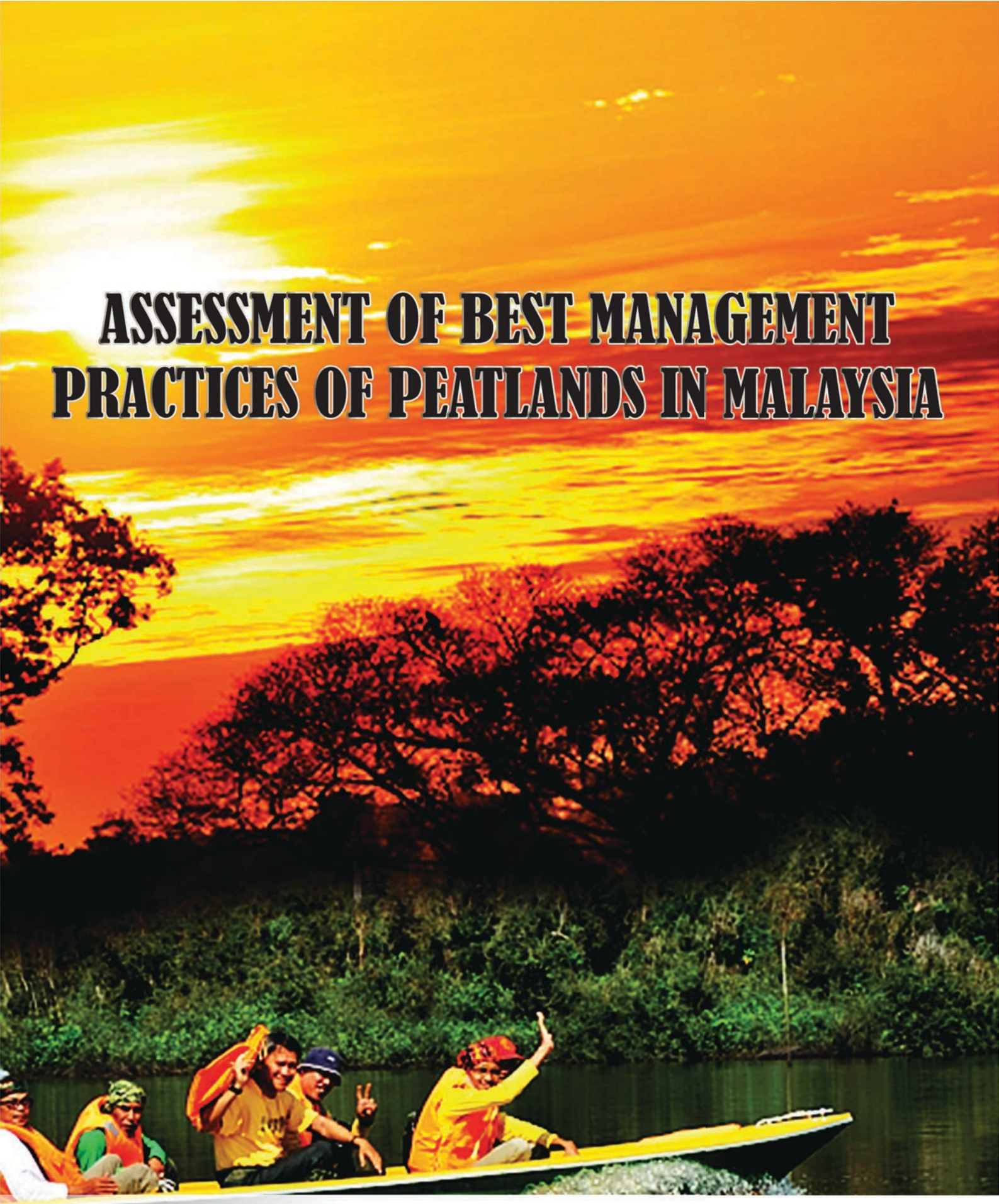
ASSESSMENT OF BEST MANAGEMENT PRACTICES OF PEATLANDS IN MALAYSIA



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ASSESSMENT OF BEST MANAGEMENT PRACTICES OF PEATLANDS IN MALAYSIA

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SEPTEMBER 2014

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ACRONYM & TERMS

APFP	ASEAN Peatland Forest Project
ASPA	Amanah Saham Pahang
BMP	Best Management Practices
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
EIA	Environmental Impacts Assessment
EXCO	Executive Council
FAO	Food and Agriculture Organisation
FD	Forestry Department
FFB	Fresh Fruit Bunch
FDPM	Forestry Department Peninsular Malaysia
FDRS	Monitoring the fire Danger Rating System
FELCRA	Federal Land Consolidation and Rehabilitation Authority
FMP	Forest Management Plan
FR	Forest Reserve
FRIM	Forest Research Institute Malaysia
GEC	Global Environment Centre
GEF	Global Environment Facility
GIS	Geographic Information System
IMP	Integrated Management Plan
IUCN	International Union for Conservation of Nature
JAKOA	Jabatan Kemajuan Orang Asli
KFR	Klias Forest Reserve

KLFR	Kuala Langat Forest Reserve
LBNP	Loagan Bunut National Park
MAS	Malaysia Airline System
MC&I	Malaysian Criteria and Indicators
MDA	Multi-disciplinary Assessment
MNS	Malaysia Nature Society
MPOB	Malaysian Palm Oil Board
NGO	Non-governmental Organisation
NSPSF	North Selangor Peat Swamp Forest
NRE	Natural Resources and Environment
NTFP	Non-Timber Forest Products
PSF	Peat Swamp Forest
RHK	Renjer Hutan Kehormat
RIL	Reduced Impact Logging
RPS	Rancangan Pengumpulan Semula
SEPPSF	South East Pahang Peat Swamp Forest
SFM	Sustainable Forest Management
SHGSU	Sahabat Hutan Gambut Selangor Utara
SMS	Selective Management System
SOP	Standard Operating Procedure
UNDP	United Nation Development Programme
VCOS	Voluntary Carbon Offset Scheme
VU	Vulnerable
WWF	Worldwide Fund for Nature

EXECUTIVE SUMMARY

Realising the important of proper management of peatlands, Malaysia participated in the ASEAN Peatland Forests Project – APFP initiated in year 2009 entitled "Rehabilitation and Sustainable Use of Peatland Forests in Southeast Asia". The Malaysia's component of the APFP project being undertaken by the Forestry Department Peninsular Malaysia (FDPM) as the National Project Executing Agency is aimed at sustainable management of peatlands in Malaysia to address peatland degradation particularly peatland fires and their associated haze, as their impacts can be detrimental to the environment, health and socio-economics in the country. To address this issue, the project focuses on the sustainable use and rehabilitation of degraded peatlands, particularly in the State of Selangor, through capacity building, fire prevention and control, local community participation, private sector partnership and demonstration of best management practices.

In achieving its targeted outputs, various activities and programmes had been planned and implemented in accordance with the Annual Work Plan and Budget of the APFP. One of the outputs is to showcase best management practices (BMP) for sustainable peatland management at demonstration sites in selected states. To successfully achieve this output, FRIM has been appointed to jointly work together with the FDPM and to undertake the BMP for selected sites in Pahang, Selangor, Sabah and Sarawak. This Report describes some of the selected BMP activities in selected peatlands areas in Malaysia.

Most of the peatlands in Malaysia are still cover with peat swamp forests. Peat swamp forests in this country are the largest wetland types accounting for more that 75% of the country's total wetlands. Most of the peat swamp forest has been gazetted as Permanent Reserve Forest manages under the jurisdiction of the respective state's forestry department, strictly in line with the sustainable forest management (SFM) concept. Managing this peat swamp forest is crucial not only to ensure sustainable use of the resources and protection of endangered species, but also to maintain environmental stability. Peat swamp forests act as a carbon sink, helping to slow down global warming. It also plays a critical role in regulating water over vast areas, supporting agriculture by reducing the impact of floods, revitalising the soil and providing a limited source of water during droughts.

Peatland is a very fragile soil type and requires special management scheme. In term of characteristics, peat is highly acidic by nature and has an ash content of below 2%. Peat soil, also known as organic soil, is composed of at least 65% organic matter, thus less than 35% mineral material. It possesses a low mineral content and is therefore classed as oligotrophic (low fertility). In this report examples on the best management practices of selected peatlands in Pahang, Selangor, Sabah and Sarawak are highlighted. It ranges from managing peat swamp forests for sustainable timber harvesting, biological conservation, environmental protection as well as sound peatland management for agriculture crop production such as for oil palm, pineapples and other cash crops. The involvement of local communities in managing the peatland in particular the peat swamp forests is also highlighted. The submission of this report has fulfilled objectives and the requirement of the task on the assessment of BMP which among others to document experiences and lessons learned of the best management practices for sustainable peatland management in Malaysia.

CHAPTER 1

1.0 BACKGROUND

By definition, peat is an organic soil where the thickness of the organic soil materials should cumulatively be more than 50 cm in the upper 100 cm of the profile. It should have more than 65% loss on ignition (which determines the amount of organic matter in the peat). Realising the important of proper management of peatlands, Malaysia participated in the ASEAN Peatland Forests Project – APFP initiated in year 2009 entitled "Rehabilitation and Sustainable Use of Peatland Forests in Southeast Asia". The Malaysia's component of the APFP project being undertaken by the Forestry Department Peninsular Malaysia (FDPM) as the National Project Executing Agency is aimed at sustainable management of peatlands in Malaysia to address peatland degradation particularly peatland fires and their associated haze, as their impacts can be detrimental to the environment, health and socio-economics in the country. To address this issue, the project focuses on the sustainable use and rehabilitation of degraded peatlands, particularly in the State of Selangor, through capacity building, fire prevention and control, local community participation, private sector partnership and demonstration of best management practices.

The implementation of this country component also contributes to the regional component and overall project, as peatland degradation is a priority issue in the Southeast Asian region, particularly peatland fires and the associated transboundary haze pollution. Some project activities and outputs will naturally be beneficial at the regional level.

In achieving its targeted outputs, various activities and programmes had been planned and implemented in accordance with the Annual Work Plan and Budget of the APFP. One of the outputs is to showcase best management practices (BMP) for sustainable peatland management at demonstration sites in selected states. To successfully achieve this output, FRIM has been appointed to jointly work together with the FDPM and to undertake the BMP for selected sites in Pahang, Selangor, Sabah and Sarawak. This Report describes some of the selected BMP activities in selected peatlands areas in Malaysia.

CHAPTER 2

2.0 OBJECTIVES OF THE PROJECT

The APFP project has four main objectives namely:

(i) To strengthen capacity and institutional framework for sustainable peatland management;
(ii) To reduce peatland degradation;
(iii) To undertake integrated management and rehabilitation of selected peatlands; and
(iv) To promote local communities and private sector involvement to sustainable peatland management.

The APFP consists of one Regional Component which focuses on building a strong regional framework for partnership between all ASEAN member countries, as well as four Country Components for Indonesia, Malaysia, the Philippines and Vietnam. The Malaysia Component focuses on the sustainable use and rehabilitation of degraded peatlands, particularly in the State of Selangor, through capacity building, fire prevention and control, local community participation, private sector partnership and demonstration of best management practices.

CHAPTER 3

3.0 OBJECTIVES OF ASSESSMENT OF BMP

The assessment of BMP was carried out to achieve the following objectives:

i. To identify best management practices of peatland for selected demonstration sites namely the Kuala Langat FR, Selangor; South East Pahang Peat Swamp Forest, Pahang; Loagan Bunut National Park, Sarawak and Klias FR, Sabah.

ii. To document experiences and lessons learned of the best management practices for sustainable peatland management.

CHAPTER 4

4.0 SCOPE OF WORK

In general, working together with FDPM/State FD and the APFP project team, the experts in FRIM had utilized their substantial experiences in identifying best management practices of peatland for sustainable peatland management in the country. The scope of work is reflected in the following terms of reference:

i. To review and determine the best management practices in the selected project areas namely the Kuala Langat FR, Selangor; North Selangor Peat Swamp Forest, Selangor; South East Pahang Peat Swamp Forest, Pahang; Loagan Bunut National Park, Sarawak and Klias FR Sabah;
ii. To carry out assessment of the best management practices;
iii. To undertake meeting and consultation with the relevant agencies and stakeholders in the project area;
iv. To prepare a report and document the best management practices; and
v. To present and submit a consultant report upon conclusion of the assignment to the FDPM, not later than 30 days after the completion of the assignment period.

CHAPTER 5

5.0 PROJECT APPROACH AND STUDY SITES

5.1 Methodology

The assessment of BMP was conducted in a participatory manner working on the basis that its essential objective is to assess the BMP of peatlands areas in the selected study sites in Peninsular Malaysia, Sabah and Sarawak. Main emphasis was given in term of qualitative and quantitative assessment involving the following activities:

i. Desk review of secondary data/information and all related documents and publications at the office,

ii. Field data collection,

iii. Interviews with personnel from various agencies (government, private and NGOs) involve direct or indirectly in the peatland management,

iv. Interview and discussion with representatives of local communities in the respective study sites,

v. Stakeholder consultation

vi. Synthesis and analysis of data and information and preparation of final report.

5.2 Study sites

The study was carried out in five project sites (Figure 5.1) representing peatland areas in Malaysia as indicated below:

i. Kuala Langat Forest Reserve, & North Selangor PSF, Selangor;
ii. South East Pahang Peat Swamp Forest, Pahang;
iii. Loagan Bunut National Park, Sarawak and
iv. Klias FR, Sabah.

Detail description of each of the study sites is given in Chapter 7.

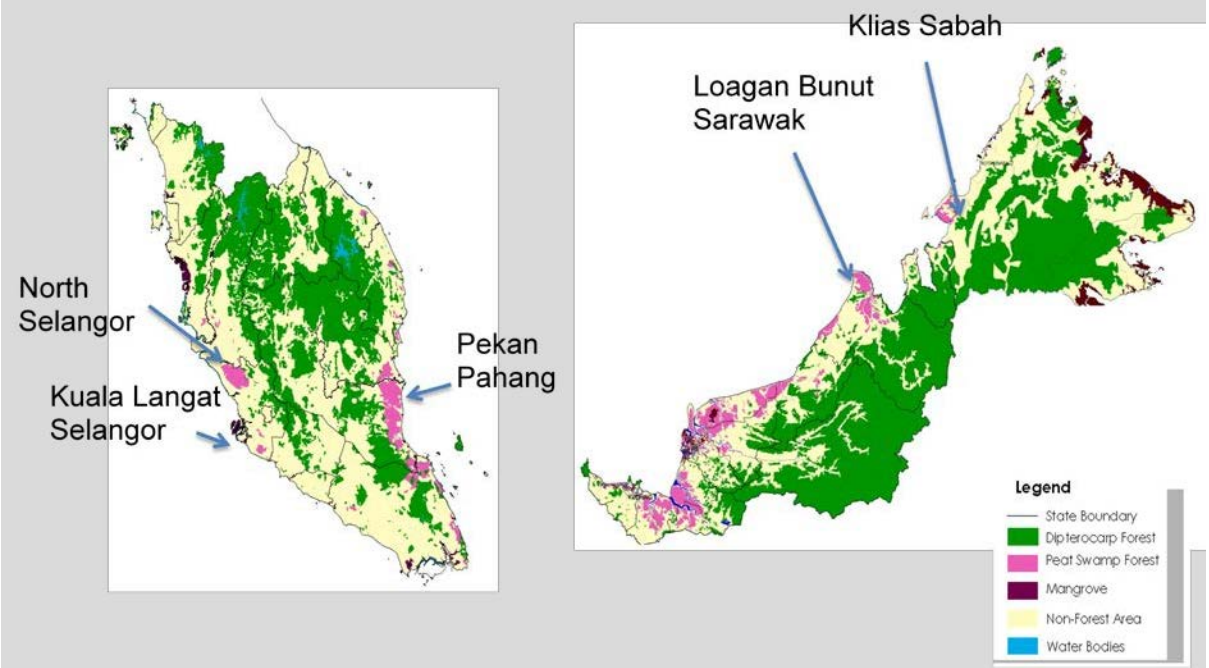


Figure 5.1 Location of study sites for the assessment of peatland BMP in Malaysia.

CHAPTER 6

6.0 PEATLAND IN MALAYSIA

Peatlands are wetland ecosystems where partially decomposed organic matter (i.e. dead tree roots, branches and leaves) have accumulated over thousands of years under waterlogged conditions to form organic or "peat" soil (www.aseanpeat.net). Peat soil is generally low in nutrients and dissolved oxygen contents and acidic in nature. Tropical peatlands are naturally covered with peat swamp forests in which the harsh waterlogged environment of the ecosystem has led to the evolution of many species of flora uniquely adapted to these conditions.

Approximately about 25 million ha of peatlands are found in Southeast Asia (www.aseanpeat.net) of which about 2.11 million ha can be found in Malaysia. This represents about 6.4 percent from the total 32.9 million ha of Malaysia's land area. Of that total about 1.54 million ha of the peatlands are still covered with peat swamp forest leaving the remaining as non-forested peatlands area of the country (FAO, 2010).

6.1 Peatland in Peninsular Malaysia

The total peatlands area in Peninsular Malaysia is estimated to be about 717,347 ha. Figure 6.1 shows the distribution of the peat soils in Peninsular Malaysia. Majority of the peat soil are located in five states namely Pahang, Selangor, Johor, Terengganu and Perak.

Even though some peatlands have been developed for agriculture and other land development activities; there are still large areas of peatlands in Peninsular Malaysia that are still covered with forest. It was reported that in 2006 the total peat swamp forest in Peninsular Malaysia was estimated to be about 300,000 ha (UNDP, 2006). Of this about 67% (201,000 ha) of the area has been gazetted as Permanent Forest Reserves (PFR). Figure 6.1 also shows the distribution of the remaining peat swamp forest in Peninsular Malaysia.

6.2 Peatland in Sarawak

Sarawak possesses the largest peatland areas in Malaysia with an estimated area of about 1.28 million ha or equivalent to about 60.5% of the total peatland in Malaysia. Figure 6.2 shows the peatland distribution in Sarawak which accounted for about 10% of the total land area of the state. The total

peatland which is still cover with forest in Sarawak was estimated to be about 1.12 million ha in 2006 (UNDP, 2006).

6.3 Peatland in Sabah

The total land area in Sabah is about 7.4 million ha. Peatland accounted for about 116,965 ha or 5.5% of the total land area. Figure 6.3 shows the peatland distribution in Sabah. It was estimated that a total of 0.2 million ha of peat swamp forest still exist in Sabah.

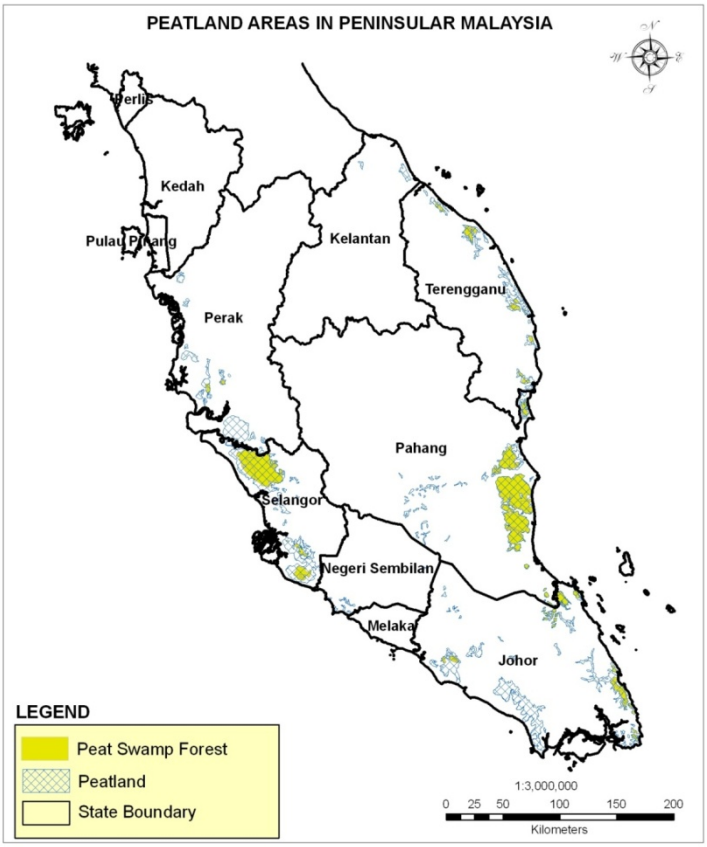


Figure 6.1 Peatland distributions in Peninsular Malaysia

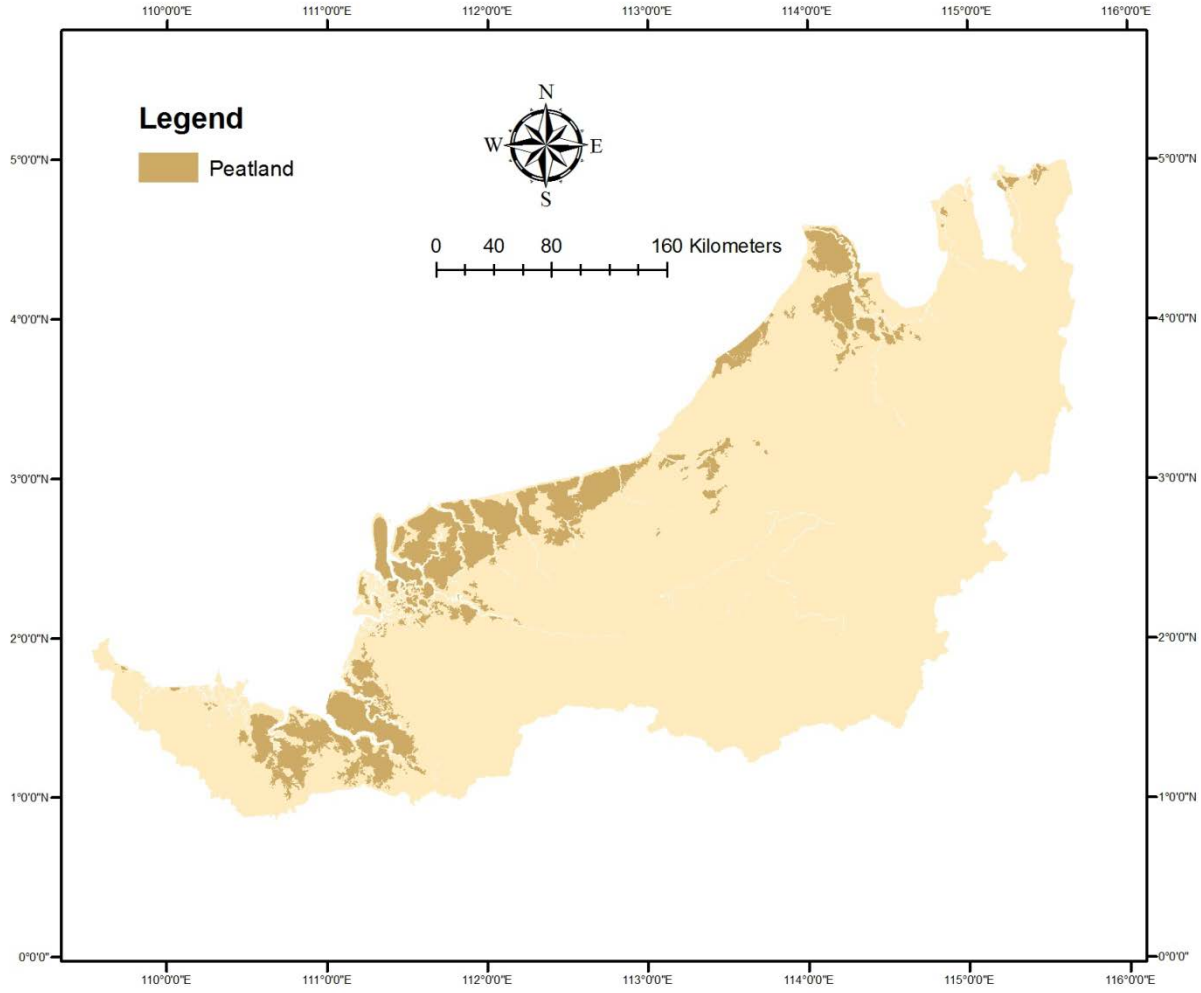


Figure 6.2 Distribution and location of peatland in the state of Sarawak

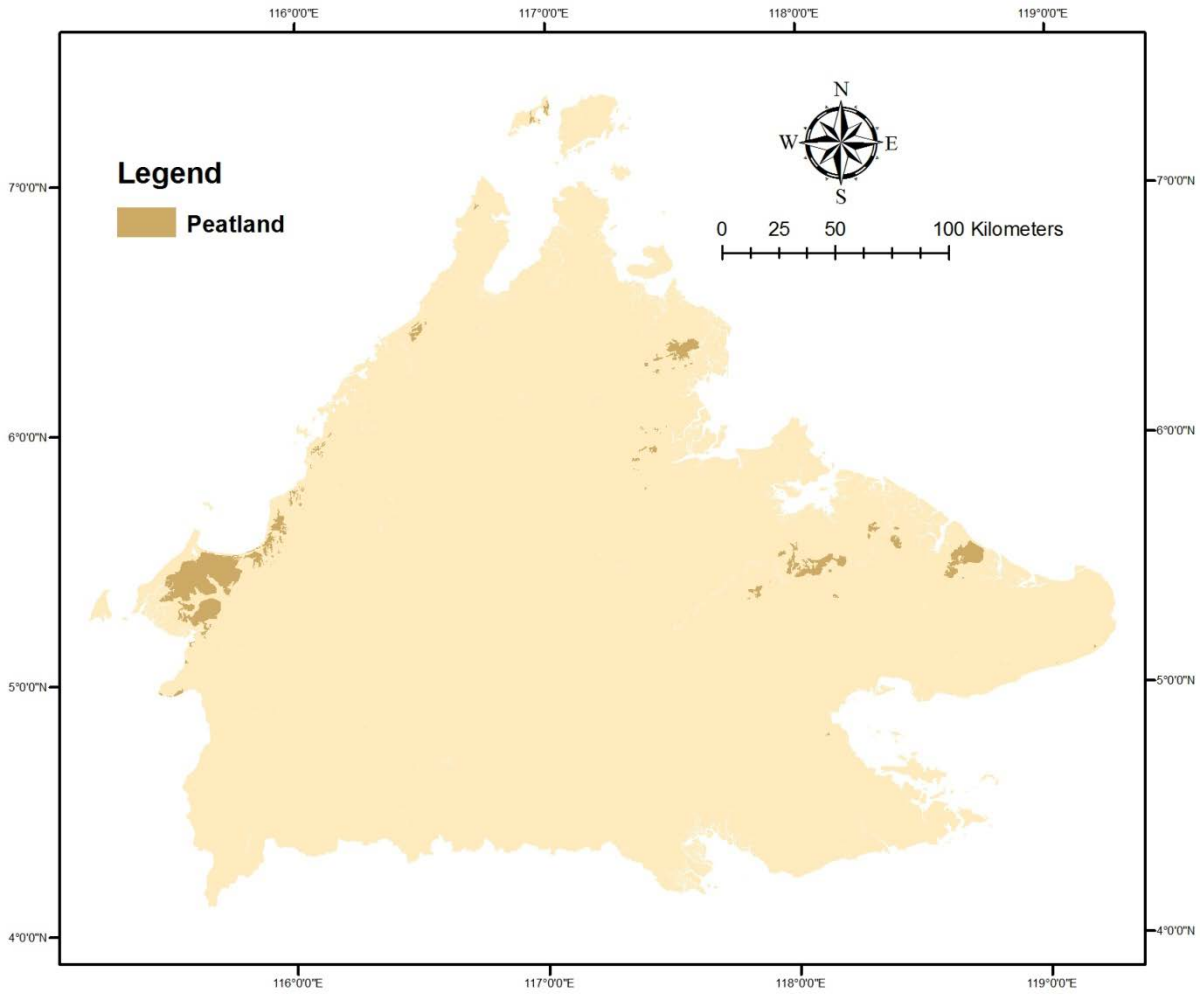


Figure 6.3 Distribution of peatlands in the state of Sabah

CHAPTER 7

7.0 PROJECT SITES DESCRIPTION

7.1 KUALA LANGAT PEAT SWAMP FOREST (KLPSF)

7.1.1 Location and Extent

In the state of Selangor the total Permanent Reserve Forest (PRF) in 2010 is about 250,128.71 ha, comprising of inland forest, peat swamp forest (PSF) and mangrove forests (Table 7.1). PSF in this state covers an area of about 83,000 ha and can be found in two large areas namely the North Selangor peat swamp forest (NSPSF) (Tanjung Karang and Raja Musa FRs) and the Kuala Langat PSF. These PSFs in nature represent a unique wetlands ecosystem that supports highly specialized flora and fauna, thus a very important for the conservation of biological diversity and storing freshwater resources. PSF with the ability to sequester and store atmospheric carbon for thousands of years, also serves as important carbon sink.

