

Mainly loose, clayey and sandy deposits.

Physiography

This is part of the east coast plain and is composed mainly of peat swamps with a narrow stretch of riverine flood plain in the north.

Pedology

The region is wholly peat except for some riverine alluvium along the Sg. Pahang in the north.

Vegetation and Land Use

Swamps, Marshlands, Wetland Forests	73.1%
Forest Lands	21.1%
Unused Land, Unclassified Land	1.6%
Grasslands	1.4%
Tree, Palm, Permanent Crops	1.2%
Cropland	1.0%

Name of Region: No. 52 GERET

Classification: L₃ W₂.

Area: 179 sq. km.

Climate

Average annual rainfall — 2,250 mm approximately.
Rainfall region — East Malaya.
Annual potential evapotranspiration — between 1,500 mm and 1,750 mm,

Potential Water Resources

Potential runoff — between 500 mm and 750 mm.

Geology

Mainly sandstones (Gagau type).

Physiography

Rolling to low hilly lands with some occurrences of “higher terraces” are found in this region.

Pedology

Dominated by red yellow and yellow grey podzolics derived from sedimentary rocks. Some grey yellow soil derived from subrecent alluvium is also present.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	78.9%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	17.0%
Cropland	..	..	..	..	..	..	..	1.6%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	1.5%

Name of Region: No. 53 KG. KACHAH

Classification: L₃ W₂.

Area: 255 sq. km.

Climate

Average annual rainfall — 2,250 mm approximately.
Rainfall region — East Malaya.
Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 500 mm and 750 mm.

Geology

Mainly sandstones (Gagau type).

Physiography

Rolling to low hilly land is predominant in this region with flat to gently undulating riverine flood plains of minor occurrence.

Pedology

Predominantly red yellow and yellow grey podzolics with some riverine alluvium.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	94.6%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	5.0%

Name of Region: No. 54 Bt. BATU BERTARAH

Classification: L₃ W₁.

Area: 208 sq. km.

Climate

Average annual rainfall — 2,000 mm approximately.

Rainfall region — South West Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — below 500 mm.

Geology

Except for some pyroclastics, tuffs and reworked tuffs to the south west, the rest mainly sandstones, predominate with conglomerates, quartzites, greywackes, shales, shists and phyllites.

Physiography

Rolling to low hilly land is predominant in this region with some “higher terraces”.

Pedology

Mainly red yellow and yellow grey podzolic derived from sedimentary rocks and some older alluvium.

Vegetation and Land Use

Forest Lands	99%
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Name of Region: No. 55 Bt. PETA

Classification: L₃ W₃.

Area: 179 sq. km.

Climate

Average annual rainfall — 3,000 mm approximately.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 1,250 mm and 1,500 mm.

Geology

Mainly sandstones (Gagau type).

Physiography

Steep hills and ridges are predominant in this region with undulating terrain and riverine flood plains of minor extent.

Pedology

The major portion is occupied by lithosols on steep land. Red yellow podzolics derived from sedimentary rocks are found on less steep area while along the Sg. Kinchin some riverine alluvium are prominent.

Vegetation and Land Use

Forest Lands	94.2%
Unused Land, Unclassified Land	3.2%
Swamps, Marshlands, Wetland Forests	2.2%

Name of Region: No. 56 JERTEH

Classification: L₄ W₄.

Area: 242 sq. km.

Climate

Average annual rainfall — 3,250 mm approximately.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 1,500 mm and 1,750 mm.

Geology

Mainly loose, clayey and sandy deposits

Physiography

The major portion of this region, particularly on the eastern side consists of riverine terraces with gently undulating to undulating topography. On the western and southern borders rolling to low hilly lands are encountered.

Pedology

This region is dominated by soils on subrecent alluvium with occasionally red yellow podzolics in steeper terrain.

Vegetation and Land Use

Cropland	27.0%
Forest Lands	26.6%
Tree, Palm, Permanent Crops	25.1%
Horticulture	11.1%
Grasslands	5.7%
Swamps, Marshlands, Wetland Forests	3.5%

Name of Region: No. 57 ULU TRENGGANU

Classification: L₁ W₄.

Area: 5,700 sq. km.

Climate

Average annual rainfall — 3,500 mm approximately.

Rainfall region — East Malaya.

Annual potential evapotranspiration — 1,500 mm approximately.

Potential Water Resources

Potential runoff — 2,000 mm approximately.

Geology

The whole region is underlain with a mixture of undifferentiated granitic rocks and shales, predominate with sandstones, mudstones and siltstones. Some minor pockets of gravel, sand, clayey sandstone and siltstones are found here and there.

Physiography

The western boundary of this region is dominated by steep, rugged mountains of the East Coast Range. The foothills, which occupy most of the remaining land in this region, are less rugged than the mountains; they are separated in places by flat to gently undulating riverine flood plains. At its extreme eastern edge pockets of peat swamps of the coastal lowlands are included.

Pedology

The whole region is mainly on steep land with red yellow podzolics derived from granites on lower slopes. This is especially evident in the northern and southern portions of this region. Soils of sedimentary origin which are frequently associated with the granite-derived soils are mainly found on the foothills.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	88.9%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	4.3%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	2.9%
Grasslands	..	..	..	..	..	..	..	2.2%

Name of Region: No. 58 KUALA BERANG

Classification: L₄ W₄.

Area: 687 sq. km.

Climate

Average annual rainfall — between 3,500 mm and 3,750 mm.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 2,000 mm and 2,250 mm.

Geology

In the central portion of the region are found gravel, sand, clay, clayey sandstones and siltstones. A small pocket of granite is found in the east. The rest of about 60% of the area consists of loose clayey and sandy deposits.

Physiography

The extreme northern portion of this region consists of peat swamps of the coastal plain. South of the swampland, rolling to low hilling land is present which is succeeded for more than half the southern portion by a flat to gently undulating coastal plain.

Pedology

Organic clays and mucks and peat are predominant in the north while in the mid portion of this region grey to light yellow soils derived from shales are dominant. This extends southwards to soils derived from subrecent to recent alluvium.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	48.9%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	17.2%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	17.2%
Cropland	..	..	..	..	..	..	..	8.2%
Grasslands	..	..	..	..	..	..	..	4.5%
Horticulture..	..	..	..	..	..	..	..	2.7%
Unused Land, Unclassified Land..	..	..	..	..	..	..	..	1.2%

Name of Region: No. 59 GUNONG GAGAU

Classification: L₃ W₃.

Area: 1,210 sq. km.

Climate

Average annual rainfall — between 2,500 mm and 2,750 mm.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,250 mm and 1,500 mm.

Potential Water Resources

Potential runoff — 1,250 mm approximately.

Geology

Mainly sandstones, predominate with conglomerates quartzites, greywackes, shales, schists and phyllites. There are some shales to the west and centre.

Physiography

Steeply sloping hills and mountain ranges dominate this region with minor occurrences of low hilly land in the west and centre.

Pedology

This area is mainly dominated by lithosols on steep land complexes with some red yellow podzolics from sedimentary rocks on gentler terrain along river valleys.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	98.8%
Unused Land, Unclassified Land..	..	..	..	..	..	..	..	1.2%

Name of Region: No. 60 MARANG

Classification: L₃W₃.

Area: 547 sq. km.

Climate

Average annual rainfall — 2,750 mm approximately.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — between 1,000 mm and 1,250 mm.

Geology

To the north and west are sandstones, predominate with conglomerates, quartzites, greywackes, shales, schists and phyllites. The rest are loose, clayey and sandy deposits.

Physiography

The coastal strip on the east is flat to gently undulating. Further inland isolated low hills with moderately steep slopes are present.

Pedology

Inland dominated by peat with pockets of light yellow to grey soils derived from shales on hilly land. The coastal strips consist mainly of regosols and podsols derived from beach and dune sands.