The Kuala Langat PSF is divided into two areas, namely the North and South Kuala Langat Forest Reserves (FRs) covering an area of 1,265 ha (Razani & Jalil 1997) and 6,908 ha (GEC 2010) respectively. The FRs is under the jurisdiction of the Pantai Kelang forest district office and is located in the south part of the Selangor, about 50 kilometres south (202°) of the capital Kuala Lumpur (Figure 7.1). A virgin jungle reserve (VJR) established by the state Forestry Department is located in the in Compartment 26 of the Kuala Langat South FR with an area of about 174 ha.

Table 7.1 Forest types under PFR in Selangor for the year 2010

Forest types	Total (ha)
Dry Inland	148,240.46
Peat swamp	82,890.25
Mangroves	18,998.00
Total (ha)	250,128.71

Source: Forestry Department Peninsular Malaysia (FDPM) 2011

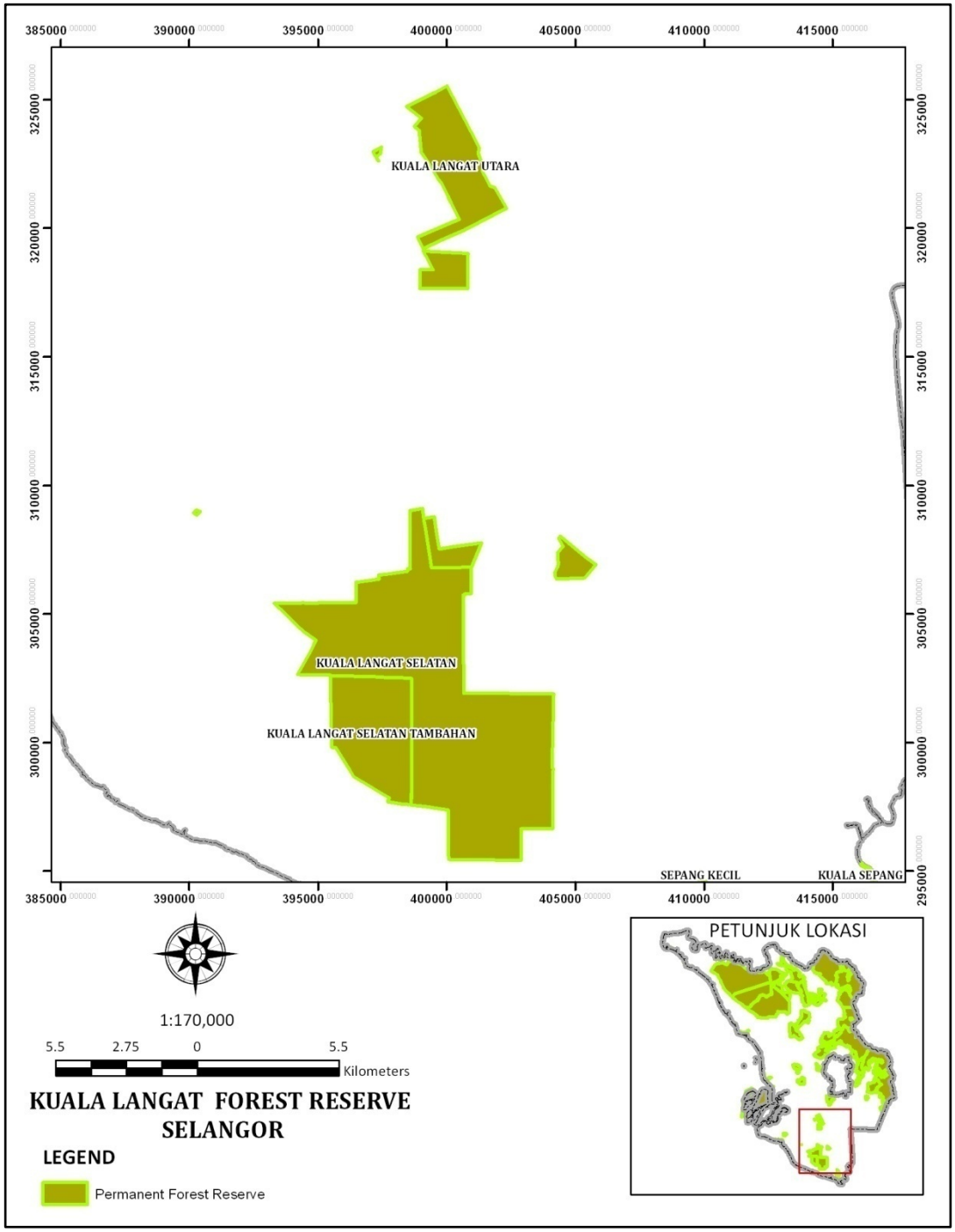


Figure 7.1 Location of the KLFR in the state of Selangor

7.1.2 Climate

The weather pattern in this area follows the general weather pattern of the entire state of Selangor. Average temperature is about 28 ^{o}C with the maximum and minimum temperature of 32 ^{o}C and 24 ^{o}C respectively. The annual rainfall is about 2000 mm, the highest normally recorded in November and Dicember, mainly influence by the monsson wind.

7.1.3 Geomorphology

The lithology map of the area which describes the physical characteristics of the rock such as texture, size or composition is shown in Figure 7.2. The map shows that the area is basically covers with peat, humic and clay.

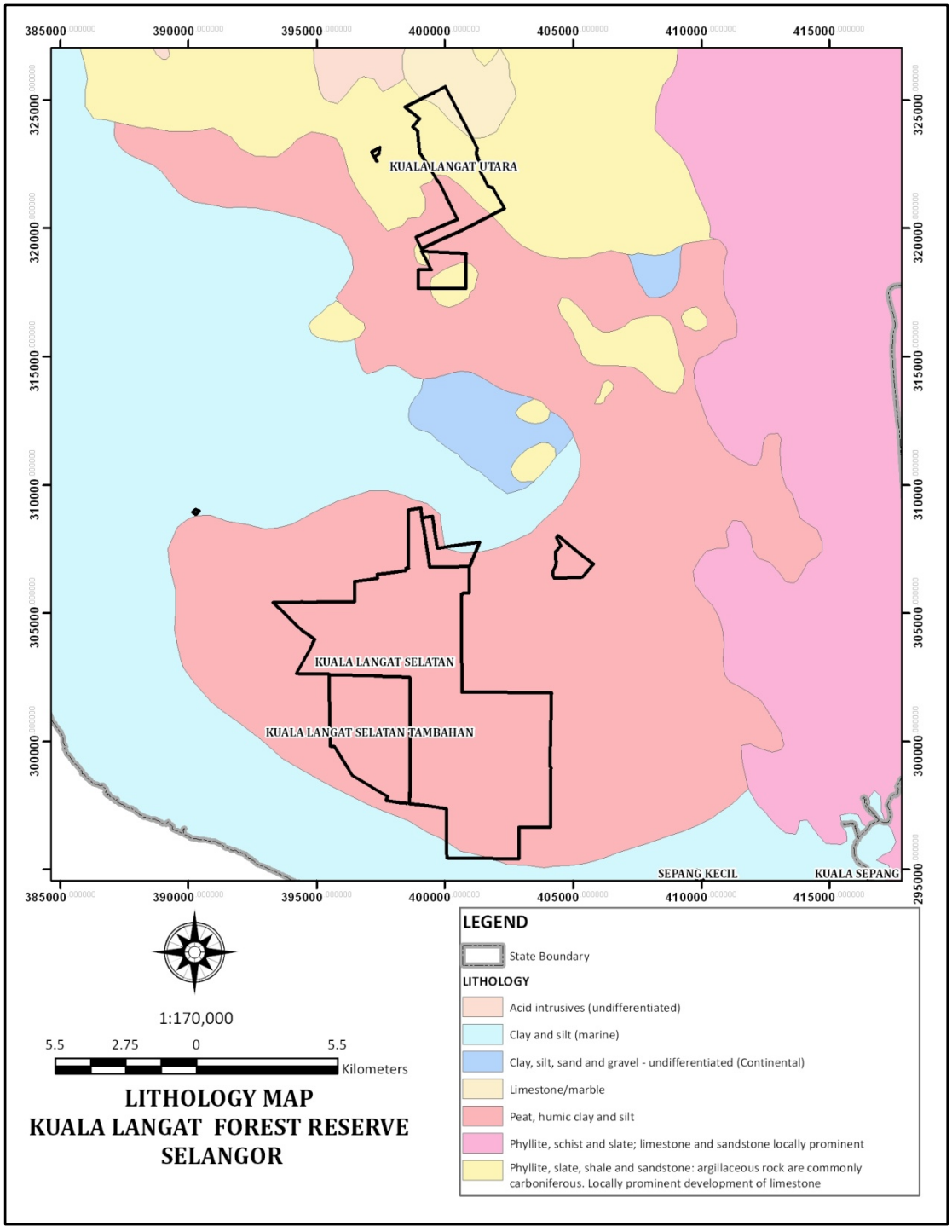


Figure 7.2 Lithology map of the KLFR

7.1.4 Peat Formation and Characteristics

Figure 7.3 shows a soil type map of the area and within the forest, the area is covers with peat. It was reported that the average peat depth in the Kuala Langat PSF is about 3.3 m. In general the peat layer of South Kuala Langat overlays with soft (and equally deep) mud layer which only can be found in marine/mangrove area. This indicates that Kuala Langat South PSF is part of larger coastal peatland that was once formed in between of river basins along the Selangor coast, and plays an important role in flood mitigation and regulation within the Selangor State.

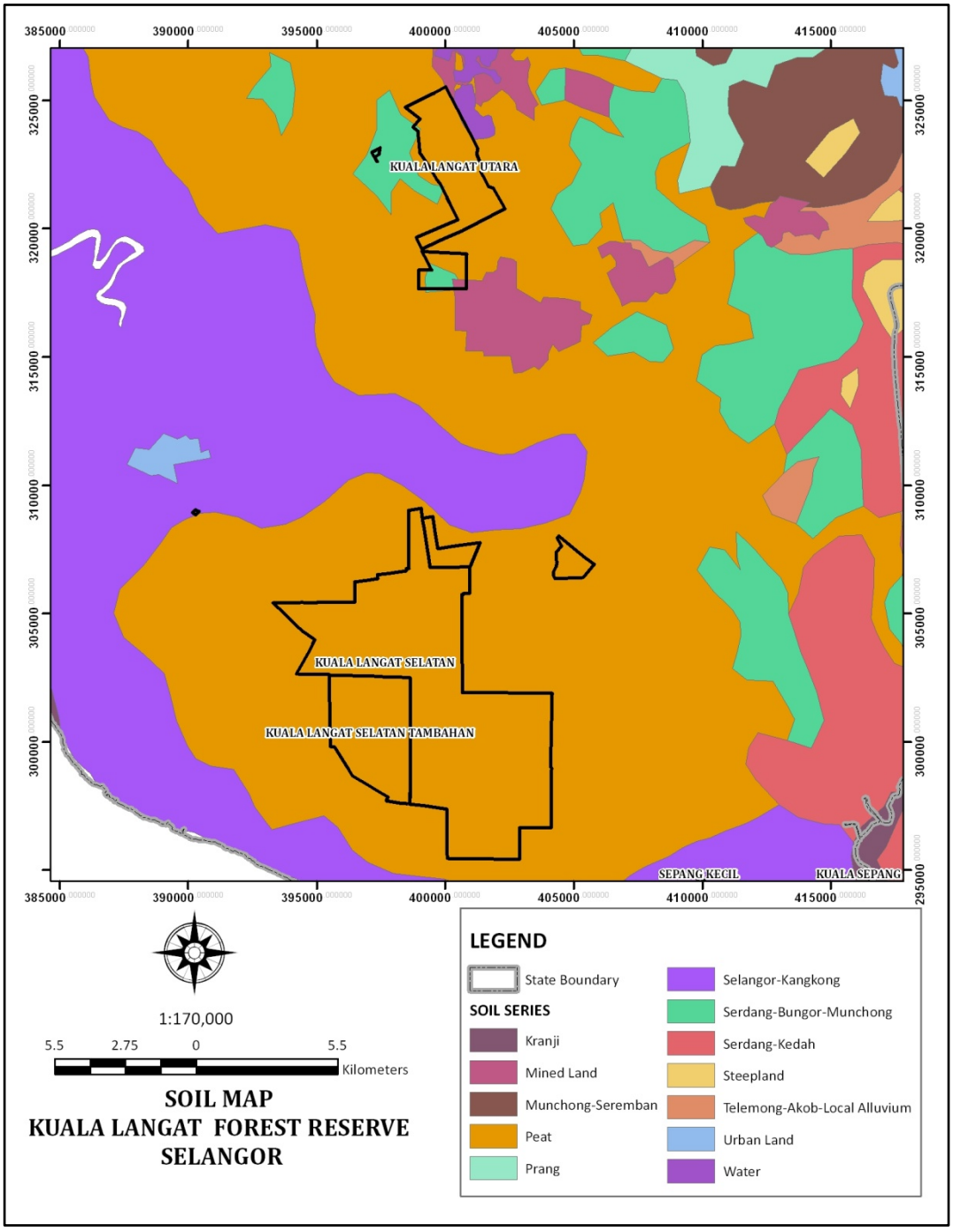


Figure 7.3 Soil map of the KLFR

7.1.5 Land Use

Landuse classification done using SPOT satellite images acquired in 2010 over the KLSFR indicates that broadly there are eight major landuse classes in the area namely the Horticulture, Mangrove forest, Oil palm, PSF, Shrub, Bareland, Urban & Residential and Water body (Figure 7.4) In additional to the different landuse classes, the PSF itself can be categorized into three (3) categories according to its vegetation density based on the Normalized Difference Vegetation Index (NDVI) value. They are namely high density, medium density and low density. Which have direct relationship with the status of the PSF ecosystem due to logging activities that occurred in early 1990 to 2000's in the KLSFR. As a comparison, a land use map prepared by the Agriculture Department in 2006 is shown in Figure 7.5.

The results show that oil palm is dominating the area with an area of about 26,047.99 ha (Table 7.2). Majority of the oil palm plantation is located outside and around the KLSFR boundary except about 834.27 ha of the oil palm planted inside the KLSFR. Other than oil palm plantation, horticulture is also the major land use class that can be found in the area with the total extent of 2,856.76 ha.

Table 7.2 Landuse area classification

	Landuse class		KLSFR (ha)	State land (ha)	Total (ha)
1	Peat swamp forest				
	-	High dense	68.74	19.18	87.92
	-	Medium dense	4,888.91	613.97	5,502.88
	-	Low dense	346.65	69.38	416.03
	Total peat swamp forest		5,304.30	702.53	6,006.83
2	Oil palm		834.27	25,213.72	26,047.99
3	Horticulture		1,200.70	1,656.06	2,856.76
4	Shrub		50.59	80.44	131.03
5	Urban & residential		0.00	2,347.86	2,347.86
6	Bare land		0.00	253.36	253.36
7	Mangrove forest		0.00	72.19	72.19
8	Water body		0.00	2,464.80	2,464.80
	Grand Total		7,389.86	32,790.96	40,180.82

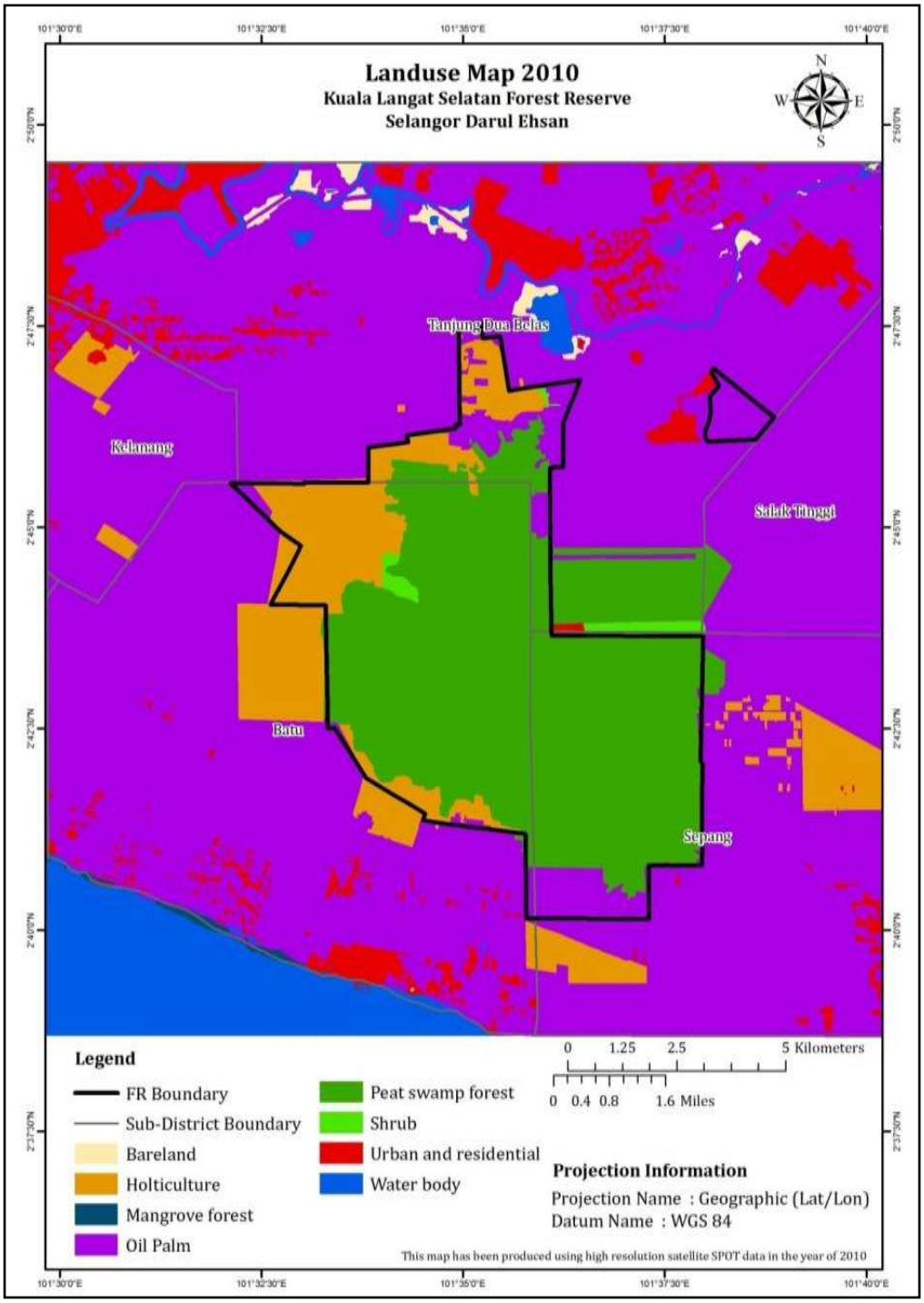


Figure 7.4: Landuse Map of KLSFR from SPOT Satellite image

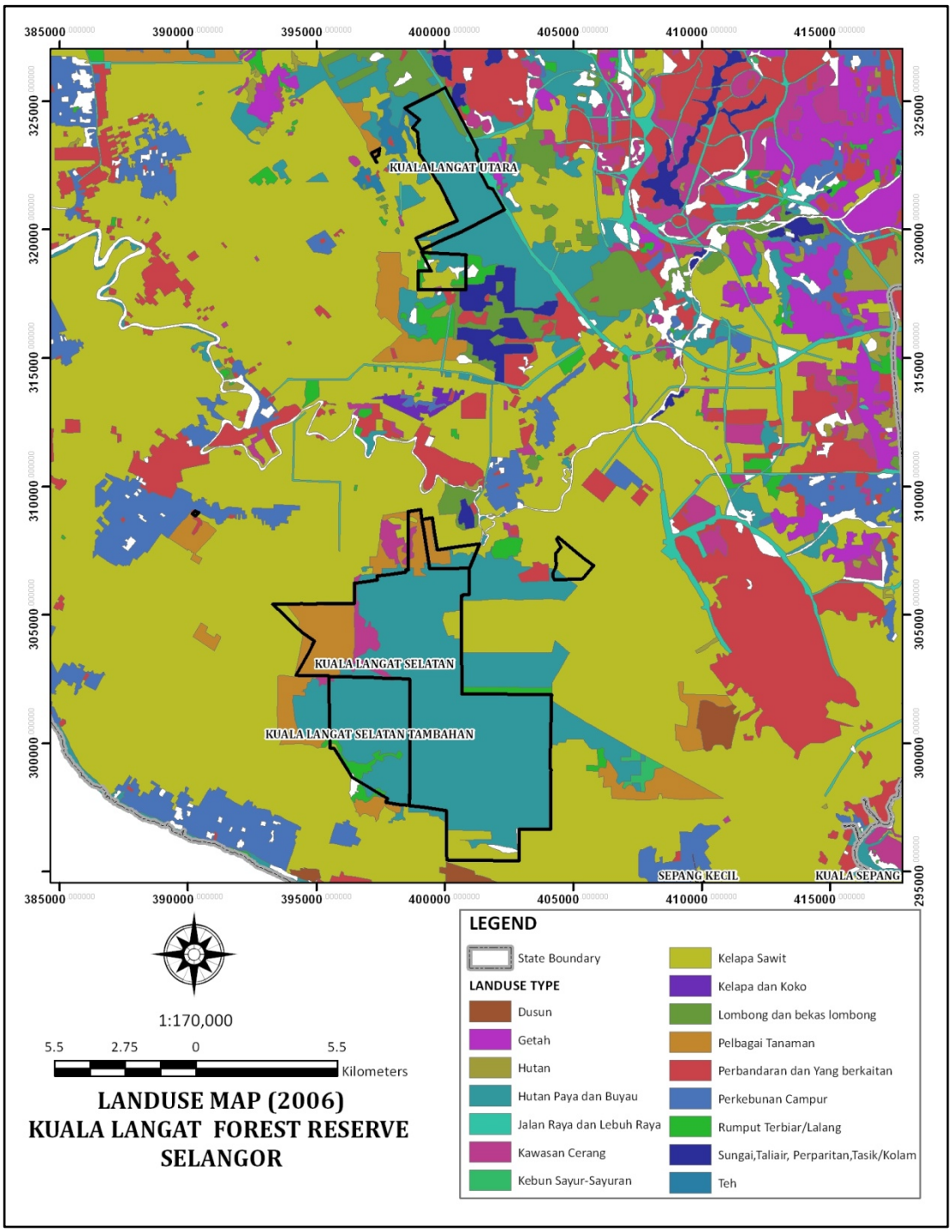


Figure 7.5 Landuse map of the KLFR prepared by the Agriculture Department (2006).

7.1.6 Hydrology

The area is situated in the Kuala Langat River Basin. However, there are not many river tributaries within the PSF. Figure 7.6 shows the rivers and tributaries surrounding the Kuala Langat PSF.

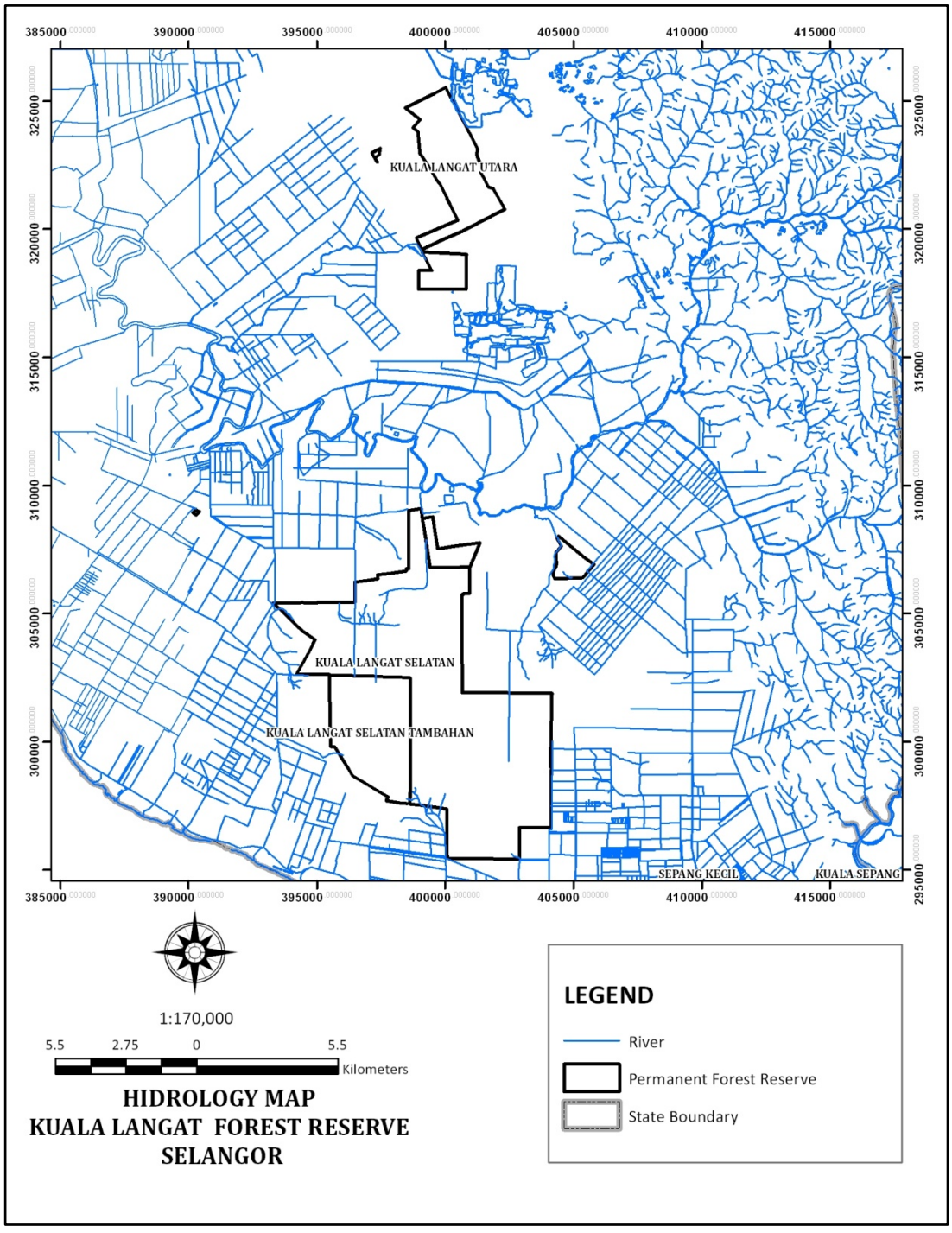


Figure 7.6 Hydrology map showing the rivers networks surrounding the Kuala Langat FR

7.1.7 Vegetation

There is yet a complete and detail flora inventory in this Kuala Langat PSF. Shamsudin and Chong (1992) reported that there were 54 tree species (dbh > 5 cm) from 27 families recorded in the VJR plot of the FR. In general within the intact forest of the Kuala Langat PSF, the forest structure still appears to

be in good condition with a distinct typical three layers structure consisting of main canopy, lower canopy and forest floor. The main canopy consists of tress with high reaching up to 25 m where as the forest floor is dominated by herbs and shrub. Common species found in the main canopy include *Koompassia malaccensis*, (kempas), *Shorea teysmanniana* (meranti bunga – critically endangered species), *Tetramerista glabra (*punah) *Cratoxylum arborescens (*geronggang*), Paratocarpus venenosus ssp. Forbesii (*ara bertih paya*), and Palaquium ridleyi (*bitis paya*).* Other species found in the PSF include *Gonystylus bancanus (*ramin*) Madhuca motleyana (*nyatoh ketiau*), Pouteria maingayi (*nyatoh nangka merah*), Xylopia fusca (*jangkang paya*), Polyathia hypoleuca and Calophyllum ferrugineum.*

At the lower canopy the dominant species is *Stemonurus secundiflorus. Other species including Dillenia pulchella, Litsea gracilipes, Litsea grandis, Caralia brachiata, Elaeocarpus petiolatus* can also be found in large numbers. Forest floor species found in the PSF include *Eleiodoxa conferta*, *Cyrtostachys renda*, *Antidesma montanum*, and *Carallia brachiata.*

In another study, ITP-Asian Wetland Bureau (1993) reports that poor and sparse ground flora is found in Kuala Langat South Forest Reserve. Herbaceous species found include *Nepenthes ampullaria, Hanguana rnalayana, Dracaena sp., Zingiber sp.* & *Calanthe sp.*

7.1.8 Fauna

In term of fauna, it was reported that in the Kuala Langat South FR a total of 565 individuals mammal were recorded comprising of four Orders, six Families, 10 Genera and 12 Species (Norhayati et al 2004). The survey was conducted using line transect method. Among the mammals, the Long-tailed macaque (*Macaca fascicularis*) is the most common primate in the study area. The study suggested that the high estimate obtained for *Macaca fascicularis* was most probably due to food supply, which was abundant from the forests, and especially from the surrounding orchards, oil palm and rubber plantations. The study also showed that the mammalian assemblage in the fragmented peat swamp forest tended to be dominated by common, widely distributed forest species, and forest edge species, such as *Macaca fascicularis*, *Sundasciurus tenuis*, and *Callosciurus notatus*. The report suggested that the low occurrence of forest dependent species and dominance of generalist species indicate that the forest reserve is degraded, but due to the other food supply from the surrounding oil palm and rubber plantations, many species can persist, and even flourish here.