Vegetation and Land Use

Forests Lands	..	..	..	..	..	..	..	45.3%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	30.4%
Grasslands	..	..	..	..	..	..	..	11.4%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	7.7%
Unused Land, Unclassified Land	..	..	..	..	..	..	..	2.0%
Horticulture	..	..	..	..	..	..	..	1.8%
Cropland	..	..	..	..	..	..	..	1.2%

Name of Region: No. 61 SG. MERCHANG

Classification: L₄ W₄.

Area: 556 sq. km.

Climate

- Average annual rainfall — 3,500 mm approximately.
- Rainfall region — East Malaya.
- Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

- Potential runoff — between 1,750 mm and 2,000 mm.

Geology

Mainly loose clayey and sandy deposits with minor pockets of gravel, sand, clay, clayey sandstones and siltstones in the north and some shales in the south west.

Physiography

Most of this region consists of flat to gently undulating land with isolated low hills breaking the continuity of the flat land. The main concentration of low hills, however, is in the south and west where wide and gently undulating riverine flood plains separate the hills.

Pedology

The area between Sg. Dusun and Sg. Merchang is mainly peat. North of Sg. Merchang, light yellow to grey soils derived from shales are found in undulating to hilly terrain with recent riverine alluvium occupying the alluvial flats. Similar soil complexes are encountered south and west of Sg. Dungun.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	64.5%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	25.1%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	3.7%
Grasslands	..	..	..	..	..	..	..	3.2%
Horticulture	..	..	..	..	..	..	..	1.3%

Name of Region: No. 62 SG. JABOR

Classification: L₃ W₄.

Area: 948 sq. km.

Climate

- Average annual rainfall — between 3,000 mm and 3,500 mm.
- Rainfall Region — East Malaya.
- Annual potential evapotranspiration — between 1,500 and 1,750 mm.

Potential Water Resources

- Potential runoff — Between 1,750 mm and 2,000 mm.

Geology

Mainly sandstones predominate with conglomerates, quartzites, greywackes, shales, schists and phyllites.

Physiography

In the eastern half of this region hills and mountains occupy the northern portion with rolling to low hilly land in the south. The western half of the region is dominated by rolling to low hilly land with a wide expanse of flat to gently undulating riverine flood plain midway between the north and centre.

Pedology

In the eastern half of this region, there is steepland in the north and red yellow podzolics derived from sandstones in the south.

In the western half, light yellow to grey shale derived soils are dominant in the north grading into yellow grey podzolics, also derived from sedimentary rocks at the southern portion.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	89.1%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	6.1%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	3.2%

Name of Region: No. 63 KOTA BHARU

Classification: L₅ W₃.

Area: 2,550 sq. km.

Climate

Average annual rainfall — between 2,750 mm and 3,000 mm.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,500 mm and 1,750 mm.

Potential Water Resources

Potential runoff — 1,250 mm approximately.

Geology

Loose, clayey and sandy deposits.

Physiography

The terrain towards the coast is flat to gently undulating with a peat swamp towards the centre. Further inland the topography is more undulating consisting of low and intermediate riverine terrace.

Pedology

Inland the region is dominated mainly by alluvial soils and grey soils on recent riverine, subrecent and marine alluvium. Most of the coastal strip consists of regosols and podzols on beach and dune and organic with grey soils.

Vegetation and Land Use

Cropland	..	..	..	..	..	..	..	29.5%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	19.6%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	14.9%
Horticulture	..	..	..	..	..	..	..	13.0%
Forest Lands	..	..	..	..	..	..	..	10.3%
Grasslands	..	..	..	..	..	..	..	8.1%
Unused Land, Unclassified Land	..	..	..	..	..	..	..	3.4%
Urban and Associated Areas	..	..	..	..	..	..	..	1.2%

Name of Region: No. 64 TANAH MERAH — ULU SELANGOR

Classification: L₁ W₃.