7.1.9 Socio-Economic

The state of Selangor is one of the states in Malaysia, which shows the fastest economic growth rates. The area is situated south to the Klang Valley, Malaysia highly developed urban conurbation where the nation's capitol Kuala Lumpur is located. Rapid economic growth, urbanization and industrialization in the Kuala Langat surrounding areas has provided ample job and business opportunities for its population, besides attracting foreign migrants workers.

The ecosystem surrounding the PSF has undergone rapid change. In 1960s and 1970s much of its original lowland dipterocarp and peat swamp forests were converted to agricultural plantations and

human settlements. Figure 7.7 shows the distribution of human settlements including the Orang Asli villages. In term of aborigine's population, the Orang Asli of the Temuan community live in the surrounding areas. In 1991 their population in the Kuala Langat and Hulu Langat districts totaled to about 2,148 consisting of around 412 families, with an average size of 5.2 persons per family. With the rapid development, the Orang Asli has change their lifestyle from relying on forest products to a more stable jobs in oil palm and rubber plantations, government agencies and private companies.

In Mukim Tanjung Dua Belas near Kuala Langat North FR there are three Orang Asli Settlements in Kg Busut Baru, Kg Bukit Cheeding and Kg Pulau Kempas. The total land area in the Kg Busut Baru is about 404.6 ha with a population of about 397 peoples. Main agriculture activities in this village is oil palm plantation managed by FELCRA (230 ha) and JAKOA (34 ha). In addition JAKOA also manages 34 ha of orchard in the village area. Kg Pulau Kempas with an area of about 250 ha and population of 243 peoples also rely on agriculture activities as a source of income. The main activities in this village are oil palm (200 ha), orchards (8.1 ha) and cash crops (8.1 ha). The Kg Bukit Cheeding is occupied with 231 villagers with an area about 73.1 ha. The villagers main activities include practicing agriculture activities in oil palm (60 ha), rubber (4.04 ha) and orchard (2 ha).

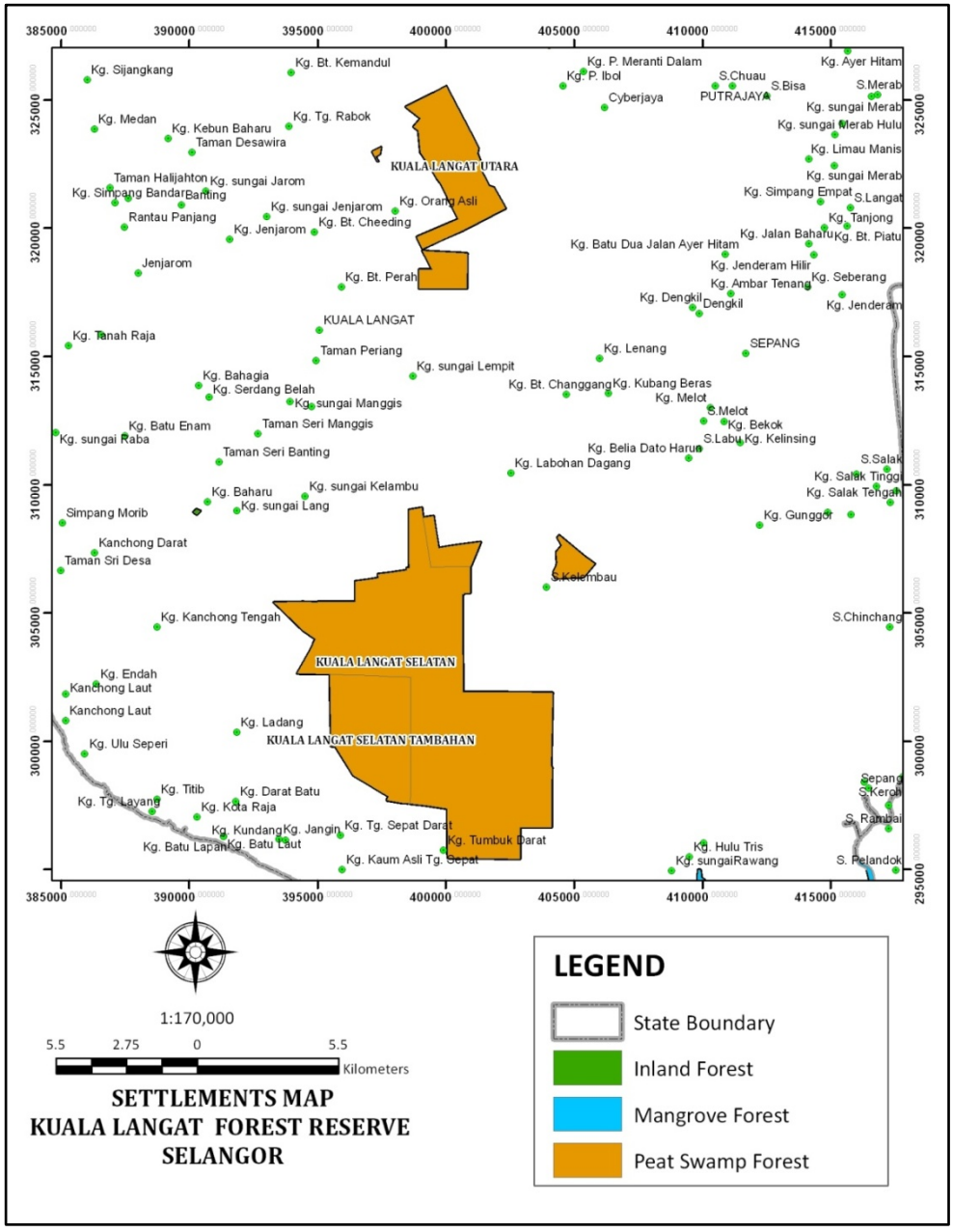


Figure 7.7 Location of settlements surrounding the Kuala Langat FR.

7.2 NORTH SELANGOR PEAT SWAMP FOREST (NSPSF)

7.2.1 Location and Extent

Located on a flat coastal plain in the northern part of the State of Selangor, the North Selangor Peat Swamp Forest (NSPSF is the largest PSF in this state. It consists of the Raja Musa and the Sungai Karang Forest Reserves, and covers a total area of 73,660 hectares. Figure 7.8 shows the location of the NSPSF.

7.2.2 Climate

The NSPSF is located in a humid tropical zone, and the climate is characterised by heavy rainfall and high humidity and temperature. Record shows that the mean annual temperatures is 28 ˚C, and mean relative humidity is 77%. The mean annual rainfall ranges from 1,750 mm along the coastal belt to 2,750 mm further inland. The rainfall pattern is being influenced by the south-west and north-east monsoons in which the months of April-May and November-December normally receive more than average rainfall.

7.2.3 Geomorphology

The peat swamps of Peninsular Malaysia have developed on different deposits of sedimentary origin. Along the sheltered West Coast, where the NSPSF is located, peat swamps are generally found on clay deposits formed by fine sedimentation of clay materials. Figure 7.9 shows the lithology map of the NSPSF area.

7.2.4 Peat formation and Characteristics

The NSPSF was reported to have is dome-shaped, with an estimated central dome height of 5 meters (*Pons et al 1988)*. A preliminary analysis of aerial photos shows that the difference in elevation between centre and edge of the NSPSF could be as much as 10 meters (Zulkifli et al, 1999). It was also reported that the depth of the peat varies according to the underlying geological material. Studies by Hahn-Schilling (1994) and Zulkifli et al (1999) showed that the peat depth ranges from 1.3 meters at the southern edge to the deepest point of 7.0 meters towards the north. Figure 7.10 shows the soil map of the NSPSF.

7.2.5 Land Use

The NSPSF is surrounded by various agricultures and land development activities. Figure 7.11 shows the map of land uses around the NSPSF area. The land use on the land adjoining the forest reserve are the Tanjong Karang Irrigation Project to the south-west and west, oil palm plantations owned by small holders to the north and north-west, and the Sungai Dusun Wildlife Reserve to the east. To the south-west, the Main Irrigation Canal separates the forest from the irrigation scheme.

7.2.6 Hydrology

Most of the forests in the NSPSF have been logged in the 1990s mainly using canals and rail systems. It is generally acknowledged that logging and establishment of canals affect the hydrology of the peat swamp forest (Zulkifli et al 1999). Detail study on the hydrology of the NSPSF was carried out and reported by Zulkifli et al 1999 and can be referred to in case further complete information is needed. Figure 7.12 shows the river network around the NSPSF area.

7.2.7 Vegetation

Due to the harsh PSF environment such as low levels of pH and nutrients, only the most tolerant species can grow and able to survive in this ecosystem. As such it is expected that the diversity of plants in the PSF is low when compared with dry land forest types in the tropics.

There have been some flora inventories carried out in the NSPSF. Of recent was done by the Selangor State Forestry Department together with MNS and few others research institutions and universities in 2013 during a biodiversity expedition programme. A total of 107 tree species were recorded during the expedition.

Previous inventory in NSPSF as reported by Hahn-Shilling (1994) also recorded a total of 107 tree species from 27 different families (> 5cm dbh). Of non-tree species, Hahn-Schilling (1994) found 26 species in logged-over forest in the NSPSF, including] 1 woody climbers, 4 herbs, 3 non-woody climbers 4 ferns, 3 palms, and one grass species.

Appanah et al (1999) reported a total of 48 tree species from 25 families were recorded in 17 sampling plots during a survey in the NSPSF. He noted that stemless palms and Pandanus are common elements of the ground flora, especially in water logged areas. Local communities regularly harvest fruit from *Zalacca conferta* (Kelubi). The sealing wax palm *(Cyrtostachys lakka)* usually forms clumps of individuals in the lower canopy layers (Appanah et al 1999).

7.2.8 Fauna

As stated earlier, most of the area in the NSPSF had been logged with few areas left undisturbed. This is expected to give some negative impact to the diversity and population of wildlife in the forest. However, there is lack of detailed study to properly survey the wildlife population in this area. Some of the previous record on the wildlife in NSPSF were based on studies done by Prentice and Aikanathan (1989), Lundahl and Olsen (1999), Traeholt and Lim (1999), Zakaria, (1999), Ng et al (1994), and Buch-Andersen and Cold (1999). These studies reported that a total of 28 species of mammals, 5 species of reptiles, 173 species of birds and 47 species of fishes were found in the NSPSF. Recent survey undertaken during the biodiversity expedition programme in 2013 showed that there is not much different in term of the fauna species recorded from the previous studies. This indicates that the PSF provides habitats for wildlife including the rare and endangered and is therefore of value for conservation and protection of wildlife.

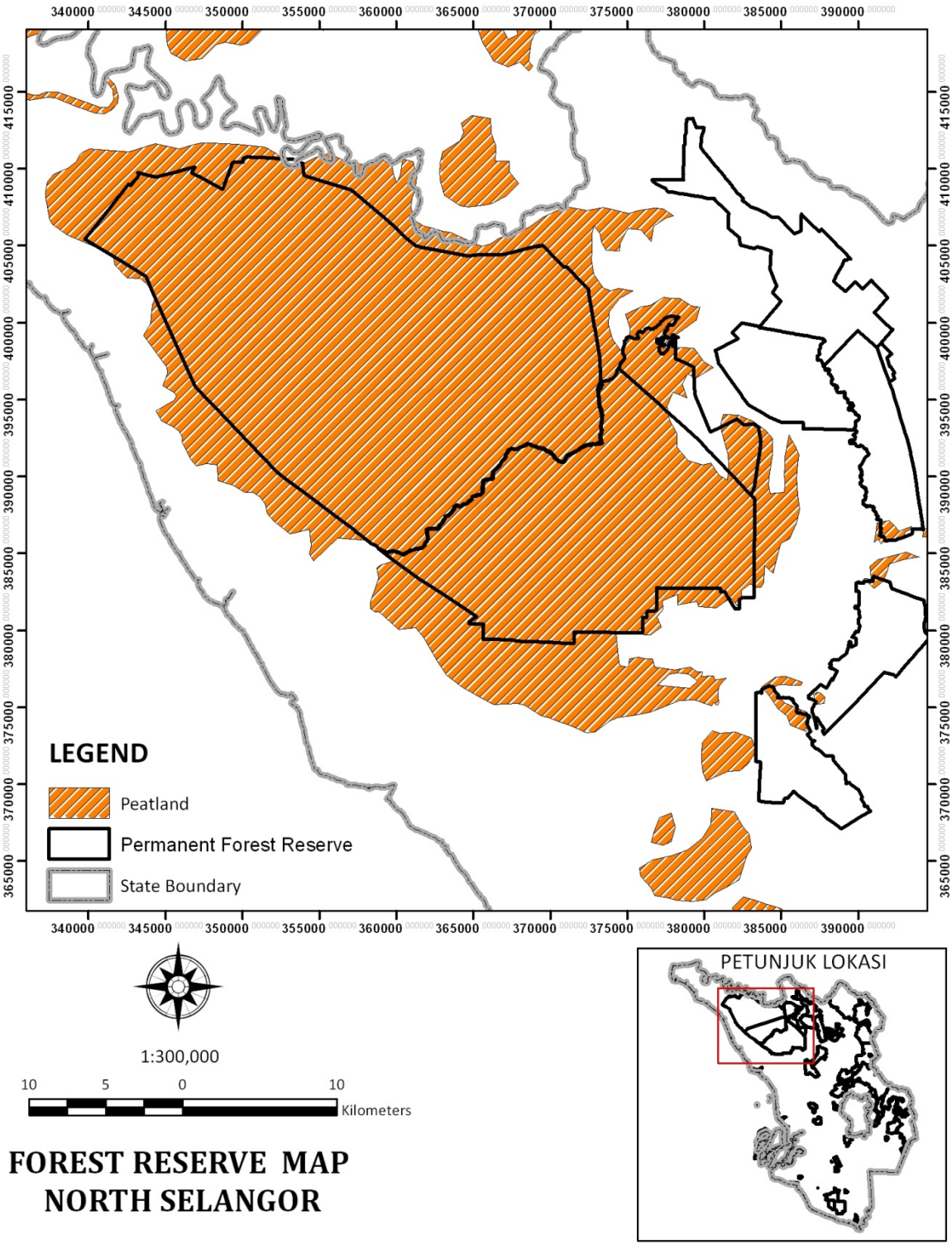
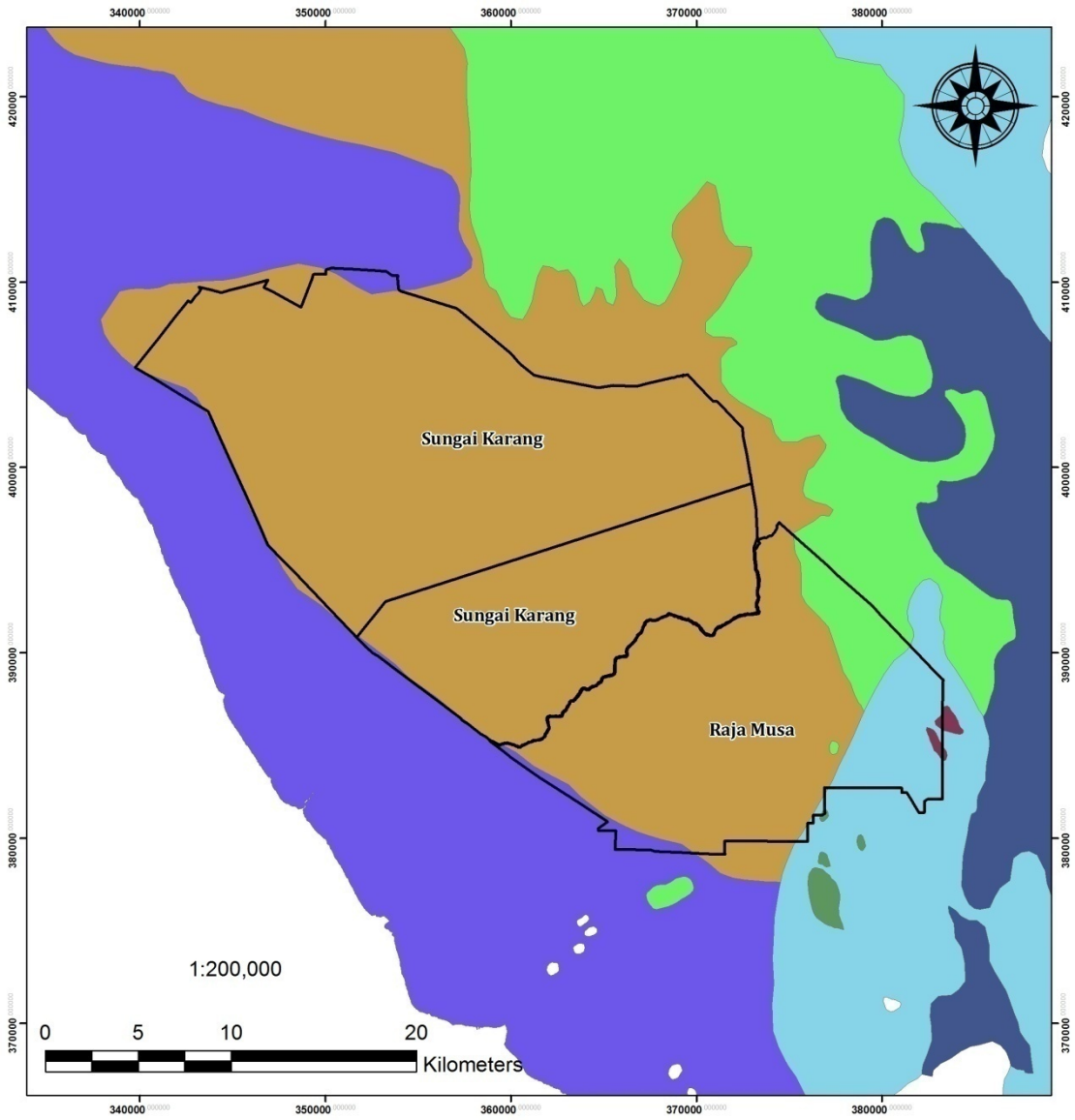


Figure 7.8 The location of the NSPSF



NORTH SELANGOR LITHOLOGY MAP

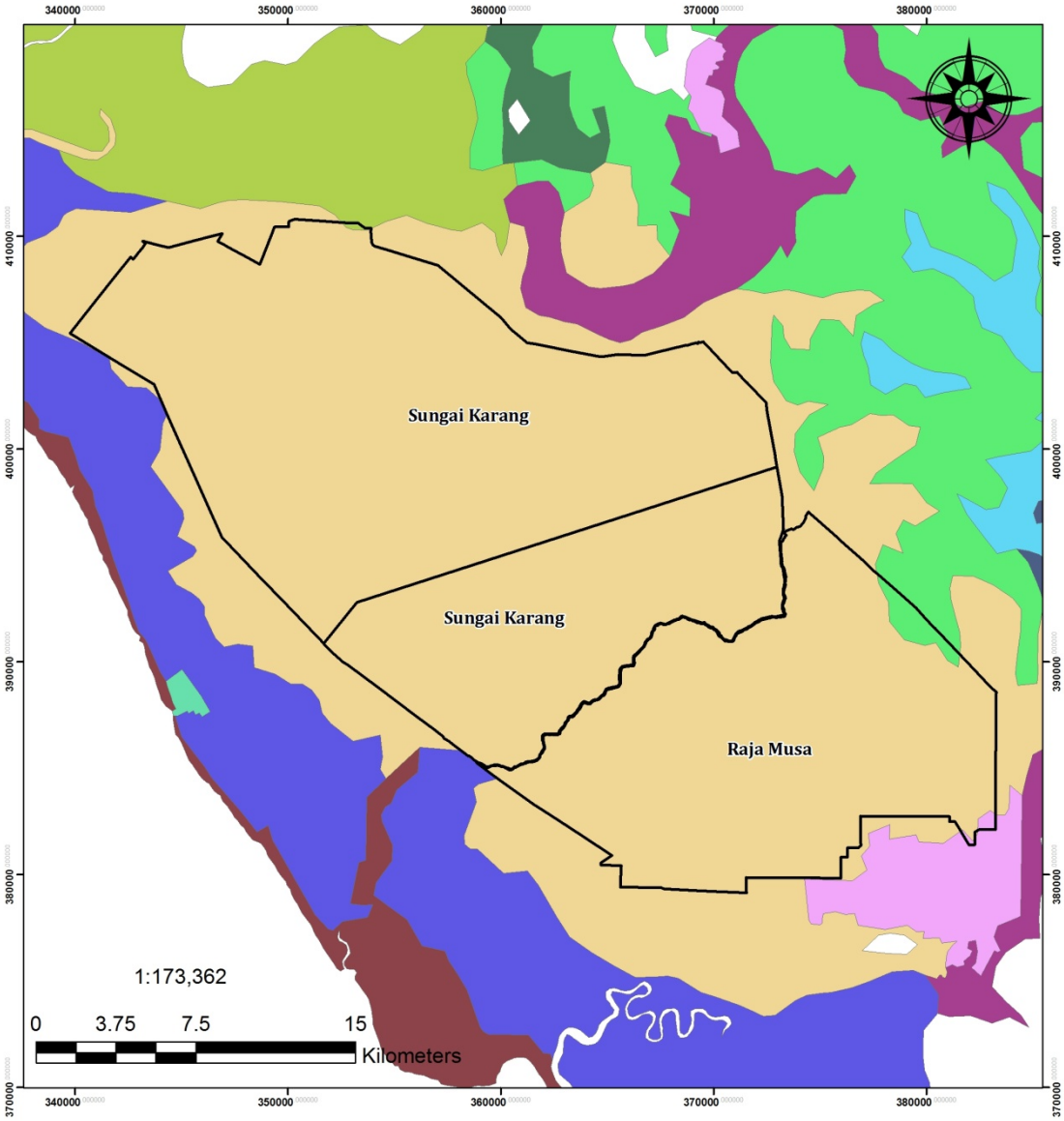
LEGEND

- Forest Reserve Boundary

LITHOLOGY

- Acid intrusives (undifferentiated)
- Clay and silt (marine)
- Limestone/marble
- Peat, humic clay and silt
- Phyllite, schist and slate; limestone and sandstone locally prominent
- Sandstone and mudstone
- Schist, phyllite, slate and limestone. Minor intercalations of sandstone and volcanics

Figure 7.9 Map showing the lithology of the NSPSF area



NORTH SELANGOR SOIL MAP

LEGEND

- Forest Reserve Boundary

Soil Series

- Briah-Organic Clay and Muck
- Kranji
- Mined Land
- Organic Clay and Muck
- Peat
- Selangor-Kangkong
- Serdang-Bungor-Munchong
- Serdang-Kedah
- Steepland
- Telemong-Akob-Local Alluvium
- Urban Land

Figure 7.10 The soil map of the NSPSF area

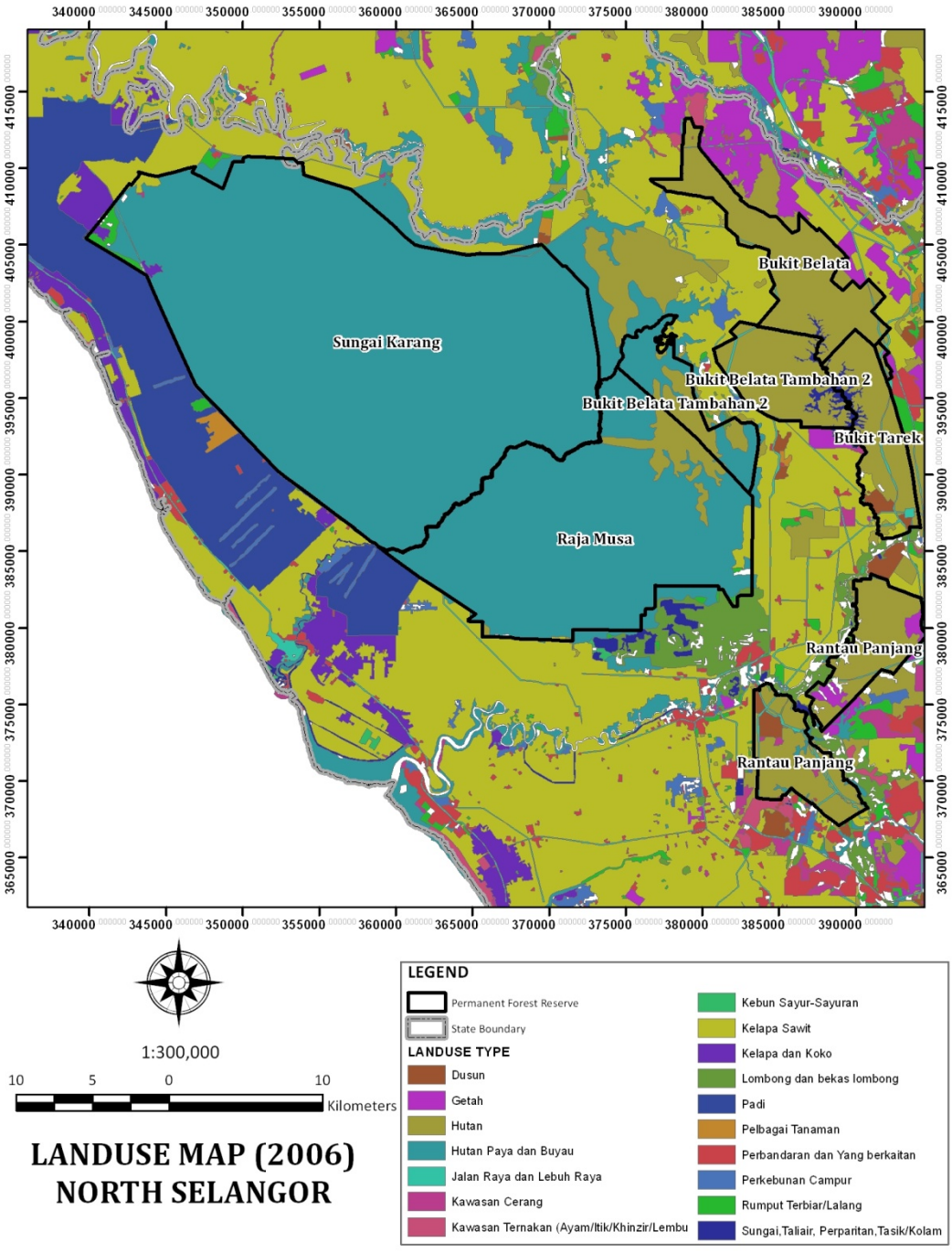


Figure 7.11 The map of land uses around the NSPSF area.

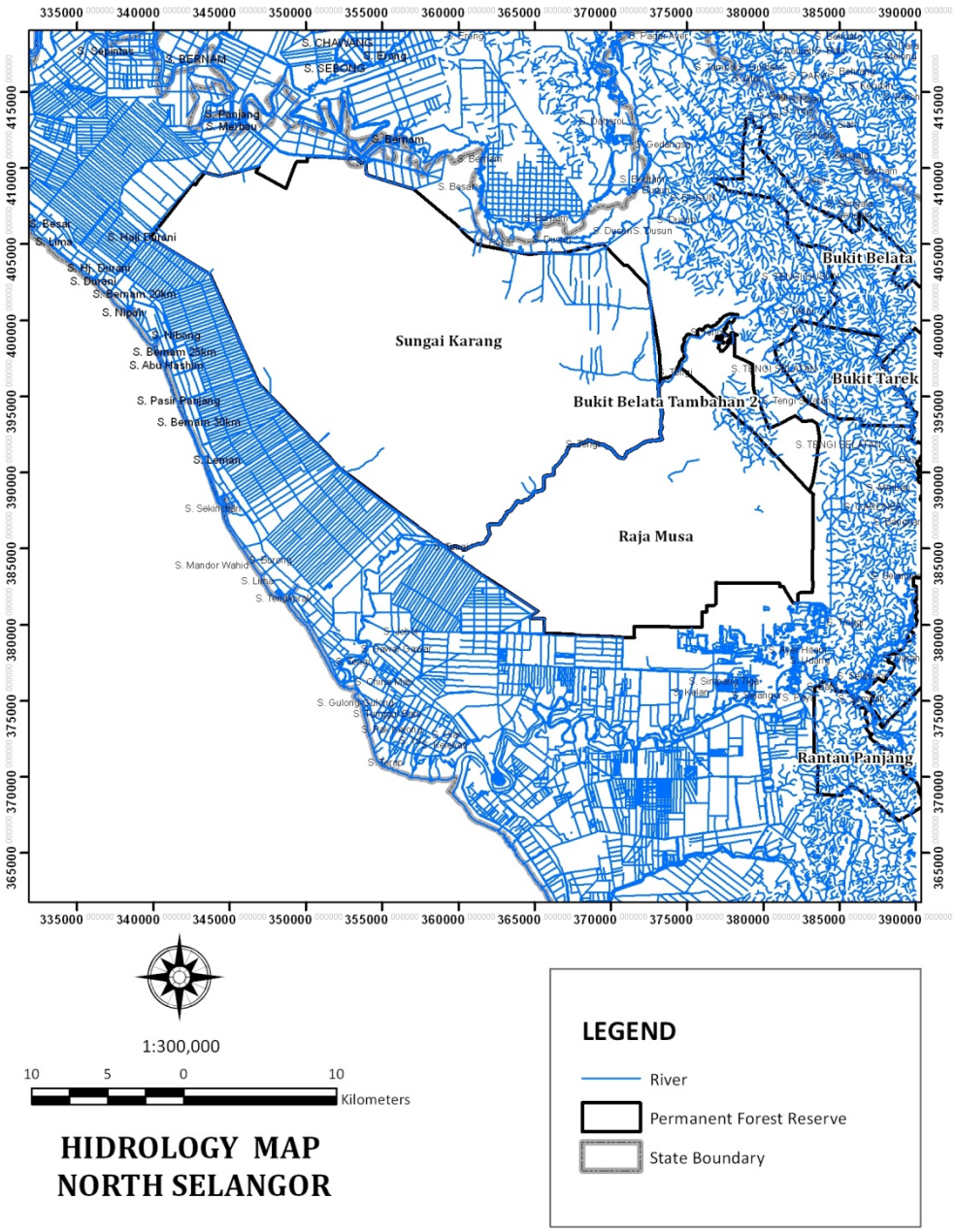


Figure 7.12 The river network around the NSPSF area

7.2.9 Socio-Economic

The NSPSF with an area of 73,660 ha represents 9% of the total land area in the state of Selangor. The area plays very significant role in term of providing water to the paddy fields in the vicinity of the NSPSF. This reflects the social and economic importance of the NSPSF in the local and the national context. Undoubthly, the PSF provides services to the communities living in or around the forest. Figure 7.13 shows the map of settlement around the NSPSF area. The most important social value of the peat swamp forest is the environmental benefits derived from the NSPSF in terms of water for irrigation and domestic use. Other environmental services include flood control and prevention of saline intrusion. Eco-tourism and harvesting of Non-Timber Forest Products (NTFP) constitute another type of social benefits from the peat swamp forest.

A Socio-economic survey undertaken showed that people in the villages surrounding the NSPSF use the forest for fishing, collection of fruit and medicinal plants, and hunting. It was found that most important uses are fishing and fruit collection. Woon et al (1999) estimated the total annual economic value of fish harvested in the NSPSF as RM 166,000, while the annual economic value of fruit collection is less than RM 2,000.

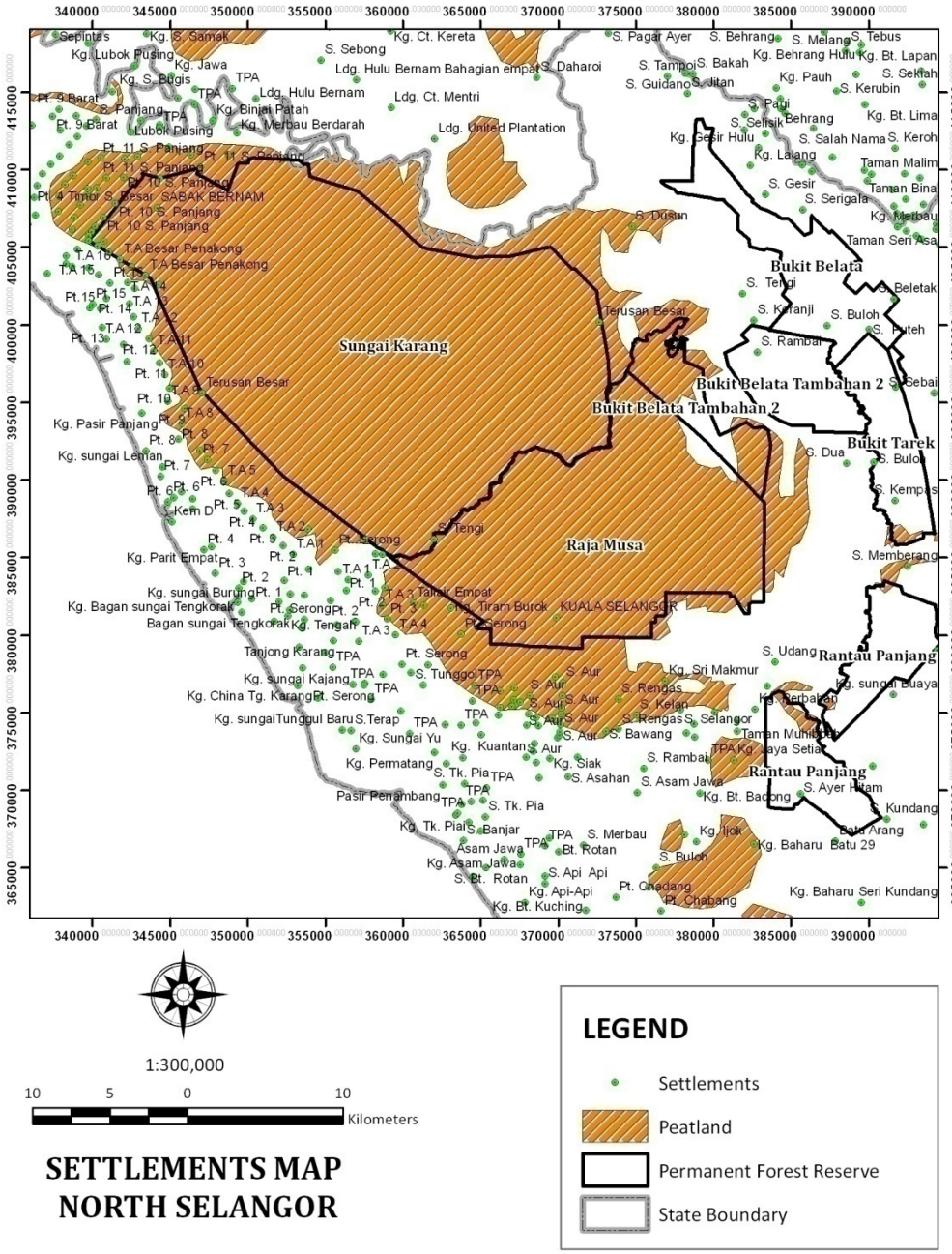


Figure 7.13 Map showing settlement around NSPSF

7.3 SOUTH EAST PAHANG PEAT SWAMP FOREST (SEPPSF)

7.3.1 Location and Extent

The South East Pahang Peat Swamp Forest (SEPPSF) Project is located south of the lower reaches of the Pahang River. It covers an area of approximately 230,600 hectares. Its northern limit is the Sungai Pahang, the eastern limit being the coastline (excluding costal urban centres), the western boundary is the Muadzam Shah-Rompin road and the southern boundary is defined by the Pekan-Rompin district administrative boundary. The extent of the peat swamp has not been stable in term of acreage. In 2004, the area of actual PSF was 95,000 ha. The project area consists of four Permanent Reserved Forest, namely Pekan, Kedondong, Nenasi and Resak. Figure 7.14 shows locations of the forest reserves in the SEPPSF.

7.3.2 Climate

Rainfall intensity and distribution across the SEPPSF is important as the peat swamp's water source is principally from rain (ombrogenous swamp). The project area experiences a relatively drier period lasting 8 months from February to September, followed by four months of heavy rain between October and January, the peaks being in December and January. December records the highest mean monthly rainfall with an average of 483 mm and the driest July with 106 mm. Moderate mean monthly rainfall is experienced in the months of October (230 mm) and November (266 mm). The mean annual rainfall over a 10 year period is 2715 mm. Overall, the project area is considered to receive an adequate amount and distribution of rainfall throughout the year for peat swamp maintenance and agricultural use. In term of temperature, the mean maximum temperature is 33.3 ºC and the minimum 23.4 ºC. The mean temperature difference between night and day is 8.9 ºC.

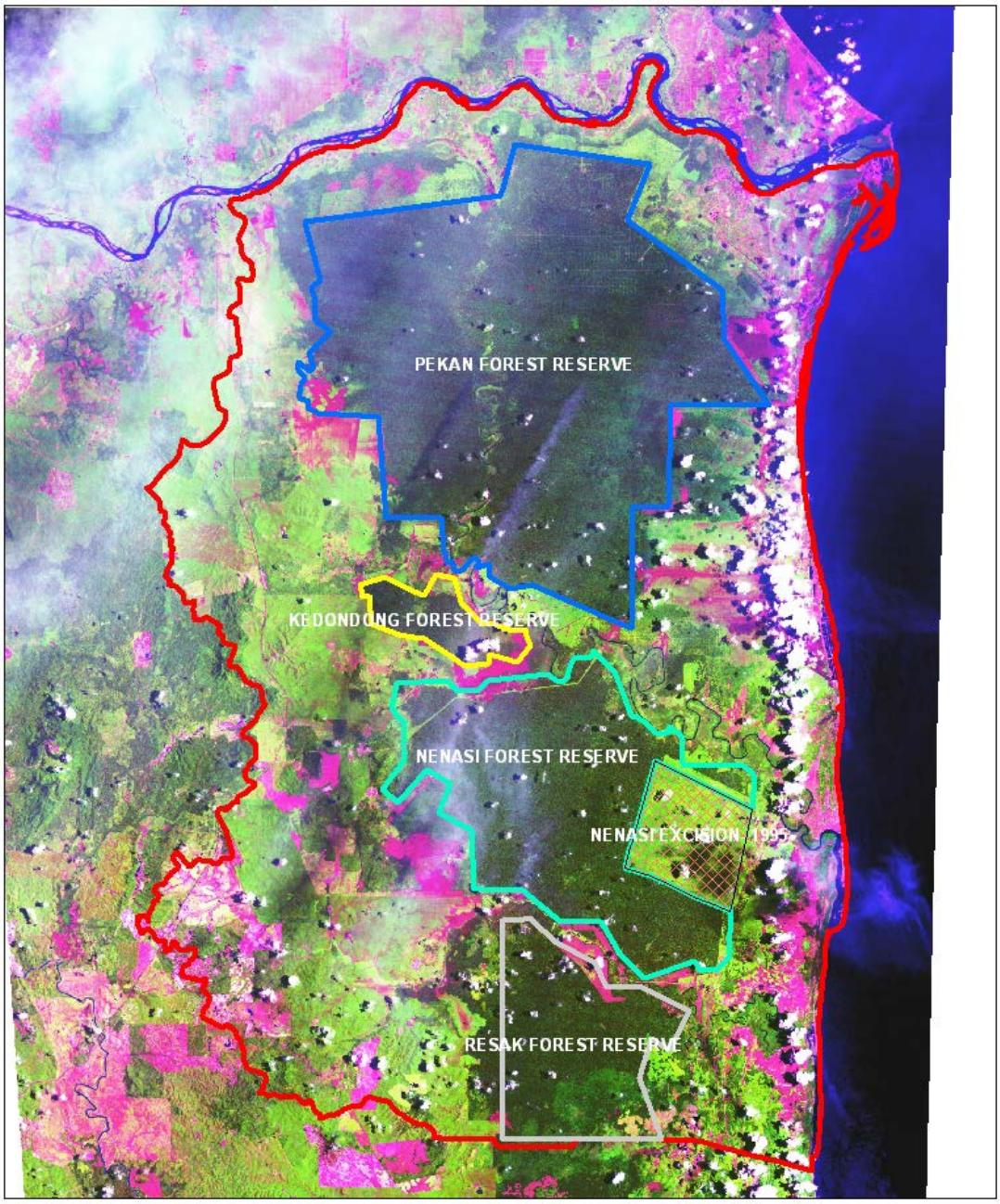


Figure 7.14 Location of the four Permanent Reserved Forests of SEPPSF

7.3.3 Geomorphology

Most of the tropical peat swamps in Malaysia are found along the coastal plains, particularly the peat swamp in South East Pahang. This peat swamp is separated from the sea by a series of beach ridges and swales which are adjacent and parallel to the coast and totally cut off tidal influences to the swamp except where the rivers breach these ridges. Further inland, hills of igneous, sedimentary and metamorphic rocks are found and mark the inland boundary of the swamp.

The Pekan-Nenasi coastal belt consists of recent deposits which can be divided into three broad geomorphic units (Figure 7.15)

- Coastal beach ridges interspersed with swales (BRIS)
- Inland swamp basin
- Sungai Pahang flood plain

The BRIS region occurs along the coast as an unbroken strip from Pekan town in the north to Rompin town in the south and its east west width varies between 400 meters to about 8 kilometers. The well drained sandy beach ridges with varying widths are separated by swales which are swampy, and the beach strand lines are narrowest in the central part and widest up north in Pekan and down south in Rompin. Its geomorphic characteristic owes its origin to the longshore littoral drift; the periodic influence of stronger waves during the monsoon and a retreating shoreline.

The inland swamp basin has resulted from a succession of old lagoons during the late Pleistocene[1] period. This geomorphic unit is very extensive and it runs parallel to the coast but inland from the coastal beach ridge unit. This unit extends inland at an average width of 20 km where it meets the hilly land in the west outside the SEPPSF area. The continuous lowering of the sea level over the years has allowed the peat or organic deposit to develop extensively in this geomorphic unit. Old beach strands can still be found within this unit.

The Sungai Pahang flood plain is a narrow geomorphic unit occurring along the banks of Sungai Pahang. The unit consists of estuarine deposits at the river mouth with a levee on each side of the river and a floodplain further inland. Figure 7.16 shows the lithology of the SEPPSF, the area is dominated by peat, humic clay and silt giving it very special characteristics.

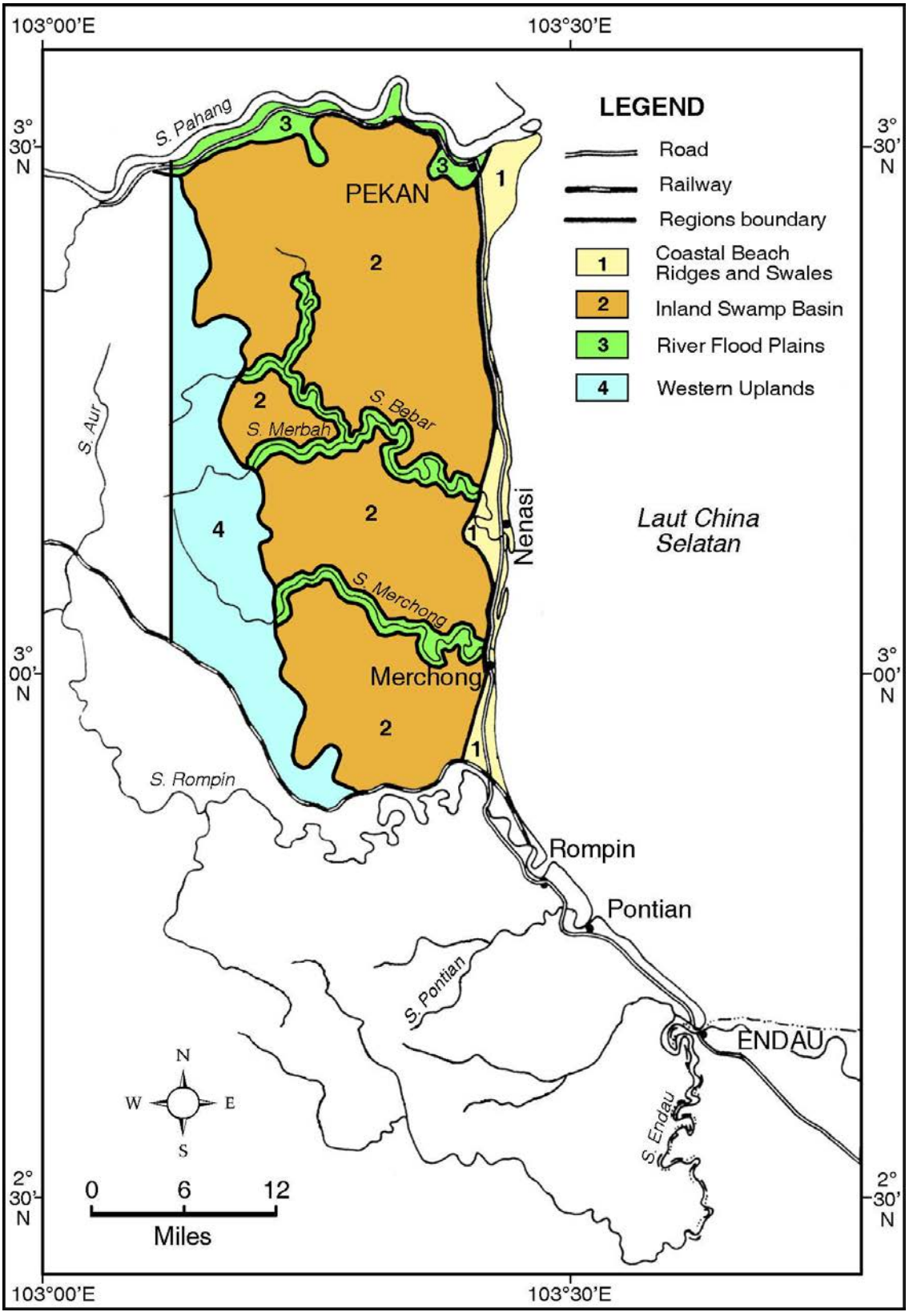


Figure 7.15 Physiographic regions of the South East Pahang

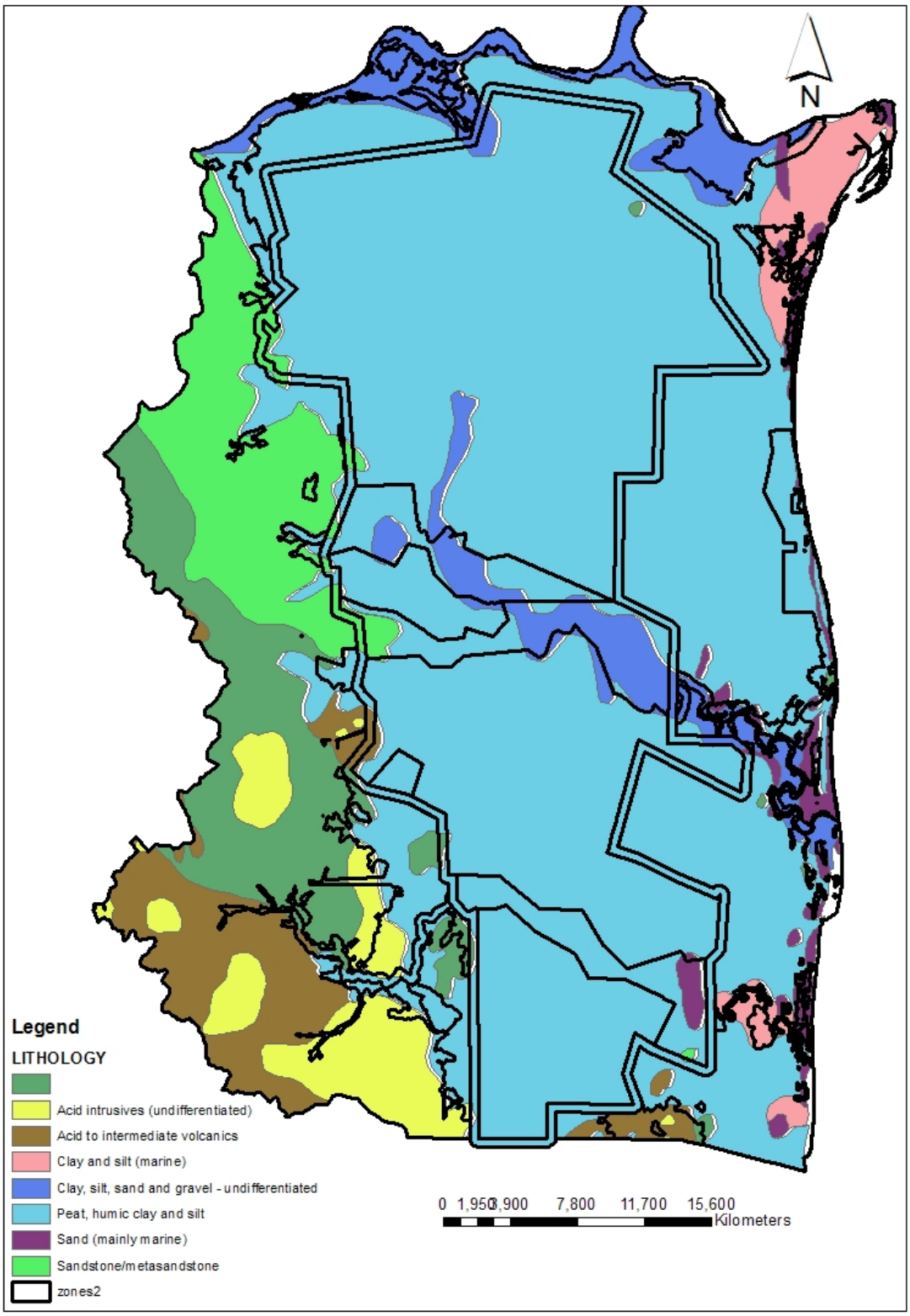


Figure 7.16 Lithology of the SEPPSF

7.3.4 Peat Formation and Characteristics

The peat swamp formation in the South East Pahang is lowland peat forming in depressional areas where the water table is high for prolonged periods. The formation may have taken place during the Holocene period (in the last 10,000 years) when the sea water level rose and during the Pleistocene period where the sea water level was 100 m lower than present. The SEPPSF peat formation does not however have such a pronounced dome as in the case of Sarawak and Riau, Sumatra. Gentle domes are present, an indication of it being of relatively recent formation.

Historically, the definitions of organic soils in Peninsular Malaysia, Sabah and Sarawak have been different. Paramananthan *et al.* (1984) consequently proposed a Unified Classification Organic Soils in Malaysia. This has now been incorporated into the *Malaysian Soil Taxonomy — Second Approximation* (Paramananthan, 1998). This classification has been recently up-dated (Paramananthan, 2006). Under this system of classification, a control section of 150 cm is used to identify the soils and a series of Keys used to identify the name of the soil types.

The organic soils within the lowland peat swamps of South East Pahang were more than 150 cm deep and had hemic materials in their subsurface tier. The underlying materials were mainly riverine clays. Thus the Gondang Series made up most of the organic soils. The soil maps of the Pekan, Kedondong, Nenasi and Resak peat swamps and their surrounding areas are given in Figures 7.17, 7.18, 7.19 and 7.20 respectively while the extent and description is summarized in Table 7.3. From this summary it can be stated that soils of the Gondang Series make-up 79,149 ha or 94% of the four Forest Reserves which covers an area of 84,289 ha. The peat mineral soil boundary has been identified in the SEPPSF to better plan land use especially for agricultural development. The peat areas are hydrology dependent and thus a description of the soils of the area is seen as important in guiding decisions on conversion and minimizing hydrological impacts of the surrounding land use on the four Forest Reserves.