Area: 9,920 sq. km.

Climate

Average annual rainfall — between 2,500 mm and 2,750 mm.

Rainfall region — East Malaya.

Annual potential evapotranspiration — between 1,250 mm and 1,500 mm.

Potential Water Resources

Potential runoff—between 1,000 mm and 1,250 mm.

Geology

Mainly undifferentiated granitic rocks. There are some shales (predominate with sandstones, mudstones and siltstones), volcanic rocks and some schists in the part of the region. Shales and gravel, sand, clay, clayey sandstones and siltstones are also found on the south eastern part of the region.

Physiography

The western portion of this region consists of steeply sloping hills and mountains. Only in the north is the topography subdued with rolling to low hilly land in evidence.

Pedology

The majority of the western strip of this region is dominated by lithosols of steep-land complexes. Some red yellow podzolics of granitic origin are found along Bt. Jeli and this extends southwards into yellow grey podzolics of sedimentary origin. Soils around Tanah Merah town are mainly of sedimentary origin and are lateritic generally. Granite derived red yellow podzolics are again encountered around Machang and this grades southwards towards lithosols of steep-land complexes.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	84.5%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	8.0%
Cropland	..	..	..	..	..	..	..	2.3%
Grasslands	..	..	..	..	..	..	..	2.2%
Swamps, Marshlands, Wetland Forests	..	..	..	..	..	..	..	1.3%
Horticulture	..	..	..	..	..	..	..	1.0%

Name of Region: No. 65 KUALA KERAJ — ULU LANGAT

Classification: L₁ W₂.

Area: 23,450 sq. km.

Climate

Average annual rainfall — between 2,250 mm and 2,500 mm.

Rainfall region — West Malaya.

Annual potential evapotranspiration — 1,500 mm approximately.

Potential Water Resources

Potential runoff — between 750 mm and 1,000 mm.

Geology

In the upper portion of the region are found undifferentiated granites, shales (predominate with sandstones, mudstones and siltstones), pyroclastics, tuffs, reworked tuffs, gravel, sand, clay, clayey sandstone, and siltstone and some minor pockets of limestone mostly crystalline and some schists.

In the lower portion, the same rock types occur together with some minor pockets of sandstones (predominate with conglomerate, quartzites, greywackes, shales, schists, phyllites).

Physiography

Hill and mountain complexes are predominant in this region. It is only the foothills of this highland complexes that hills with some subdued slopes occur.

Pedology

The whole of the northern part of this region is dominated by lithosols on steepland complexes with yellow grey podzolics of sedimentary origin on lower slopes. Soils around Kuala Lipis town are also mainly of yellow grey podzolics with some recent riverine alluvium along the main rivers. These soil types extend southwards and are found in the lower slopes of the steepland complexes which predominate in the southern section of the region.

Vegetation and Land Use

Forest Lands	..	..	..	..	..	..	..	85.1%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	9.5%
Grasslands	..	..	..	..	..	..	..	2.1%

Name of Region: No. 66 P. TIOMAN

Classification: L₁ W₃.

Area: 153 sq. km.

Climate

- Average annual rainfall — between 2,500 mm and 2,750 mm.
- Rainfall region — East Malaysia.
- Annual potential evapotranspiration — between 1,500 mm and 1,600 mm.

Potential Water Resources

Potential runoff — 1,000 mm approximately.

Geology

Mainly acid and undifferentiated granitic rocks. On the eastern coast are found pyroclastics, tuffs and reworked tuffs.

Physiography

Most of this region is covered by hilly terrain with narrow stretches of beaches around the island.

Pedology

Mainly lithosols on steeplands in the centre with red yellow podzolics of granitic origin on lower slopes.

Vegetation and Land Use

Forest	..	..	..	..	..	..	..	91%
Unused Land Unclassified Land	..	..	..	..	..	..	..	5%
Tree, Palm, Permanent Crops	..	..	..	..	..	..	..	3%