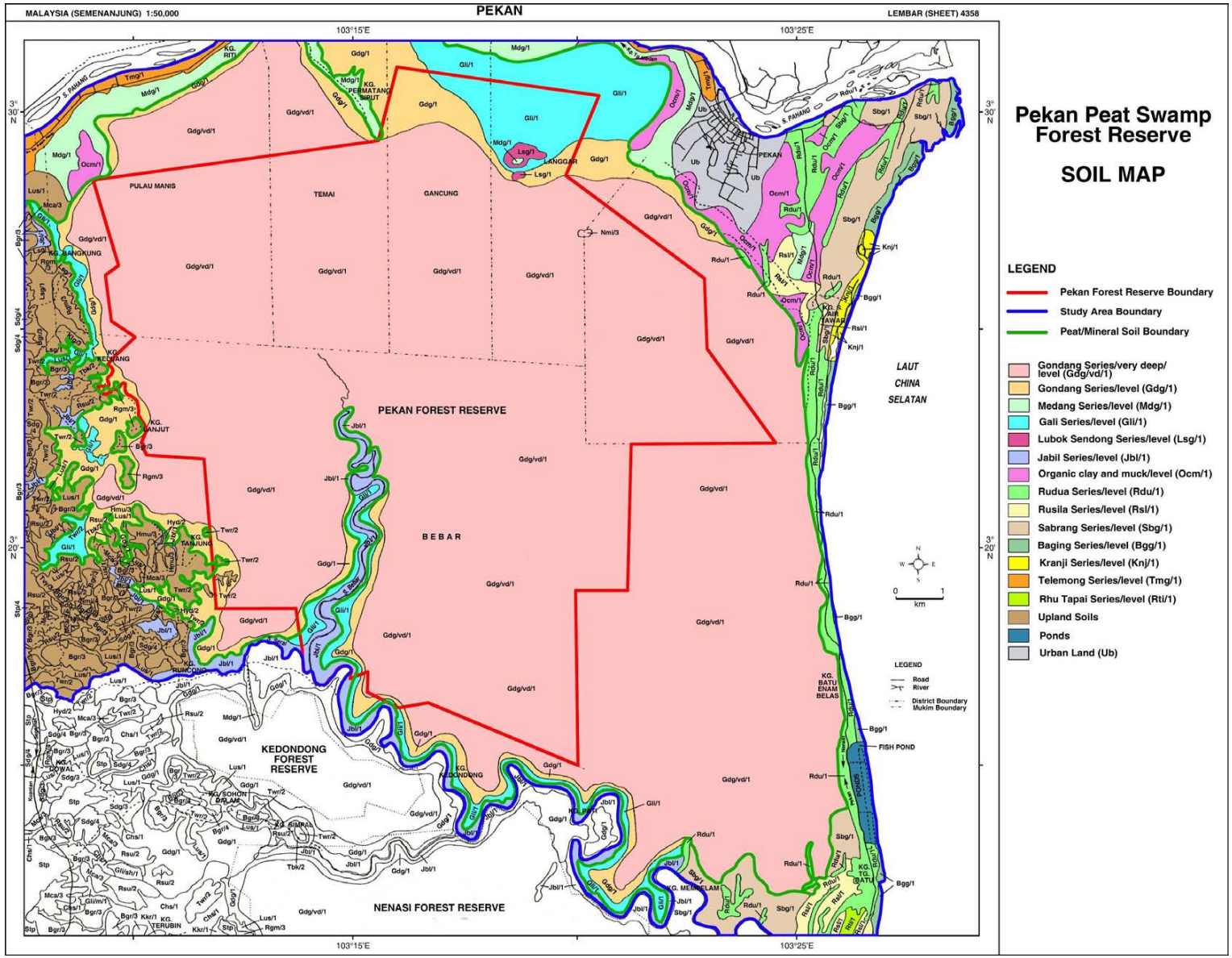


Figure 7.17 Soil map of the Pekan peat swamp and surrounding areas.

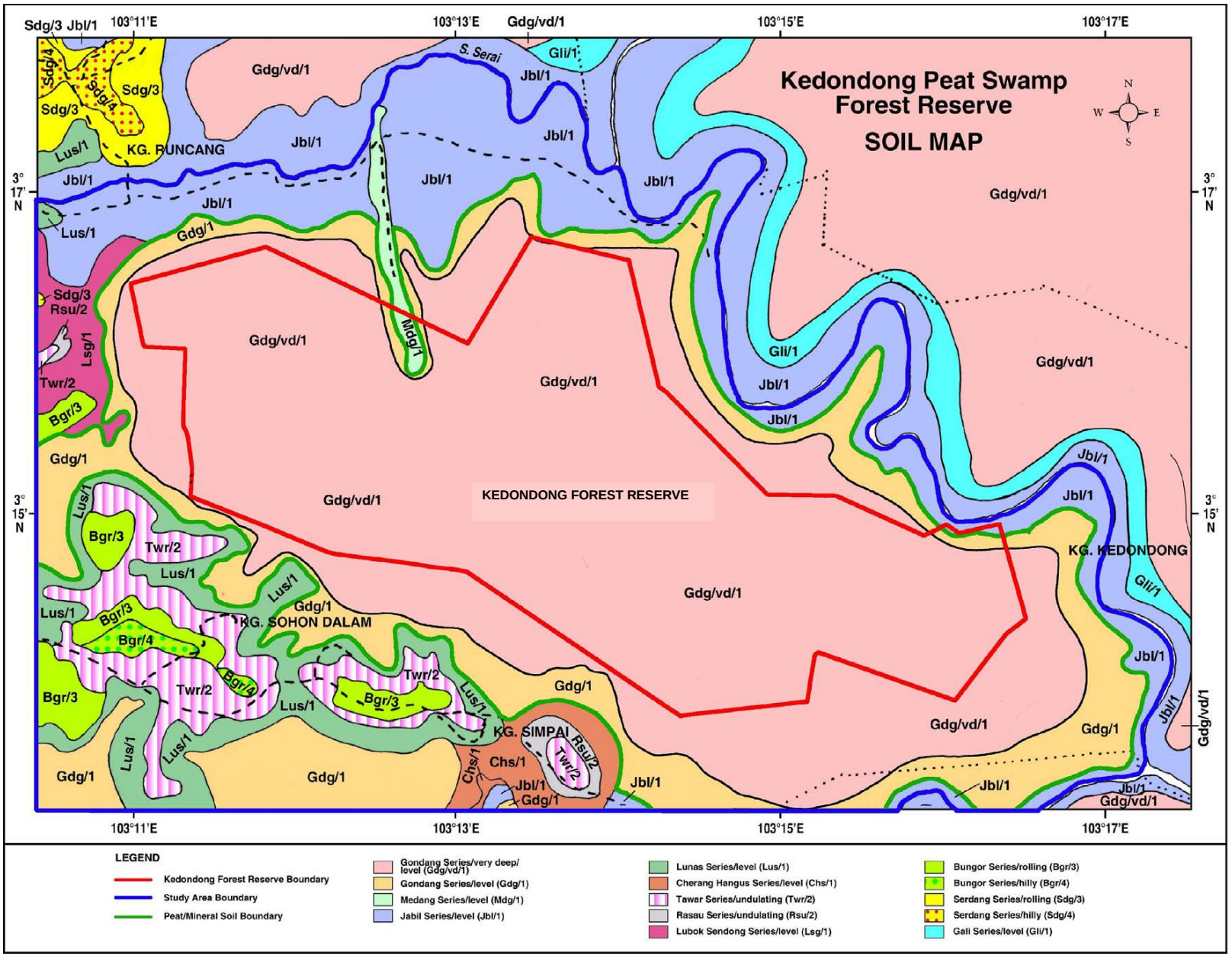


Figure 7.18: Soil map of the Kedondong peat swamp and surrounding areas.

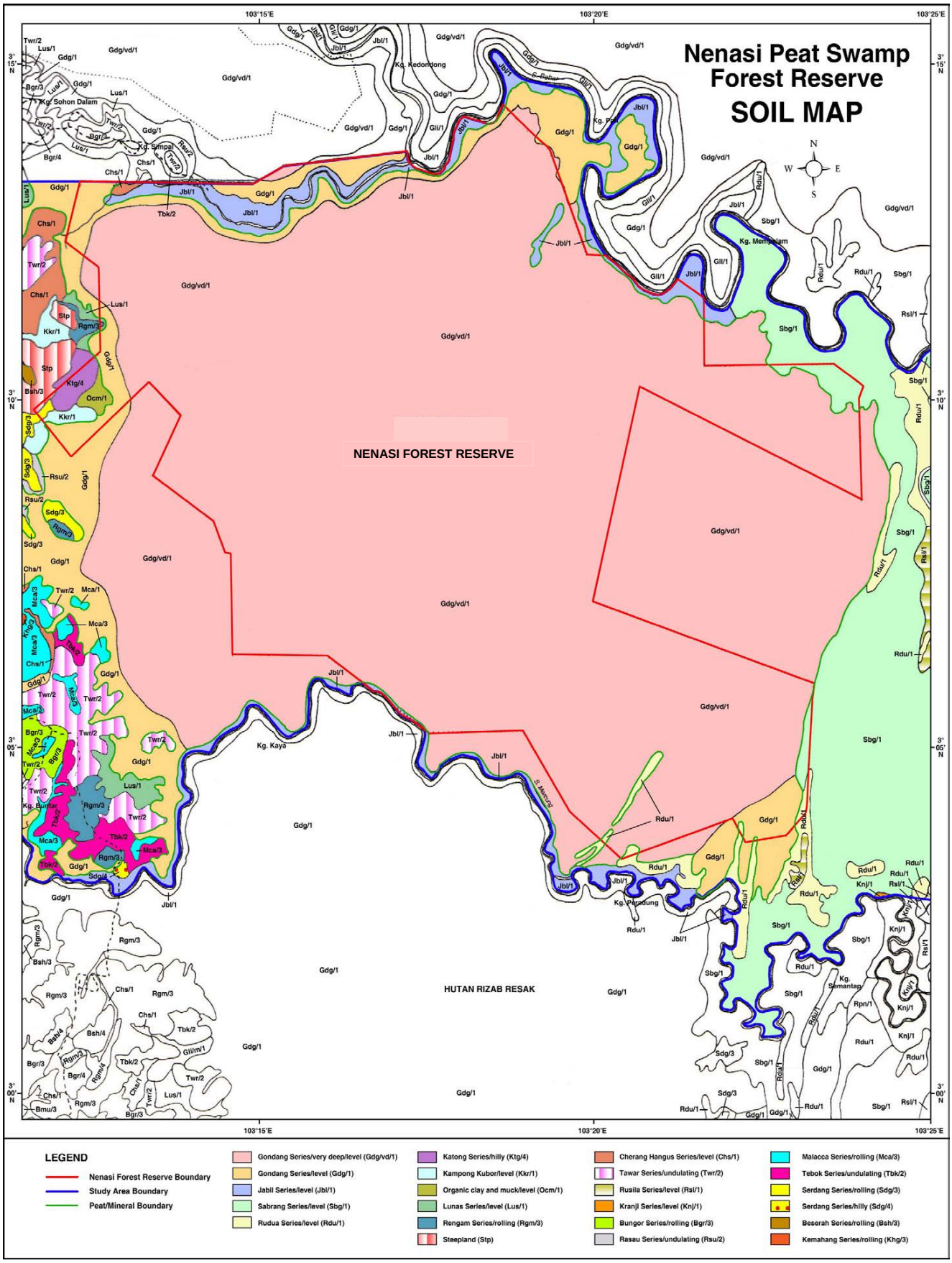


Figure 7.19 Soil map of the Nenasi peat swamp and surrounding areas.

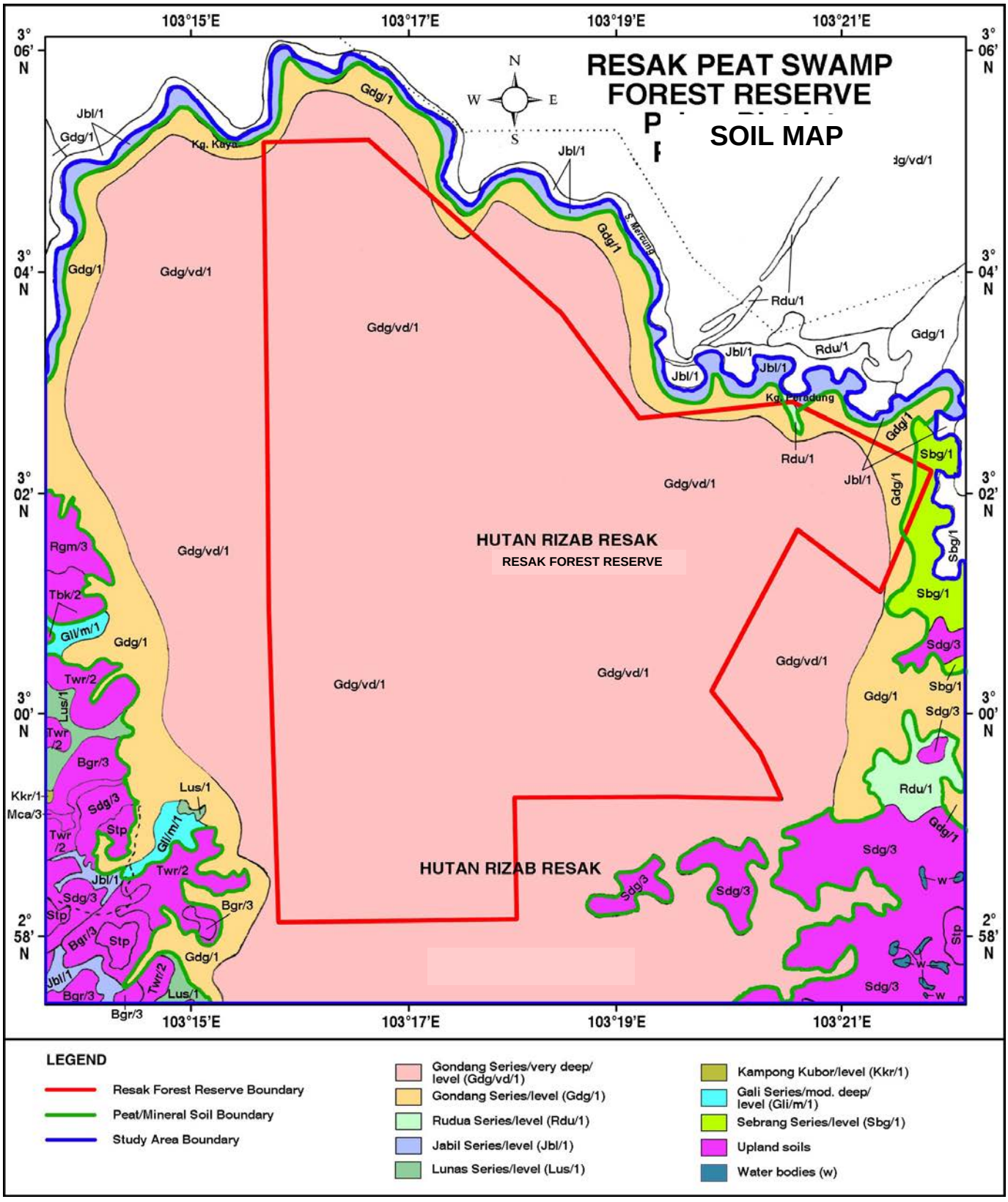


Figure 7.20 Soil map of the Resak peat swamp and surrounding areas

Table 7.3 Characteristics and extent of the soil mapping units within the peat swamp forest reserves.

Physiographic Unit	Map Symbol	Soil Series	Slope Class (%)	Description	Extent									
					Pekan Peat Swamp		Kedondong Peat Swamp		Nenasi Peat Swamp		Resak Peat Swamp		Total:	
					Ha	%	Ha	%	Ha	%	Ha	%	Ha	%
Coastal Beach Ridges and Swales and Estuarine Deposits	Rdu/1	Rudua	Level (0-4)	Deep, somewhat excessively drained white sand overlying brown cemented humus-rich spodic horizon between 50 to 100 cm. Structure less, loose. Soils developed on beach ridges away from coast.	-	-	-	-	84	0.4	16	0.2	100	0.12
	Sbg/1	Sabrang	Level (0-4)	Deep, poorly drained brown silty clay to clay to around 60–90 cm below which is a bluish marine clay. Soils on estuarine and brackish water deposits.	-	-	-	-	168	0.8	49	0.5	217	0.26
Inland Swamp Basin	Gli/1	Gali	Level (0-4)	Shallow to moderately deep (50-150 cm) partly decomposed hemic organic soil material overlying light grey riverine clay. Surface tier (0-50 cm) mainly highly decomposed sapric organic soil material. Very poorly drained. Organic deposits.	2,385	4.7	-	-	-	-	-	-	2,385	2.83
	Gdg/d/1	Gondang	Level (0-4)	Deep (150–300 cm) to very deep (>300 cm) organic deposits. Partly decomposed hemic organic soil material in subsurface tier (50–100 cm) overlying fibric organic soil material in bottom tier (100–150 cm) with pieces of wood. Surface tier (0–50 cm) highly decomposed sapric material. Organic deposits overlying light grey riverine clay.	2,334	4.6	53	1.7	930	4.4	264	2.8	3,581	4.25
	Gdg/vd/1		Level (0-4)		44,405	87.5	3,071	97.6	19,127	90.7	8,965	96.5	75,568	89.65
	Ocm/1	Organic clay and muck	Level (0-4)	Dark brown humic clay, deep, very poorly drained.	-	-	-	-	42	0.2	-	-	42	0.05

Table 7.3 - continued

Physiographic Unit	Map Symbol	Soil Series	Slope Class (%)	Description	Extent									
					Pekan Peat Swamp		Kedondong Peat swamp		Nenasi Peat Swamp		Resak Peat Swamp		Total	
					Ha	%	Ha	%	Ha	%	Ha	%	Ha	%
Riverine Floodplain	Mdg/1	Medang	Level (0-4)	Deep, imperfectly drained brownish yellow to light grey fine sandy clay. Moderate medium subangular blocky; friable. Patchy clay skins. Maybe layered at depth. Soils over recent riverine alluvium.	51	0.1	18	0.6	-	-	-	-	69	0.08
	Jbl/1	Jabil	Level (0-4)	Deep (>100 cm) light grey clay to sandy clay. Moderate medium subangular blocky; slightly sticky; patchy clay skins. Soils on recent riverine alluvium.	1,218	2.4	5	0.1	594	2.8	-	-	1,817	2.16
	Lsg/1	Lubok Sendong	Level (0-4)	Deep, somewhat poorly drained, light grey fine sandy clay. Weak coarse angular blocky; sticky. No clay skins. Soils over recent riverine alluvium.	152	0.3	-	-	-	-	-	-	152	0.18
Upland Soils	Ups	Upland mineral soils	Level to steep (0-50)	Areas of upland mineral soils.	203	0.4	-	-	155	0.7	-	-	358	0.42
Total:					50,748	100.0	3,147	100.0	21,100	100.0	9,294	100.00	84,289	100.00

Explanatory Note:

The planning exercise prompted the soils of the 4 forest reserves and the surrounding areas to be surveyed. This was done primarily to identify the peat mineral soil boundary and the extent of soil types. What is evident from the surveys is that the ***peat –mineral soil interface*** *in most cases is outside the forest reserve boundaries and thus is afforded no development control or protection. An added factor to be considered seriously is the depth of peat. Approximately 89.6 % of the 4 forest reserves is classified as very deep (>300cm) peat deposits and these extend outside the forest reserves. These deep peat areas outside the forest reserves have either been degraded by logging and abandoned or developed for agriculture. The main concern arising out of this situation is the hydrological impact of agriculture development. Developing these areas without proper guidelines and due consideration to hydrological fragility of the peat system warrants impacts on the ecosystem which in most cases is irreversible. The most sustainable alternative use of the areas outside the forest reserves would be plantation forestry not involving any form of excessive drainage.*

7.3.5 Land Use

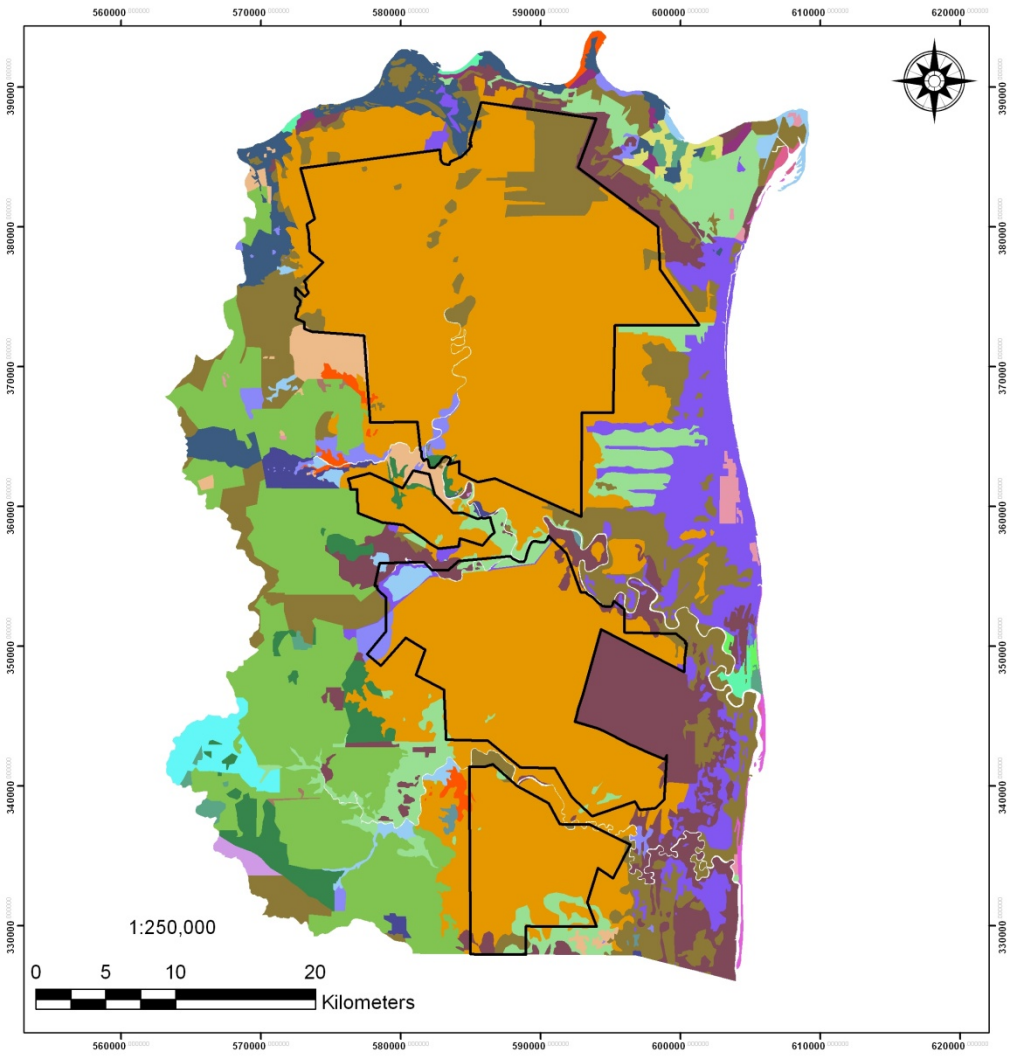
Approximately 95,000 ha of the area is still Peat Swamp Forest and an additional 43,000 ha is degraded Peat Swamp Forest undergoing various stages of secondary succession. A visual extent and location of the land use classes is presented in Figure 7.21

7.3.6 Hydrology

The hydrology of the SEPPSF is dominated by the presence of extensive areas of inland swamp where the water tables remain at or above the soil surface for about six months in a year. The SEPPSF hydrology is to a large extent determined by the rainfall and the rivers which flow through the area. The general hydrology of the area is presented in Figure 7.22. The project area consists of 3 main hydrological units, Unit 1 being the Peat Swamp Forests and other associated wetlands, Unit 2 is the river floodplains and Unit 3 is the mineral soils on the western part of the SEPPSF as well as isolated pockets with similar characteristics.

The Pekan forest reserve is predominantly rain fed and the groundwater fluctuations depend mainly on the rainfall variability. During periods where the rainfall exceeds the evaporation and lateral groundwater run-off there will be increased groundwater storage within the Peat Swamp Forest, resulting in higher water tables. However, during dry periods with no or very little rainfall the overall groundwater storage in the forest reserve will decrease and the water table will decline.

In the Pekan forest reserve where the natural groundwater table seldom is more than 40 cm below the surface during the dry periods, and often above or close to the surface during the wet periods, the total storage capacity is low. The Pekan forest reserve has some water holding capacity which is quite limited during the wet period but noticeable during parts of the dry period, where rainfall events in the order of 20 to 30 mm can be stored without generating surface run-off.



SOUTH EAST PAHANG LANDUSE MAP

LEGEND

Forest Boundary

LANDUSE

Beach
Coffee
Croplands
Diversified Crops
Dry Forest
Early Succession, 50-90% Cov
Early Succession, 60-90% Cov
Grasslands
Improved Pasture
Late Succession, >90% cover
Mangrove
Mixed Horticulture
Newly Cleared Land, <10% Cov
Newly Cleared, Open Padang
Oil Palm
Orchards
Padi
Peat Swamp Forest
Pond Cultivation
Rubber
Scrub Forest, <50% Cover
Scrub Grasslands
Swamp Scrub, <50%Cover
Urban
Wet Forest

Figure 7.21 Land use map in SEPPSF

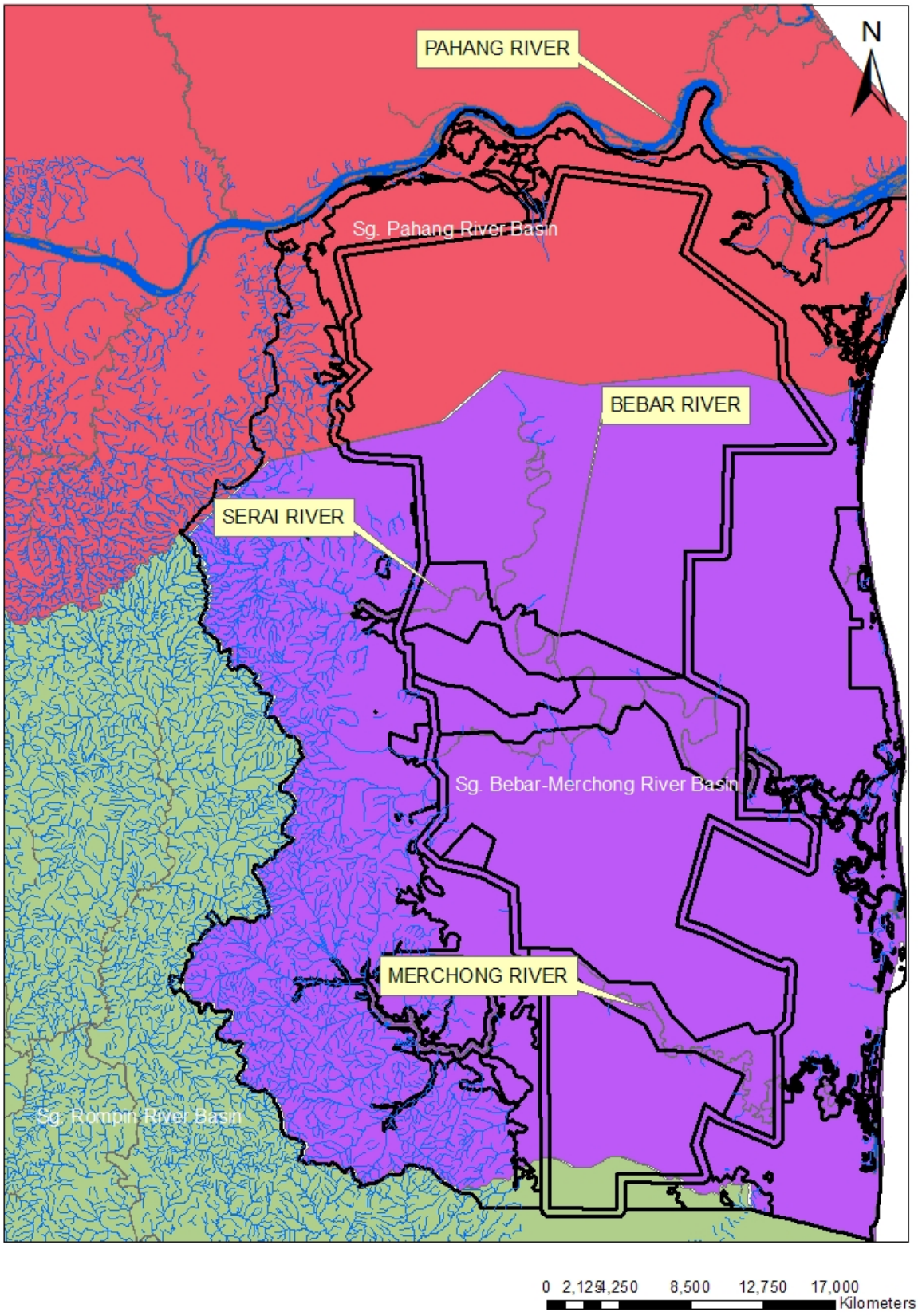


Figure 7.22 Hydrology of the SEPPSF – Sungai Pahang and Bebar-Merchong river basins

7.3.7 Vegetation

The SEPPSF forest reserves are a mosaic of different vegetation types making it an important site for biodiversity conservation as well as maintaining ecological processes. The UNDP-GEF Project implemented in 2002 – 2008 revealed that a total of 287 tree species in 52 families were recorded from the four forest reserves with Kedondong FR recorded the highest number of species (210 species) followed by Nenasi FR (106 species), Pekan FR (164 species) and Resak FR (92 species) (UNDP-GEF 2003). Overall, the species compositions are fairly uniformly distributed within the four forest reserves. This is reflected by the presence 50 species in 25 families. Species from the families of the Anacardiaceae, Bombacaceae, Burseraceae, Clusiaceae, Dipterocarpaceae, Euphorbiaceae, Leguminosae, Myrisiticaceae, Myrtaceae and Sapotaceae dominates the area. Meanwhile in term of basal area, the following species *Calophyllum ferrugineum, Campnosperma coriaceum, Diospyros maingayi, Durio carinatus, Koompassia malaccensis, Madhuca motleyana, Santiria laevigata, Santiria rubiginosa, Shorea platycarpa* and *Xylopia fusca* are found to be commonly distributed. The PSF can be characterised by the abundance of Meranti paya (*Shorea platycarpa*), Ramin (*Gonystylus bancannus*), Kempas (*Kompassia malaccensis*) and Durian paya (*Durio carinatus*). However, further inland, *Pandanus* dominates the lower strata, meanwhile the western part of the Pekan Forest Reserve is represented by pole sized trees. The even nature of the canopy is intermittently characterised by presence of emergent species such as Kempas (*Kompassia malaccensis*) and Bintangor (*Calophyllum spp.*).

7.3.8 Fauna

Faunal surveys undertaken during the UNDP-GEF Project identified 58 species of mammals, 233 species of birds and 54 species from 17 families of fishes were recorded in the SEPPSF area (UNDP-GEF 2003). The bird study also reported that the forest reserves have great potential to be developed as ecotourism destination for bird watching. Such activity is envisaged to generate additional revenue to the state, as well as employment opportunities for the local communities. However, promotion of such activities would require detail studies in order to maximize benefit to all stakeholders in the area.

The diversity of fish species in the PSF is considered rich and hence it is proposed that a detailed studies to be undertaken in order to assess the diversity and distribution of the fish species in the area and also the impact of development (Table 7.4).

Table 7.4: Summary of fish species found in the SEPPSF

No.	Family	No. of species
1.	Cyprinidae	18
2.	Cobitidae	2
3.	Balitoridae	2
4.	Bagridae	2
5.	Siluridae	5
6.	Pangasiidae	1
7.	Clariidae	2
8.	Hemiramphidae	1
9.	Aplocheilidae	1
10.	Synbranchidae	1
11.	Chaudhuriidae	1
12.	Nandidae	2
13.	Luciocephalidae	1
14.	Anabantidae	1
15.	Helostomatidae	1
16.	Belontiidae	9
17.	Channidae	4
	Total of species	54

Source: MDA Study 2003

7.3.9 Socio Economic

The district of Pekan has vast resources and potential for development of various forms. It has transformed itself from a purely agricultural economy to a mixed economy incorporating industrial development as well. This is in the form of the automotive assembly plant for the local market in Peramu within Pekan. Commercial aquaculture is also a major industry. The Pekan district structure will be contributed by the three foundations economic factors i.e. agriculture, construction and manufacturing, and commerce and finance. The agricultural sector will play a major role in Pekan. It has the third largest oil palm cultivation and the second largest padi cultivation in Pahang.

The total population of Pekan was 97,751 in the year 2000, or 8% of the population of Pahang. The major ethnic group in the area are Malays (83%) followed by the Orang Asli (9%). Population growth among the Orang Asli is 4.2% between 1991 and 2000 as compared to the overall growth in the state of Pahang in the same period.

Commercial agriculture is the main economic activity outside SEPPSF area. Oil palm is the predominant activity in areas such as Lepar, Penyor and Pulau Manis. Rubber is the second largest cultivated crop type. Others include cocoa, padi, coconut, vegetables and tropical fruits such as durian, rambutan, jackfruit, duku, starfruit, pineapple and banana.

Timber harvesting activities are carried in both stateland forests and in the permanent reserved forests (PRF). Harvesting in PRF begin in the year 2000 with the application of reduced impact logging techniques with minimal impact to the environment. However, harvesting in the adjacent stateland forest is of concern to the overall ecological integrity of the SEPPSF.

Currently there is no ecotourism activity in the SEPPSF areas, however the area has great eco-tourism potential particularly community based tourism products which focused on the Orang Asli community. Such activities have been successfully implemented in other areas such as Tasek Bera, Taman Negara and Tasek Cini. These activities could be further enhanced through educational tours to the various forest reserves in order to promote forest and biodiversity conservation. Tourism is expected to develop further and to play an important role with growth in eco-tourism, agro-tourism, culture and history.

7.3.10 The Asli Jakuns of the SEPPSF

The indigenous people in the SEPPSF are mainly from the Jakun sub group, known as Proto Malays who are believed to be the descendents of the pre-historic Austranesian (Malayo-Polynesian) migrated from South China (Yunnan province) to South East Asia between 3,000 to 5,000 years ago. Currently there are 11,672 people in the Pekan district and this is about 50% of the country's total Jakuns population. About 74% of the Orang Asli is dependent on the SEPPSF for their livelihood. A summary of forest dependency by the Orang Asli is shown in Table 7.5.

There are 19 Orang Asli villages in the vicinity of the SEPPSF as shown in Table 7.6. Out of the 19 villages, only one is under Rancangan Pengumpulan Semula (RPS), 15 under the Penyusunan Semula Kampung (PSK) and the remaining 3 villages are under Kampung Pinggir (fringe settlements) category. The RPS village is the grouping of small villages to form larger settlement equipped with basic amenities such as water, electricity, school, clinic, kindergarten, community hall, houses and including the office of JAKOA. The PSKs are the relocation of Kampung Pinggirs into the same locality to form an economic block and are provided with water and electricity facilities. Currently there are 2,641 families registered in the Pekan district. Out of this total, 2,061 families are listed as either poor or hardcore poor, while 491 families are categorized as potentially poor and the balances are regarded as not poor. The Orang Asli population and number of households in the project area and their distribution are also shown in Table 7.6 and Figure 7.23 respectively.

Traditionally, the Orang Asli practices shifting cultivation, hunting, collecting forest products and fishing for their livelihood. Among the non timber forest product (NTFP) collected include rattan, ferns, orchids, pitcher plants and medicinal plants such as Tongkat Ali, Pasak Bumi, Kacip Fatimah and many others. Wild animals such as monkeys, deer, wild boar, birds, fishes and other small mammals such as slow loris, flying fox, leopard cats, etc are hunted as a source of protein. They also plant cash crops such as yam, bananas, vegetables and fruit trees to generate additional income.

In recent years, the collection of NTFP and other forest products are not only consumed by the community but also traded commercially. In addition, some of the Orang Asli are also employed by the logging operators and nearby oil palm estates. In this regards, the JAKOA, also provide assistance to the community towards sustainable livelihood. This is undertaken through small scale business projects such as medicinal gardens, cattle rearing, mushroom farming and cottage industries for handicrafts. However due to shortage of capital, lack of supervision, capacity and skills among the Orang Asli to undertake such commercial endeavours often do not achieve the desired objectives. Therefore there is a tendency to continue to be dependent on the forest resources for their livelihood. The Orang Asli community acknowledge and fully support the conservation of the SEPPSF.

Table 7.5: Level of dependence of the Asli Jakun on the SEPPSF.

No.	Level of dependence	Percentage of households (%)
1.	Totally dependent	27
2.	Major source of livelihood	14
3.	Occasional dependence	33
4.	No longer dependent	26

Source: MDA Study 2003

Table 7.6: List of villages within SEPPSF

No.	Economic Planning Blocks (Blok Perancangan Kecil, BPK)	No. of households	Population	Area (ha.)	Village Development Category		
					RPS	PSK	Kg. Pinggir
1	Sekukuh	23	115	20			√
2	Permatang Keledang	134	481	40		√	
3	Durian Sebatang	16	70	10			√
4	Sg. Kalong	50	229	150		√	
5	Permatang Siput	89	350	256		√	
6	Arong	58	307	223		√	
7	Jambu	15	69	21			√
8	Landai	41	178	65		√	
9	Meranti	56	253	85		√	
10	Sena	33	170	61		√	
11	Serun	68	311	405		√	
12	Selingkong	26	142	607		√	
13	Api Larat/Jong	108	481	683		√	
14	Sawah Batu	171	726	458		√	
15	Padang	35	104	40		√	
16	Simpai	260	1004	1215		√	
17	RPS Runchang	223	1208	1012	√		
18	Wah-Wah	35	185	450		√	
19	Bangkong	118	459	405		√	
TOTAL		1564	6874	6489	1	15	3

Source: JHEOA 2003

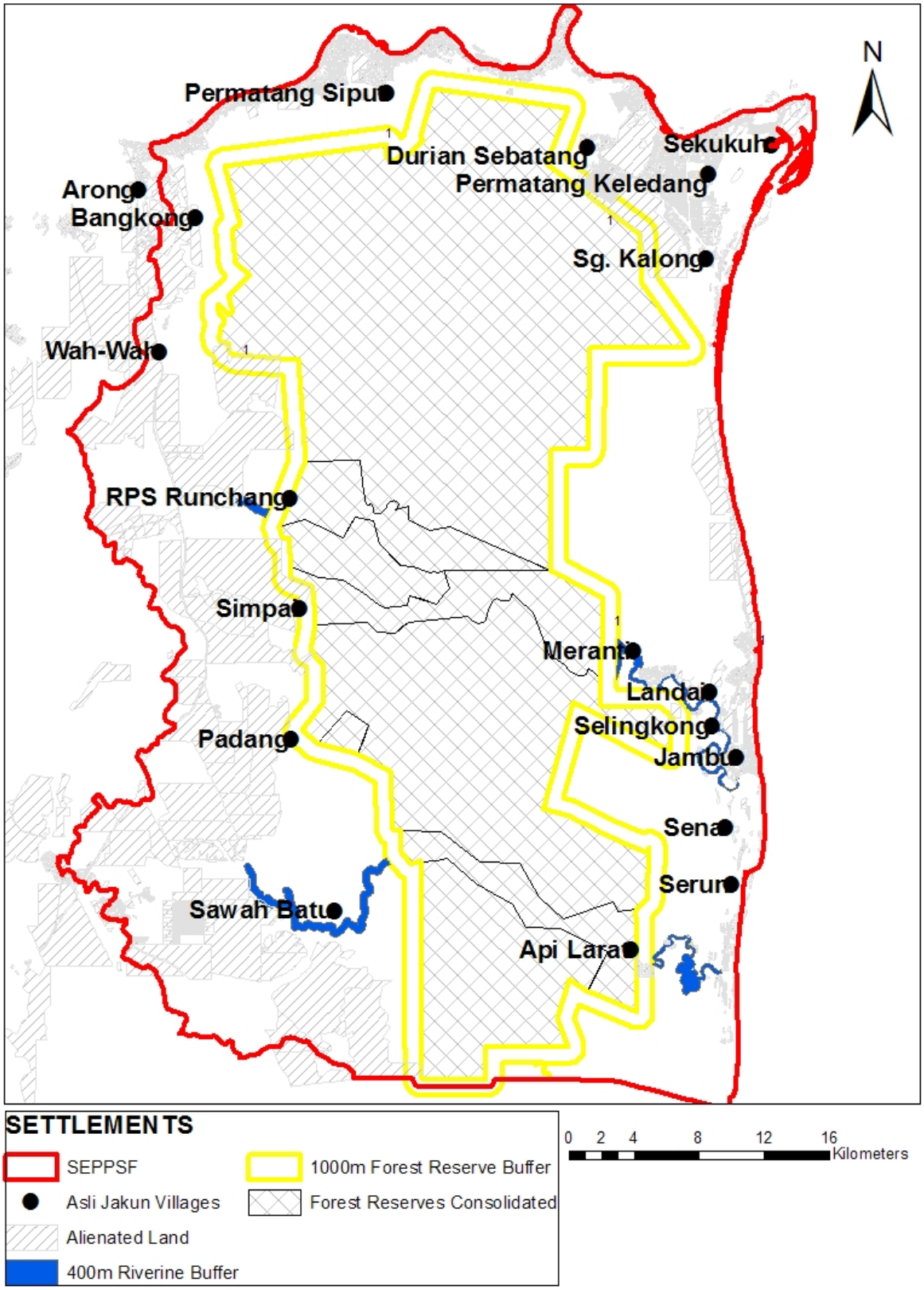


Figure 7.23: Major Asli Jakun Settlements in the SEPPSF

7.4 LOAGAN BUNUT NATIONAL PARK, SARAWAK

7.4.1 Location and Extent

Loagan Bunut National Park (10,736 ha) in Miri Sarawak is located between Sg Tinjar and Sg Teru in the upper reaches of the Baram River basin (Figure 7.24). The area where Loagan Bunut National Park is now located was a part of the Lemiting Forest Reserve and as such, was managed for timber production. The *Final Proclamation to Constitute the Loagan Bunut National Park*, dated 25 June 1990, was published in the Sarawak Government Gazette on 29 August 1991. The Park is accessible by land (2½ hours via the Bakong/Beluru-Lapok/Long Lama trunk road from the 40 km junction on the Miri-Bintulu Road) and river (a day's journey upriver from Kuala Baram).

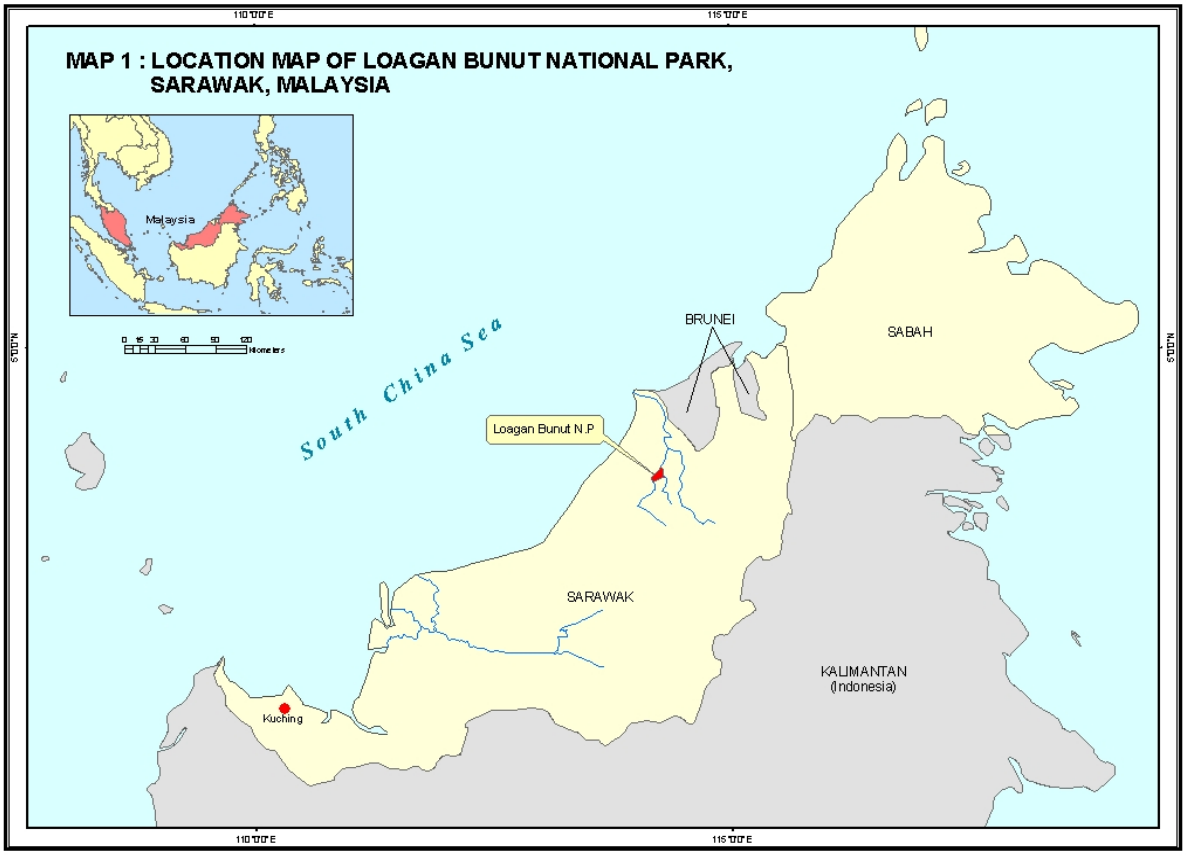


Figure 7.24 Location of the Loagan Bunut National Park

7.4.2 Climate

The climate in Loagan Bunut is tropical; hot and humid with temperatures between 25 to 35^0 C. The rainfall is uniformly high at approximately 3,000 to 4,000 mm but the Park generally experiences a distinct wet period from around November to January and a dry period between May and July.

7.4.3 Geomorphology

Some 7,000 years ago, when the sea level was at its highest point, Loagan Bunut was an estuary of Sg Tinjar. As the coastline continued moving out towards the sea the estuary became part of the landmass while Sg Tinjar eventually joined the Baram River. Initially, when Loagan Bunut was part of a large, tidal water body, grey clay was laid down. Mangroves then encroached across the mud and dominated the area. They died off when physical changes occurred. An isolated, shallow topographic depression in the back of the river floodplain gradually developed into a back-basin lake, forming Loagan Bunut.

7.4.4 Peat formation and Characteristics

The peat at Loagan Bunut National Park has been dated to 5,500 BP. It is understood to have developed on alluvial soils behind mangroves as the proto-Baram delta developed. The modern PSF succeeded a more extensive Pleistocene PSF that was drowned by the rise of the Holocene South China Sea.

Wan Sulaiman *et al.* (2006) in Tuen *et al.* (2006) note that the peat swamp at Loagan Bunut National Park has a typical dome or lens structure about 1.5 km from the lake margin to the centre of the dome and that the thickness increases from about 3 m at the margin to 20.7 m at the centre (Melling *et al.* 2006). The prevailing groundwater levels were around 20 cm below the surface.

Because majority of the area is composed of PSF, soils of the LBNP comprise mostly of organic soils. Being an oligotrophic peat generally characterized by high acidity and low nutrient content, it is infertile as it contains less than 35% mineral material and mostly deep. Mineral soils are only confined to the narrow strip of alluvium on both sides of the river channel. The cross section of five traverse lines by Melling et al (2006) through the PSF show the peat of the LBNP have a typical inverted saucer shape with a “steeper” slope at the edge and a flat to slightly curved middle part . The peat depth generally increased quite rapidly towards the centre of the peat swamp with a slope up to about 4 %. The base of the peat depth was irregular giving a wide range in peat depths with probably the deepest peat ever recorded in the world at 20.7m at one of the transects. The peat characteristics in relation to its topography had also influence the structures and floristic composition of the LBNP.

The peat are generally reddish brown to very dark brown in colour depending on the stage of decomposition but the peat consists of varying amounts of slightly to partially decomposed trunks, branches and roots of trees within a matrix of structure less organic material that originates from the same forest plants. The bulk density of raw peat is about 0.1 g/cc but can increase to 0.2 g/cc in more decomposed peat.

7.4.5 Land Use

Past and current land use in the Sg Teru catchment has significant impacts on the Park today. The lake's existence and the quality of the river will be jeopardized unless action is taken to remedy chronic problems and moderate current land use practices. The core issues are the quality of water (sediment load and nutrient levels) entering Loagan Bunut and the attenuation of soil water and river flow.

When Sg Teru is in flood, Loagan Bunut receives backflow which brings silt into the lake. Most of the silt is believed to come from human activities in the upper Sg Teru catchment. From the perspective of managing silt and eutrophication (the process whereby water bodies receive excess nutrients that stimulate excessive plant growth) sources there are three categories of land:

i. Commercial estates on alienated land
ii. Non-alienated land on which local communities have established settlements or NCR claims
iii. Stateland unencumbered by NCR claims

7.4.6 Hydrology

Loagan Bunut is Sarawak's largest natural freshwater inland floodplain lake. Satellite images show the lake area to be 650 ha when fully flooded. According to Murtedza et al (2004) Loagan Bunut's surface hydrology is such that it is fed constantly by Sg Bunan, which drains the sub-catchment to the south of the lake. He further reported that depending on the rainfall distribution the lake is fed either by discharge from the PSF or by inflow from Sg Teru via Sg Bunut. When there is substantial rainfall within the Park sub-catchment the lake water will be replenished and sustained by the previously recharged groundwater in the surrounding PSF. However, during extended dry periods and in the absence of groundwater recharge in the Loagan Bunut sub-catchment, the lake water will recede or even completely dry up through evaporation loss and discharge into Sg Teru via Sg Bunut. The lake may receive flood discharges from Sg Teru. Murtedza et al (2004) noted that the duration of flood within the lake would depend on the water level of Sg Teru – if it is lower than that of Sg Bunut then the lake water will empty into Sg Teru. The depth of water at the lake's centre fluctuates from 0 to 3-4 m. Figure 7.25 shows the hydrology map of the Loagan Bunut.

The lake cushions downstream communities and their property from destruction by absorbing flood water from upstream. During local dry periods backflow from Sg Teru entering the lake via Sg Bunut, brings in silt and nutrients brought down from the upper Sg Teru catchment on earlier occasions. The state of the PSF is

largely governed by the groundwater level. Wan Sulaiman *et al.* (2006) found a lack of inter-connectivity between the PSF and the lake with little base flow from the peat into the lake. Chai (2004) notes the PSF's ability as a natural reservoir to retain water and prevent floods has a far-reaching impact and is often overlooked.

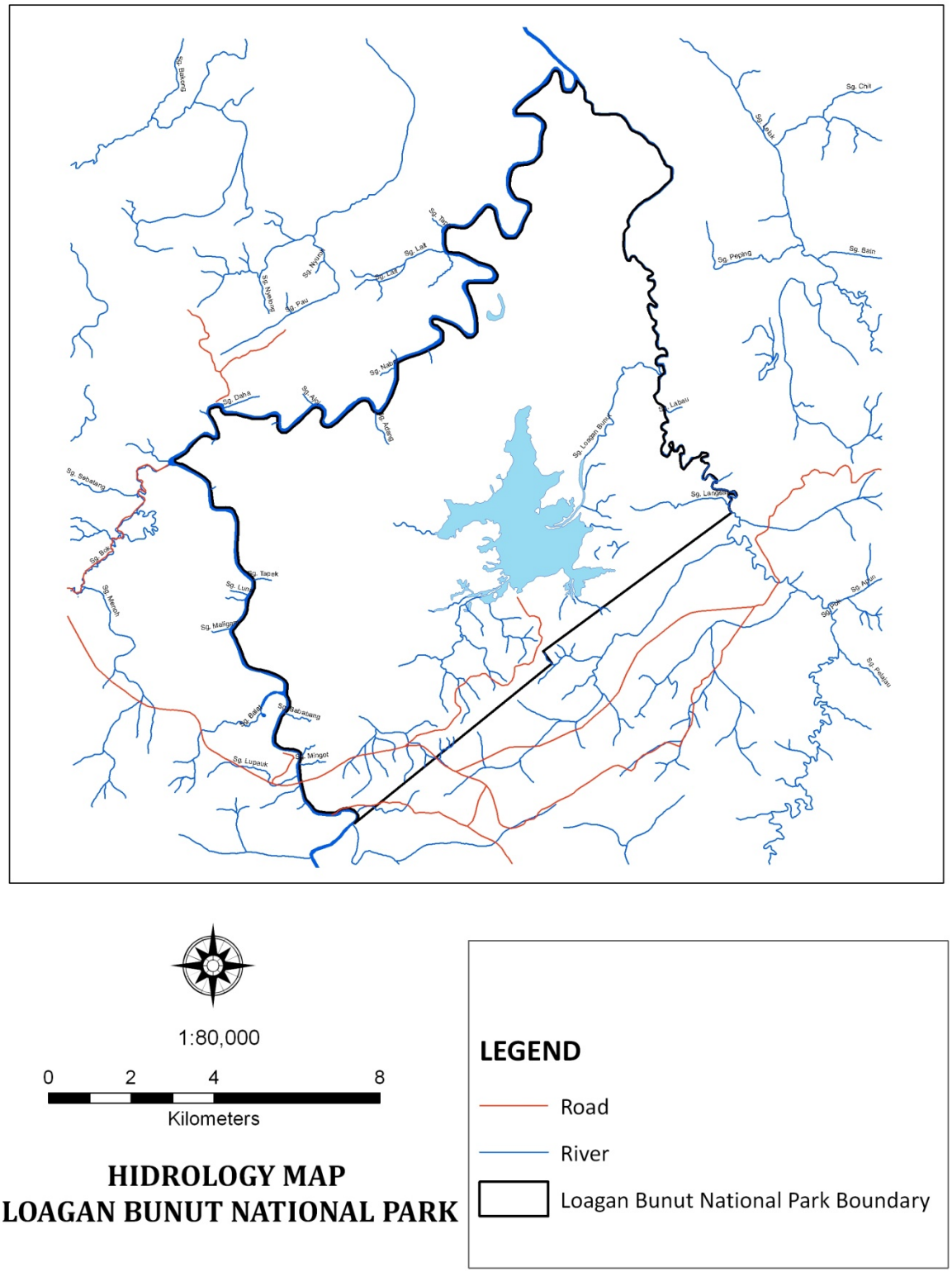


Figure 7.25 Hydrology map of Loagan Bunut National Park

7.4.7 Vegetation

In 1963 a forest type map of Loagan Bunut was prepared based on aerial photographs interpretation and the map was subsequently updated and revised in 1997. Figure 7.26 shows the forest type map of the area which shows the complexity of the vegetation. Chai (2004) describes the vegetation in detail based on his investigations in the field.

In term of flora a total of 506 plant species have been recorded in the area, including 173 species from PSF, 227 from Hill Forest and 106 from Riparian and Alluvial Forest (Chai 2004). Some of these are endemic and/or threatened. Ninety-seven flowering plants and ferns were recorded from the Peat Swamp and Riverine Forests of Sg Bunut, including seven important commercial Dipterocarp timber species. The fern *Platycerium ridleyii* is a new record for Sarawak. There are four genera of orchids and four species of pitcher plants including *Nepenthes bicalcarata* (endemic to peat swamp in Borneo). The future of Ramin (*Gonystylus bancanus*) (now listed under CITES Appendix II) was stated to be 'uncertain if no efforts are done to restore and conserve the species' (Jusoh *et al.* 2006). The Riverine Forest includes *Artocarpus* and *Ficus* species are important as food resources for fish and wildlife. Table 7.7 shows list of endemic plant species observed in LBNP.

The Forest Type map indicates that approximately 70% of the land area of the park was originally occupied by PSF. Currently the PSF at LBNP represents about 8,067 ha or 0.55% of the original total PSF in the State of Sarawak. The peat is a raised bog type where the ground level rises gradually towards the centre. Melling et al (2006) reported that at the centre, the peat was found to be up to 20.7 m deep. The peat is permanently water-logged with a water table at the surface and the pH is low. Three of the six phasic communities described for peat swamps in Sarawak (Anderson 1963) are represented. A relatively small area of Mixed Swamp Forest is located at the periphery of the swamp and fringes of the lake. Behind this Alan Bunga Forest and at the centre Padang Alan Forest occur as more extensive communities. Chai (2004) noted that in spite of past logging the remnant Peat Swamp is floristically still fairly rich with about 53% of the species known from PSFs in Sarawak and Brunei recorded. Well-known commercial species including Alan bunga (*Shorea albida*), Kapur paya (*Dryobalanops rappa*) and Ramin telur (*Gonystylus bancanus*) are well-represented.

Table 7.7 List of endemic species from LBNP

Species	Common name	Area of endemism
Copaifera palustris	Sepetir paya	Borneo
Dactylocladus stenostachys	Jongkong	Borneo
Dryobalanops rappa	Kapur paya	Borneo
Shorea albida	Alan	Borneo

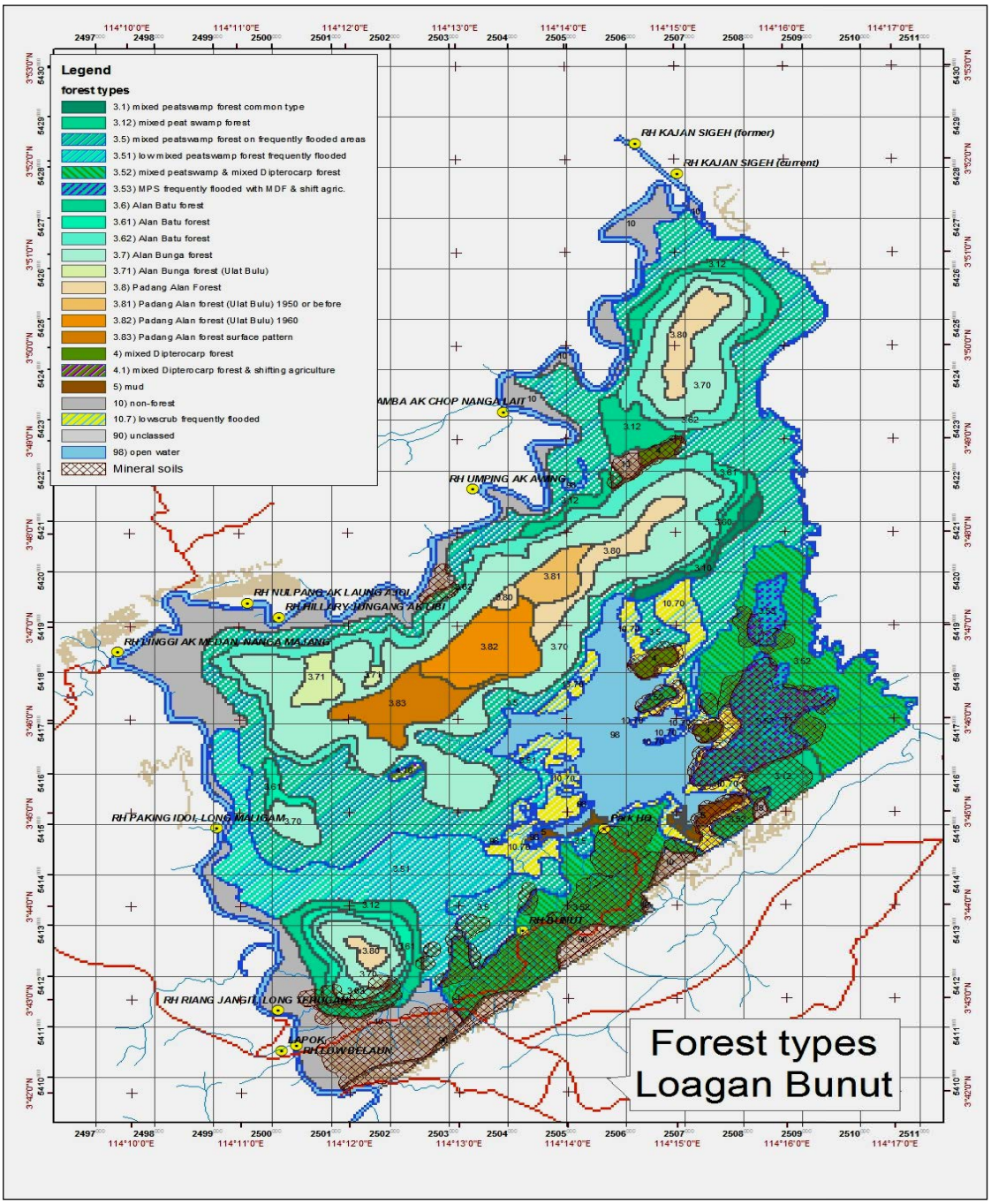


Figure 7.26 Forest types map of Loagan Bunut National Park

7.4.8 Fauna

Reports have shown that mammals recorded from the LBNP include two primates, nine other large mammal species including three deer species and the Bearded pig, and 11 small mammal species including nine bat and two rodent species. A single Black-capped fruit bat (*Chironox melanocephalus*) is the fourth record for Sarawak. The local community has indicated further mammal species occur in the park, including Clouded leopard (*Neofelis nebulosa*), Marbled cat (*Pardofelis marmorata*), Flat headed cat (*Prionailurus planiceps*) and Colugo (*Cyanocephalus variegatus*). There is also a population of up to 25,000 Flying foxes (*Pteropus vampyrus*). A total of 187 bird species, including Totally Protected and Threatened species such as all eight species of hornbill found in Borneo, Great argus pheasant (*Argusianus argus*), Lesser Fish eagle (*Ichthyophaga humilis*)) and Bornean bristlehead (*Pityriasis gumnocephala*) have been recorded (Rahim et al 2007).

The lake supports the Oriental darter (*Anhinga melanogaster*). The diversity of birds in the PSF was significantly lower than that of the neighbouring fruit orchards or Mixed Swamp Forest. Thirty-four reptile species have been collected from the Park. Globally threatened species recorded include False gharial (*Tomistoma schlegelii*), Reticulated python (*Python reticulatus*) and Biawak (*Varanus salvator*). Twenty-three amphibian species have been collected from the Park. However a generation of stream-dwelling frogs is believed to be extinct as some of the streams sampled did not have any tadpoles that graze on algae on the rocks as silt covered these rocks. Seventy-one fish species from 22 families were found in Park area. The exotic Biawan (*Helostoma temminckii*) is the dominant species in the lake.

7.4.9 Socio-Economic

Local communities can be found within as well as adjacent to the LBNP. Settlements of three major ethnic communities, the Berawan, Iban and Penan, are located either within the Park (Rh Riang Jangit, Rh Low Belaun and Rh Loagan Bunut occupy land within the Park's western boundary) or close to its demarcated boundary. Table 7.8 shows the 14 longhouses or villages are located in or around the Park.

Table 7.8 Longhouses or villages located in or around Loagan Bunut National Park

No.	Settlement Name	Ethnic group	Location	Population/ (No. of households)
1	Rh Kajan Sigeh	Berawan	Long Teru	400 (57)
2	Kg Loagan Bunut	Berawan	LBNP	166 (25)
3	Rh Ramba	Iban	Nanga Lait	200 (18)
4	Rh Linggi	Iban	Ng Majang	108 (18)
5	Rh Riang Jangit	Iban	Telungan	60 (15)
6	Rh Low Belaun	Iban	Lapok	50 (9)

7	Rh Umping	Iban	Lubok Mulung	184 (23)
8	Rh Junggang	Iban	Long Ajoi 1	128 (17)
9	Rh Nulpang	Iban	Long Ajoi 2	30 (6)
10	Rh Bris	Penan	Lapok	123 (22)
11	Rh Paking Idoi	Penan	Long Malingam	148 (28)
12	Rh Galau Upau	Penan	Bukit Limau	NA (22)
13	Rh Peberi Megilit	Penan	Sg Menok	NA (NA)
14	Rh Mat Pasu	Penan	Bukit Jelutong	NA (12)

Sources: Final MDA Report (2003); Preliminary Assessment Report (Socio-economic), report by Gabriel Tonga Noweg and Participatory Appraisal 1

Three categories of settlements exist from the perspective of Park administration and enforcement (Map 3):

i. A settlement (Rh Kajan Sigeh) considered indigenous to the area whose inhabitants have been granted privileges for conditional resource use in the Park (*Final Proclamation to Constitute the Loagan Bunut National Park*),

ii. Settlements considered indigenous to the area and located outside the Park along its northern and western boundary on the left bank of Sg Tinjar, but not granted privileges in the *Final Proclamation* (Rh Ramba, Rh Umping Awing, Rh Junggang, Rh Linggi and Rh Paking Idoi). These communities cultivate the levee areas along Sg Tinjar.

iii. Settlements whose inhabitants are considered to have recently migrated to the area, who were granted no privileges in the *Final Proclamation* (Rh Riang Jangit and Rh Low Belaun).

7.5 KLIAS FOREST RESERVE SABAH

7.5.1 Location and Extent

The Klias Peninsula is located approximately between the latitudes of 5° 10'—5° 30'N and longitudes of 115° 20'—115° 42'E. The plains are drained by three major river systems: Sg. Klias, Sg.Padas and Sg. Bukau/Api Api.The coastal plains fall within the District boundaries of Kuala Penyu and Beaufort. A large proportion of the remaining forested areas within the Klias Peninsula fall within the boundaries of existing forest reserves. Table 7.9 shows the major Forest Reserves in the Klias Peninsula including the Klias FR (KFR). The Klias FR has the status of a Class I protection forest, and was gazetted in 1984.

Table 7.9: Major Forest Reserves within the Klias Peninsula

Forest Reserve	Class	Area (square km)	Area (ha)	Major vegetation type
Sungai Binsuluk	Class I	122	12,196	Mixed peat swamp forest
Siaunggau	Class I	8	806	Mangroves, mixed peat swamp forest and G*ymnostoma* swamp forest
Klias	Class I	36	3630	Mangroves, mixed peat swamp forest and *Gymnostoma* swamp forest
Padas Damit	Class I V	90	9027	Mixed peat swamp forest
Kampung Hindian	Class I V	6	580	Mixed peat swamp forest and nipa swamps
Menumbok	Class V	57	5710	Mangroves
Nabahan	Class I V	3.6	356	*Gymnostoma* swamp forest, nipa swamps and mangroves

The Klias Forest Reserve (Figures 7.26 and 7.27) is the core area of natural peat swamp vegetation, which covers an area of about 10,000 ha. The area is part of the larger Klias peat deposit which has been estimated to cover approximately 60,500 ha.

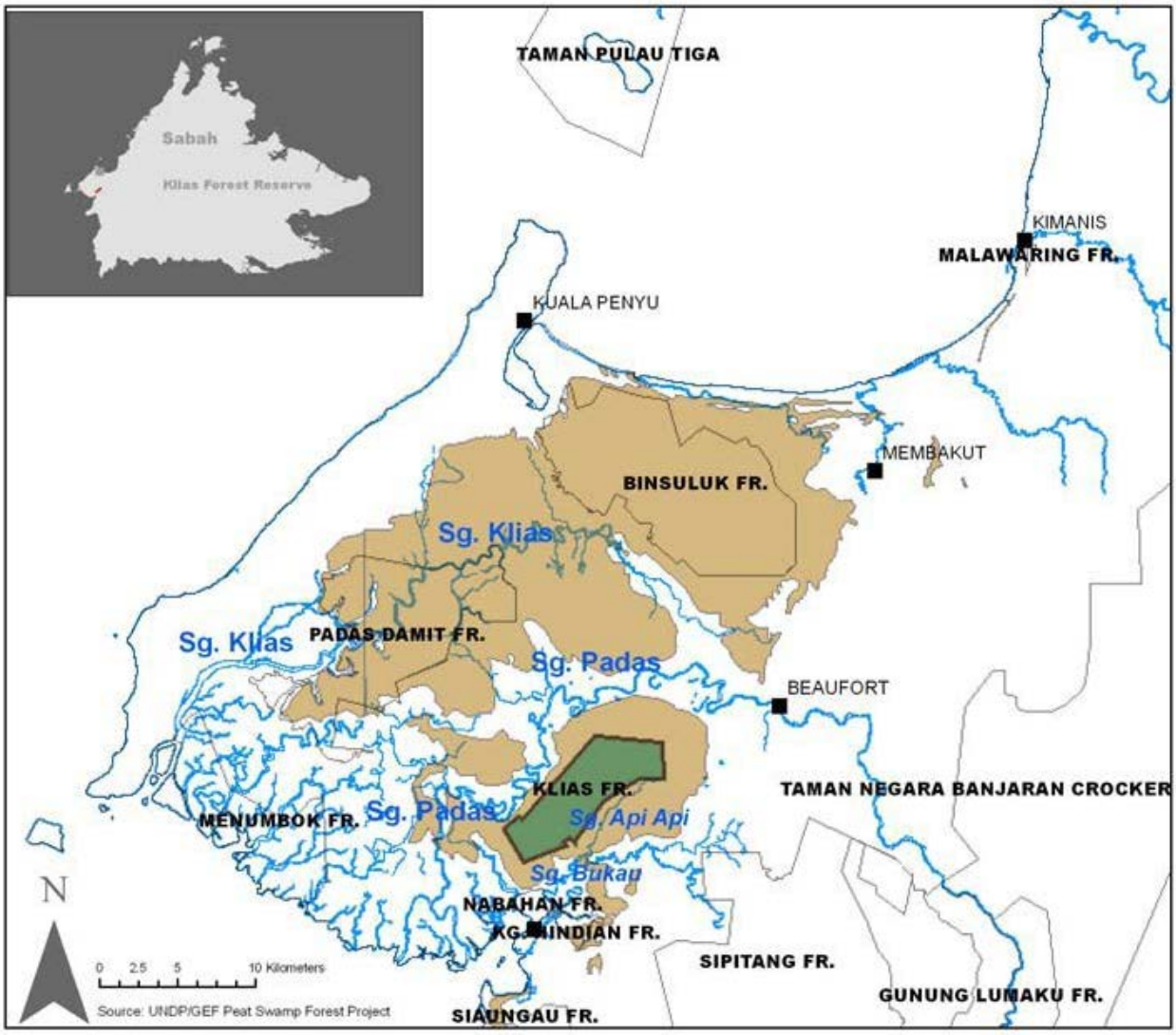


Figure 7.27 KFR and other Major FR and peat deposits within the Klias Peninsula

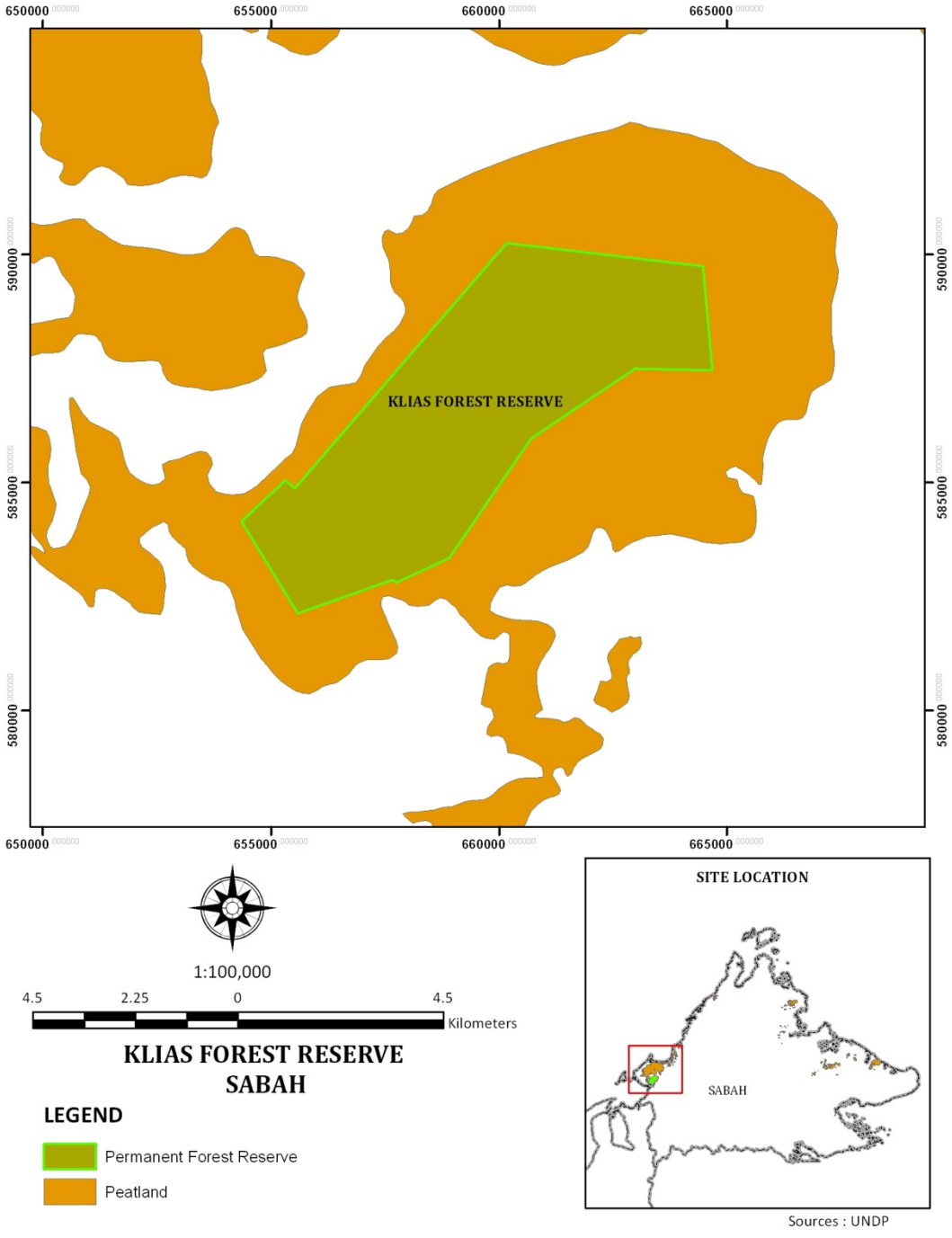


Figure 7.28 Klias Forest Reserve and peatland distribution surrounding it

7.5.2 Climate

The average rainfall in the KFR is relatively high, around 3,400 mm/year. The potential evaporation, based on standard pan observations, is estimated to be around 1,300-1,400 mm/year (Abdul Rahim et al, 2007).

7.5.3 Geomorphology

Soil map of the KFR and surrounding areas is shown in Figure 7.29.

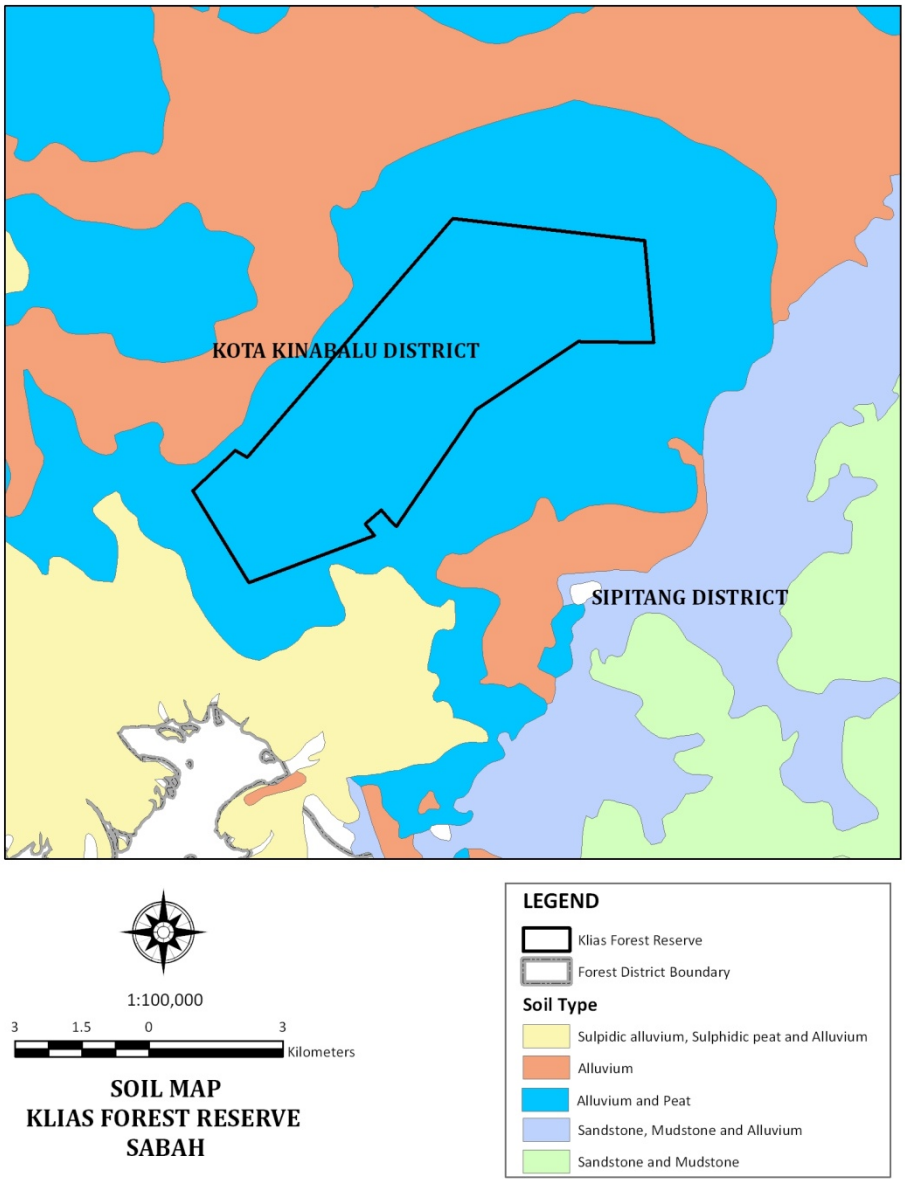


Figure 7.29 Soil map of the KFR and the surrounding area

7.5.4 Peat Formation and Characteristics

The Klias peat deposit is characteristically domed shaped, also referred to as lens shaped (Sabah FD, 2005). In this nature, the central part of the peat deposits is elevated compared to the edges of the swamp. The main peat deposit is at the northern end where the maximum height of the dome reaches 7.3 m above sea level (Sabah FD, 2005). Below sea level the peat deposits extends another 6 m in the centre, meaning that the maximum depth of the deposit at some location reach 12 – 13 m.

7.5.5 Land Use

Land use issues play a major role in the conservation of KFR. Since a majority of the communities are highly dependent on agriculture and fishing for income, land's increasing importance have led to exploration and development of forested areas; almost all of the forested areas in close proximity to village settlements have been surveyed for agriculture development, particularly for oil palm plantation. The majority of the communities in the area owned at least 3-5 acres of land. Figure 7.30 shows the land use map of the KFR and surrounding area. Main agriculture crops preferred by the communities include rubber and oil palm.

It was informed by the communities that scarcity of land has also caused illegal encroachment onto State land and FR areas by local communities. Pressured by the need for land resources to generate more income from agriculture, some communities have developed state land and forest reserves areas without prior legal permission and hope that once developed, the State government would allocate these lands to them in the future.

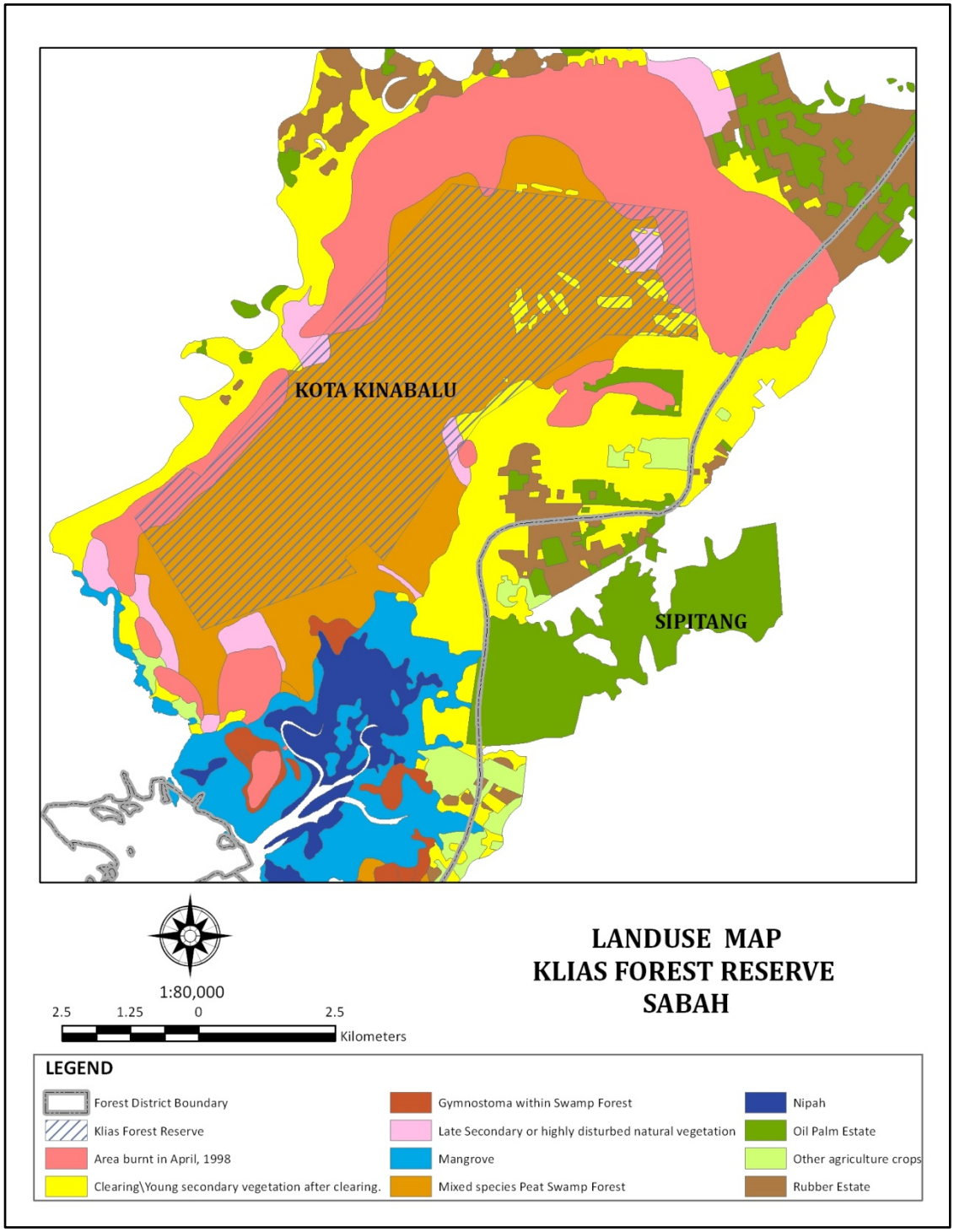


Figure 7.30 Land use map of the KFR and surrounding area.

7.5.6 Hydrology

The PSF in Klias is situated between the Padas River and the Bukau River, where the peat deposits stretches up to seven km wide and fifteen km in length. The Api-Api River dissects the peatlands and forms the eastern hydrological boundary of the peat deposit where Klias FR is located. Satellite image clearly showed old log transport canal which extends along the north-western boundary of the Forest Reserve for about 2/3 of the length. The canal is practically situated at the Forest Reserve boundary and was, a priory, expected to have a significant influence on the water level inside the KFR.

Also, a flood mitigation channel has been constructed from Sg. Padas and southwards to Sg. Api-Api, in practice constituting the eastern hydrological boundary of KFR. The same is the case for the south-western boundary, where Sg. Padas (at Kg. Suasa) has been connected to Sg. Nabahan by a 3 km long flood mitigation channel. This result in the relatively well defined of the hydrological boundaries of KFR as the log transport canal and rivers/channels more or less constitute a ring system around the forest reserve (Figures 7. 31 and 7.32).

It was reported that the water quality in Sg. Padas complies with the Class I requirements except for the sediment concentration. Water quality in the rivers is not expected to have a significant impact on KFR. This is supported by the fact that those tributaries coming from KFR all have typical peat drainage water properties. The hydraulic gradient is generally directed from the central part of KFR towards the boundaries following the dome shape of the Forest Reserve. Therefore, any pollution that would occur in Sg. Padas and/or Sg. Bukau/Api-Api will generally be prevented from entering KFR, since it would have to travel against the water gradient to do so. During periods of high flow/flooding from Sg. Padas into Sg. Bukau/Api-Api, pollution transport via the floodwater could temporarily affect a part of the Forest Reserve, however, only the fringes of the protected area would be affected (Abd. Rahim et al, 2007).

Figure 7.31 The hydrological boundaries of KFR

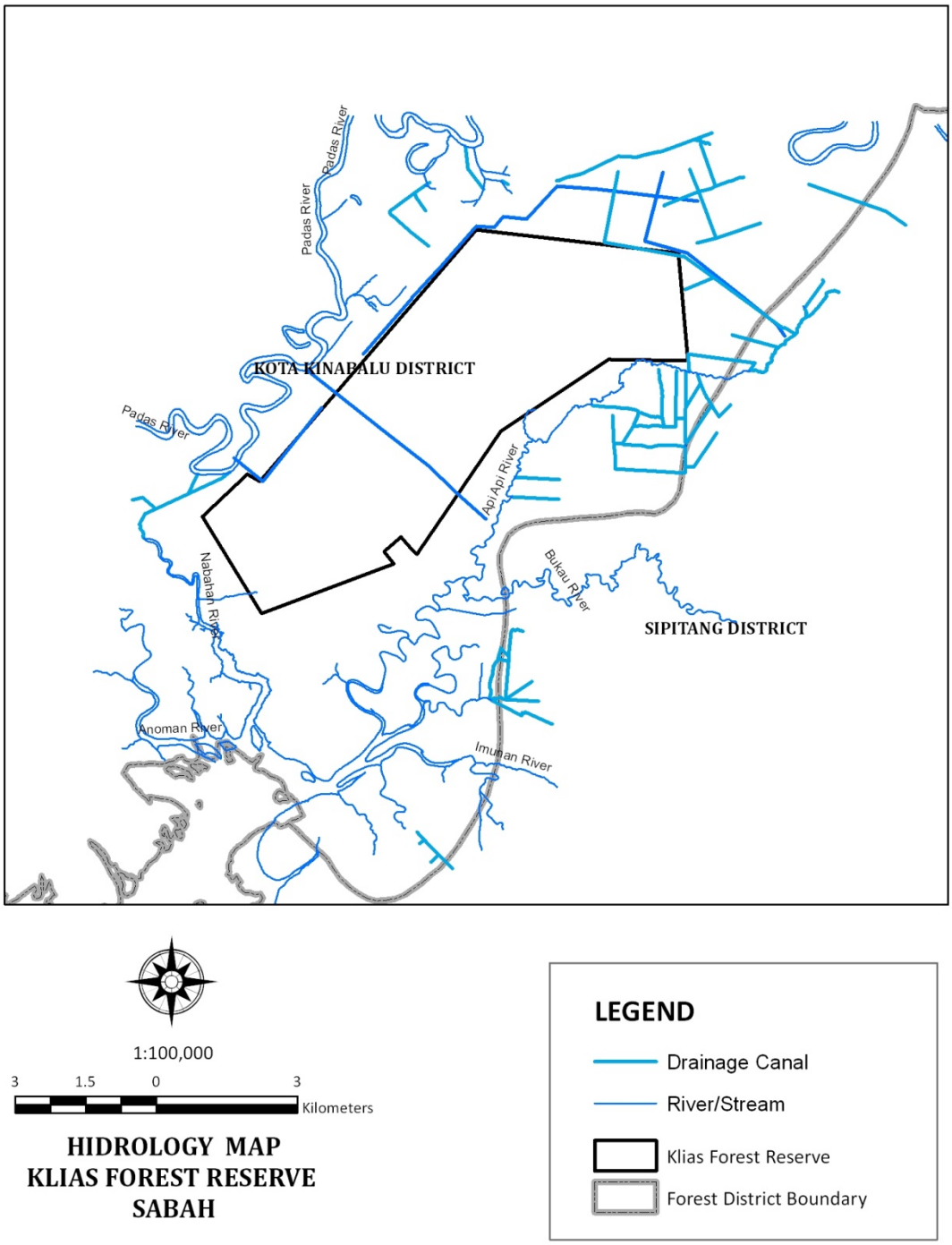


Figure 7.32 Hydrology map of Klias Forest Reserve

7.5.7 Vegetation

Together with five other forest reserves and the unprotected land of the Klias Peninsula, KFR constitute a complex of diverse habitats; mangroves, nipah swamps, fresh water swamp forests, secondary dryland forest, peat swamp forests and kerangas (white sands). This landscape mosaic sustains a considerable biodiversity, despite each forest type not necessarily being very diverse in itself (compared to other lowland forest). KFR itself mainly consists of mixed swamp forest in different stages of regeneration after various disturbances, the main incidents being felling in 1962-64 and the wildfires in 1998 and 2003.

The mixed swamp forest of KFR displays what is likely a disturbed forest structure with originally four strata: large emergent trees, a middle and understorey tree layer, and an herbal layer. The disturbance may date back to the years 1962-64, where felling took place in the area, and now shows as a more homogenous stands of even-aged trees without emergent trees.

It was reported that a total of 140 plant species from 58 families have been recorded in KFR, among which were a population of Kapur paya (*Dryobalanops rappa*), a Bornean endemic of peat swamp forests (Abd Rahim et al, 2007). This tree species is in Sabah confined to the western part of the state, and the peat swamp forests of eastern Sabah have a very different floristic composition. Also, *Hopea pentanervia* and *Shorea smithiana* were found, both Bornean endemics as well.

7.5.8 Fauna

For fauna, the species diversity is characteristic of peat swamp forests, with generally fewer, but more specialised species. The intact KFR support at least 66 birds' species and 11 mammal's species of which at least 22 are of conservation significance under IUCN. Besides Abd Rahim et al (2007) reported that there are two red-listed species encountered namely the Little Egret (*Egretta garzetta*) and proboscis monkey (*Nasalis larvatus*). The latter was not encountered in the Forest Reserve itself, but appeared on the southern riverbank of Sg. Nabahan at a consistent time of day during several survey visits to the area. Proboscis monkey is endemic to Borneo and has high global conservation significance (defined as Vulnerable – VU, by IUCN).

During night proboscis monkeys reside and sleep in trees adjacent to rivers. At dawn they generally move inland away from the river and return at dusk to the riverside. The importance of riverside habitat depends thus on adjacent habitat further away from the river, ensuring not only suitable sleeping sites, but also inland feeding areas. Most observations show that proboscis monkeys do not venture into agricultural lands, clearings, or villages, as well as areas lacking riverine vegetation or areas that comprise mainly tall grass and scrub. Shrinkage or fragmentation of habitats thus impacts the proboscis monkeys badly, and isolation of population groups impedes the long-term survival of the species.

7.5.9 Socio-Economic

The majority of ethnic communities living in Klias Peninsula comprise of Bisaya, Kadazandusun, Brunei, Kedayan, Dusun, Tatana, Murut and Bajau. These ethnic communities are mostly concentrated along the banks of the Sg. Klias, Sg. Padas, and Sg. Bukau/Api-Api Rivers, and along the main Kuala Penyu - Menumbok road. Ethnic Malay and Chinese communities are concentrated in larger settlements and towns such as Beaufort and Weston. Figure 7.33 shows the general locations of major villages surrounding the KFR. In general ccommunities surrounding KFR are concentrated in three main locations:

- Bukau / Api-Api area (South East of KFR)
- Padas Damit and Padang Taratak Area (West of KFR)
- Kota Klias and Binsuluk area (North of KFR)

A large proportion of the residents living around the peatland areas derive a living from agriculture and fisheries. Perennial and cash crops such as fruit trees, oil palm, rice and rubber provide the main sources of income. Fishing in freshwater rivers, coastal waters or in aquaculture ponds are the other main sources of income for villagers living in this area (Muhamad Saini 1998).

Generally, most of the communities residing in the areas surrounding the KFR are engaged in farming and fishing activities. Although the village communities are less dependent on the forests for their livelihood today, some communities still utilise nearby forests to log and hunt, as well as gather food and medicine on an occasional basis. With the perceived degradation of the (water) environment, the communities are gradually losing their source of income from fishing activities, and a higher dependency on agriculture has led more communities to request construction of drainage in the belief that this will relieve flooding problems in the area, and consequently improve crop yield.

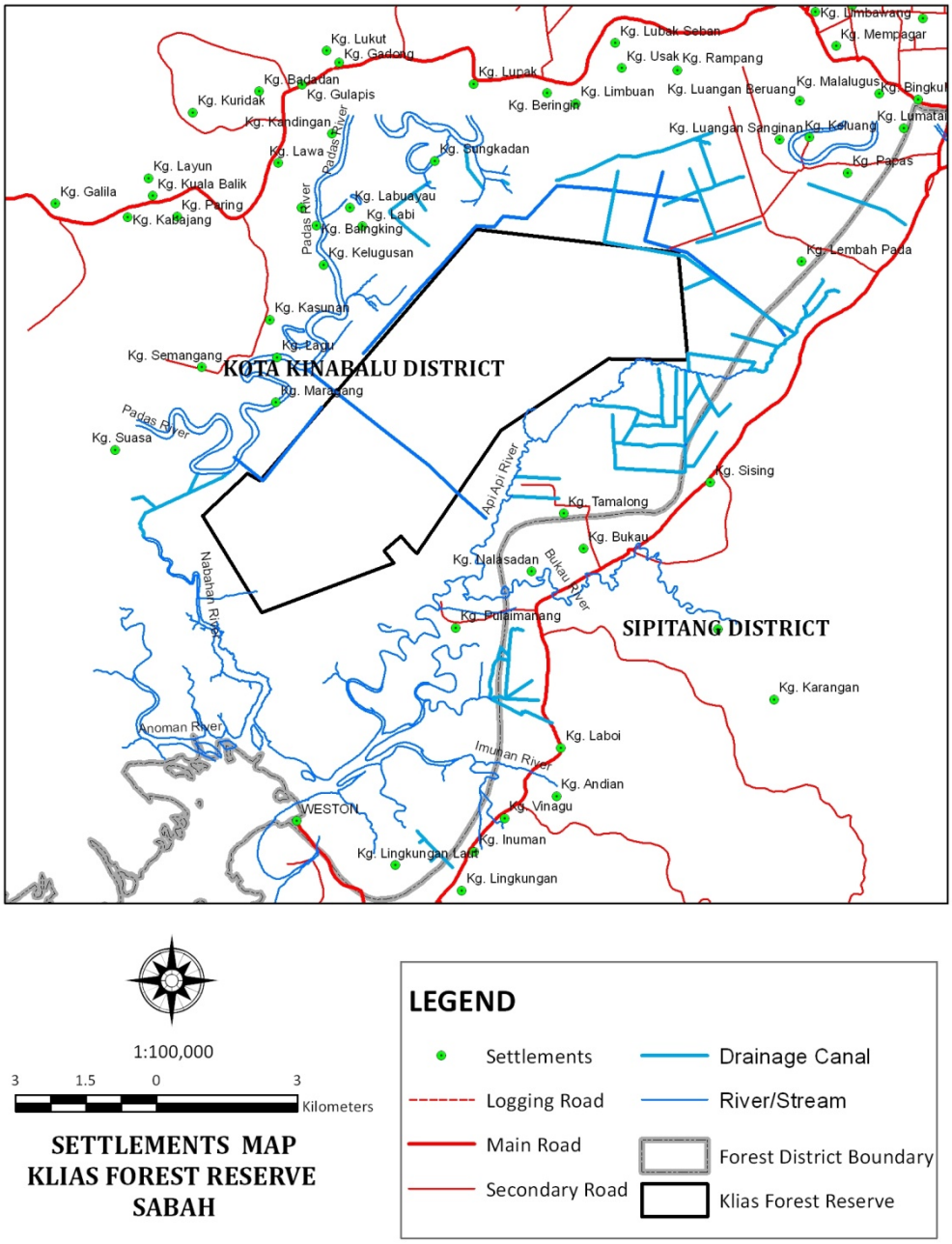


Figure 7.33 Distribution of human settlements surrounding the KFR

CHAPTER 8

8.0 PEATLANDS BEST MANAGEMENT PRACTICES

8.1 KUALA LANGAT FOREST RESERVE

8.1.1 Forest Management

The Kuala Langat FR is under the jurisdiction of the Pantai Kelang forest district office. As reported in the Selangor Forest Management Plan (2011 – 2020) the area has been categorised as Production forest and logging is allowed. However, no new logging licence has been issued as the state is putting more emphasis to manage the forest for conservation and protection purposes.

Forest management in this area face a huge challenge due to rapid land development activities surrounding the area. It is located close to agriculture land and constantly being threatened by illegal land encroachment for planting agriculture crops such as pineapple, tapioca, ginger, corn, sweet potato, and banana. Fire is another threat to the Kuala Langat FR. To overcome this, a proper forest management plan is require for management of this critical site and environment. In addition a continuous and frequent monitoring of the forest areas is required to protect the overall peat swamp forest ecosystem in the FR.

8.1.2 Agriculture on Peatland

Outside the forest reserve, most of the peatland in this area has been converted to agriculture crops. This include oil palm plantation in the Kg Busut Baru, Kg Bukit Cheeding and Kg Pulau Kempas Orang Asli settlements located near North Kuala Langat FR (Figure 8.1). A total of about 928 ha of land had been planted with oil palm in the three villages. To ensure a profitable return from the crop, the management of the oil palm plantation is being monitored closely by FELCRA and JAKOA.

Besides oil palm there are also other cash crops planted on peatland outside the Kuala Langat FR. These types of crops are normally planted by local villagers as a source of income. As an example, Mr. Zakaria a farmer from Sg. Kelambu village planted mix-crops on 13 acres of land rented from a local land owner. The crops include banana, sugar cane, cassava and vegetables including ladies fingers (Figure 8.2). The locations of some agriculture crops planted on peatland nearby Kuala Langat FR are shown in Figure 8.3.

Majority of agriculture crops can grow well in properly drained peatland areas. However, mechanization poses a major problem in most of the peatland. Again water management plays very important role as most agriculture crops have a very low flood tolerance and the water level has to be maintained at 0.30 to 0.60 m below the soil surface.

Figure 8.1 Oil palm plantation owned by the indigenous Orang Asli settlements near Kuala Langat FR

Figure 8.2 Agriculture crops planted by villagers on land adjacent to the Kuala Langat FR

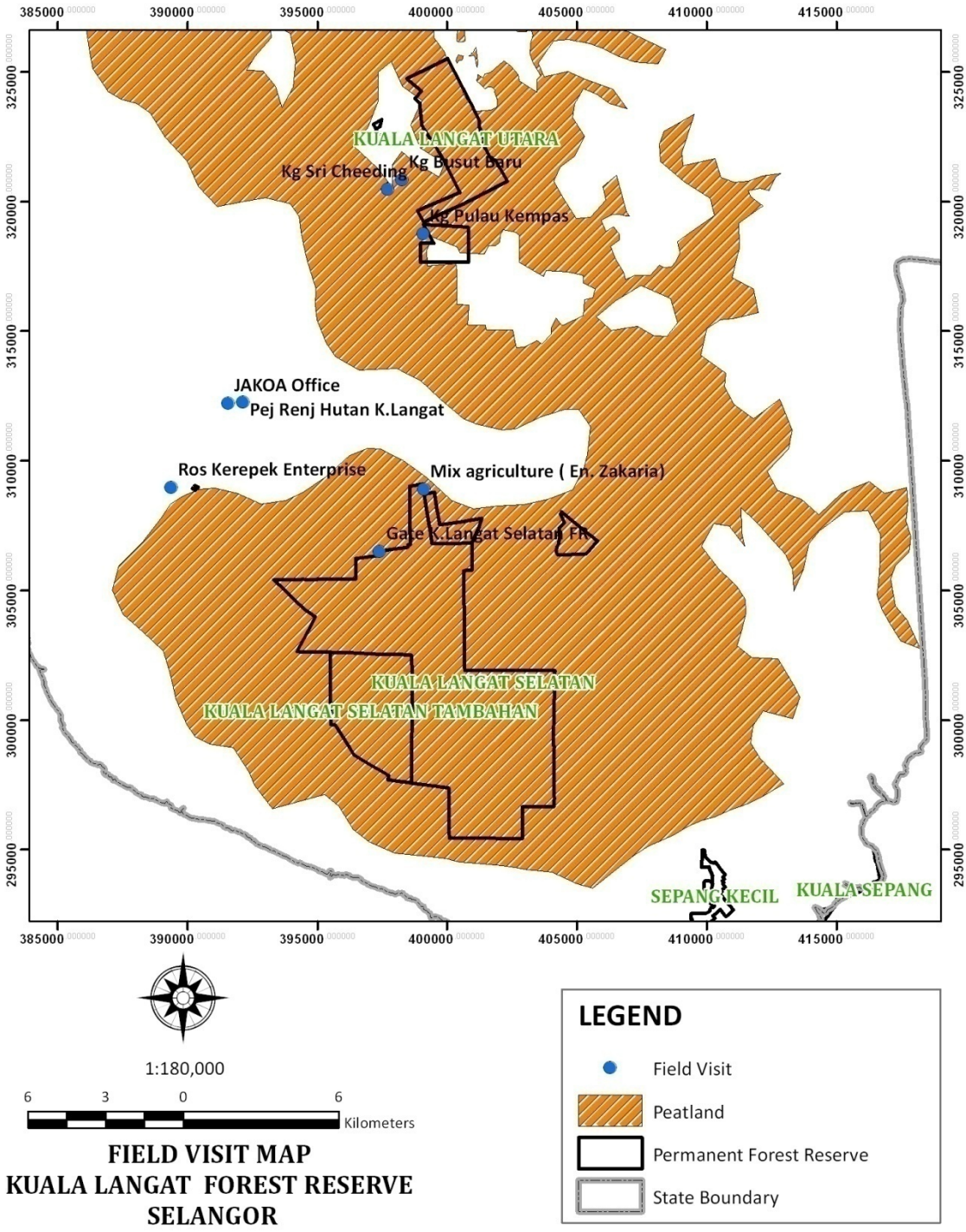


Figure 8.3 Map showing locations of oil palm and other agriculture crops planted on peatland near Kuala Langat FR

8.2 NORTH SELANGOR PEAT SWAMP FOREST

8.2.1 Peat Swamp Forest Management

The NSPSF which comprises of Raja Musa and Sungai Karang Forest Reserves with a total land area of about 73,660 ha is the largest peat swamp forest in the state of Selangor. It is also the largest remaining contiguous areas of peat swamp forest on the west coast of Peninsular Malaysia.

The area was a stateland forest prior to 1990/1991 and had been logged extensively and as a sequence the present condition of the forest can be considered as a regenerating forest. Logging in this area started way back in 1930s mainly using canals to extract timbers. After gazettement of the forest as Permanent Reserves Forest (PRF) in 1990/1991, more systematic logging based on Selective Management System (SMS) was used. In this system pre-felling inventory was carried out prior to harvesting and minimum cutting limits are prescribed; normally not less than 45 cm dbh. At that time a 55 years rotation period was used in the PSF.

Timber harvesting initially rely on the use of traditional kuda-kuda method in which logs will be hauled manually from the stump to small narrow gauge railways resulting to the less damage to the forest ecosystem. With times, timber harvesting become more mechanised and traxcavator and canal system was introduced. Canals are used for hauling logs from the forest to a river or road after which the logs will be transported to the sawmill. Compared to the traditional kuda-kuda method, canal logging system posed problem to the ecosystem due to the disturbance of the natural hydrology of the PSF.

The forest area is exposed to various threats including forest fire and encroachment for agriculture land. Efforts is being undertaken by the state authority to minimise the threats and rehabilitate back the degraded forest peat swamp forest areas through various activities involving not only the government agencies but also private companies, NGOs, and local communities.The Selangor State Government through the Selangor State Forest Department, is also in the process to strengthen the protection and conservation of the NSPSF by implementing various major actions include removing illegal agriculture activities, blocking drainage ditches to increase the height of the water table height, as well as replanting of forest trees under the rehabilitation programmes. The state is also studying alternatives as well as ways to shield the forest from the pressure of surrounding agriculture activities that threaten to encroach and further degrade the forest reserve.

In 2008, the Selangor State Government has set a moratorium of 25 years of no logging activities in the PRF resulted in no licence for harvesting will be issued including in the NSPSF during that period. As such currently management of the forest areas focuses more on the rehabilitation and conservation related activities.

The current on-going APFP project initiated in 2009 which focused at NSPSF as the pilot study site is part of the state government initiatives together with Forestry Department Peninsular Malaysia (FDPM) as the National Project Executing Agency to improve the management of the remaining PSF in this area. The APFP Project is aimed at sustainable management of peatlands in Malaysia to address peatland degradation particularly peatland fires and their associated haze, as their impacts can be detrimental to the environment, health and socio-economics in the country. To address this issue, the project focuses on the sustainable use and rehabilitation of degraded peatlands, particularly in the State of Selangor, through capacity building, fire prevention and control, local community participation, private sector partnership and demonstration of best management practices.

8.2.2 Community Participation Project

In December 2008, GEC and the Selangor State Forestry Department started a partnership to rehabilitate part of NSPSF through the community-based rehabilitation programme. The programme aims to protect and rehabilitate up to 1000 ha of degraded areas along the borders of Raja Musa FR. In December 2010, a collaborative agreement (MOU) was officially signed between Selangor State Government and GEC. Under the MOU, GEC is to provide technical assistance to the Selangor State Forestry Department in areas and facilitate community and corporate partnership related to peatland management and conservation for an initial period of 3-years. The Selangor State Government through its various agencies has played an active role implementing the collaborative programme in the rehabilitation of PSF.

The rehabilitation programme started through a series of re-vegetation process and by replanting suitable pioneer tree species including *Mahang* and *Tenggek Burung.* Other species including *Mersawa Paya* and *Ramin* had also been planted at the project site.

Community based rehabilitation programme aims to promote local community ownership and participation in forest rehabilitation at Raja Musa PSF was initiated by GEC. Highlighting the awareness of peat swamp forest conservation issues and effectively sharing the importance of NSPSF to the public. Under the programme canal blocks have been put in drains in the edge of the forest reserve. Canal blocking has been undertaken inside and outside of the forest reserve to prevent further drainage of the area. In areas with good access, canal blocks were made using excavators. In other areas it was done manually by using bags filled with peat/sand and supported by mangrove poles. A total of more than 800 canal blocks have been put in drains in the edge of the forest reserve. GEC is now working with local communities to block drains outside of the forest area in the adjacent oil palm and agricultural land.

Fire prevention is considered one of the major aspects of the rehabilitation programme. Fire associated with land clearing and developments in adjacent areas are common and threaten the rehabilitation process. Monitoring the Fire Danger Rating System (FDRS) is taken on a daily basis. FDRS for peatlands was

developed by Malaysian Meteorological Department with input from Forestry Department and GEC. Patrols are undertaken from ground and from time to time using helicopters.

A society known as Sahabat Hutan Gambut Selangor Utara (SHGSU) was established by the local community with support of GEC. This provides a platform for the local community to be actively involved in various tasks required for the rehabilitation of PSF and the management of the buffer zone. SHGSU involving four communities currently which are Kg raja Musa, Kg Bestari Jaya, Kg Seri Tiram Jaya and Kg. Ampangan. Among SHGSU activities are raising forest tree seedlings to be supplied to the state government for forest rehabilitation programme in the degraded PSF (Figure 8.4). The SHGSU members also actively involved in promoting peat swamp forest as tourist attraction destination including providing homestays facilities and various packages such as boat cruising, fishing, kayaking and jungle trekking activities in the peat swamp forest (Figure 8.5). Another important contribution by the SHGSU members is their involvement in assisting the state authority to combat peat fire in the PSF (Figure 8.6).

The formation of community base association such as the SHGSU definitely will give advantage to the state authority in the effort to properly manage the fragile peat swamp forest. The community which resides close to the PSF can be regarded as the front linear that will be the first to be alerted if there is something happening to the PSF such as forest fire. Hence, their participation and involvement in managing the PSF should be encouraged by the authority. What has been shown by the SHGSU in NSPSF is another notable example of best management practices of peatland management in this country in relation to the community participation and involvement.

Figure 8.4 SHGSU member involve in raising forest seedlings for forest rehabilitation programme

Figure 8.5 Tourist package including water activities (boat cruising, fishing and kayaking) and jungle trekking activities in the peat swamp forest (behind)

Figure 8.6 SHGSU is voluntarily helping the authority to combat peat fire at NSPSF

8.3 SOUTH EAST PAHANG PEAT SWAMP FOREST, PAHANG

The SEPPSF which comprises of four main FRs have been gazetted as production forest to be managed for both sustainable timber production and conservation of biological diversity. The recently concluded UNDP-GEF Project (2002 – 2007) carried out by FRIM and the Pahang State Forestry Department had successfully demonstrated how integrated management of the PSF can be achieved with the active involvement of various stakeholders. This has been highlighted as of one the best management practice of production forest of the PSF in this country.

8.3.1 Integrated Management Plan (IMP) of SEPPSF

In order to promote the conservation and sustainable management of peat swamp forests, the Malaysian Government with the assistance of United Nations Development Programme and Global Environment Facility (UNDP/GEF) had successfully conducted a project entitled *"Conservation and Sustainable Use of Tropical Peat Swamp Forests and Associated Wetland Ecosystems"* (Abd Rahim et al, 2008). The Project started in 2002 and completed in 2007 in three different locations namely the Loagan Bunut, Sarawak, Klias Peninsular in Sabah and South East Pahang Peat Swamp Forest (SEPPSF) in Pahang focusing on three main objectives and six main outputs. The objectives were to:

a) demonstrate the necessary steps in planning for biodiversity conservation and sustainable resource utilization in peat swamp forests

b) demonstrate the implementation of biodiversity conservation and sustainable resource utilization strategies in peat swamp forests

c) To strengthen institutional and human technical capacities and awareness

The six outputs were:

a) Output 1: Data collection and setting up of a monitoring programme and information management system to facilitate management and decision-making,

b) Output 2: Well-formulated site management plans, addressing issues such as biodiversity, physical functions and sustainable use,

c) Output 3: Conservation and sustainable use of peat swamp forest ecosystem resources and functions demonstrated,

d) Output 4: Inter-agency networks at State level to integrate biodiversity overlays into development planning on peatlands,

e) Output 5: Decision-makers, communities and other stakeholders better aware of the importance of conserving peat swamp forests and associated wetland ecosystems,

f) Output 6: Strengthened institutional and human capacities to conserve and sustainably manage biological diversity in peat swamp forests and associated wetland ecosystems.

As indicated above, one of the main outputs (Output 2) of the project is well-formulated site management plan addressing issues such as biodiversity, physical functions and sustainable use. In the case of SEPPSF Project area, this specifically referred to the Integrated Management Plan (IMP) which articulates the aspects and actions which are critical to the long-term survival of the SEPPSF ecosystem.

The SEPPSF project area is located in Pekan District, in the state of Pahang and is by far the largest intact PSF area (160,000 ha) in tropical Asia. Over half of the area is located within four Permanent Reserved Forests (PRF). Approximately 80% of the PRF is still pristine peat swamp forest whereby most of the stateland forests have been harvested and are undergoing various stages of succession. Due to the growing pressures of land uses in and around the area, an integrated management plan was prepared to facilitate the management of the forests by the state government.

The SEPPSF IMP comprises of various recommended actions to address ecosystem threats affecting sustainability of the peat swamp forest. The IMP was developed with the full support and co-operation of the Pahang State Government and after a lengthy process of consultation with no less than 11 state agencies, local communities, NGOs and a broad range of stakeholders. The objective of integrated management planning for the area is to ensure biological diversity conservation, and sustainable use of forest resources while maintaining its ecological integrity and hydrological functions. The four PRFs in the SEPPSF have become fragmented and the land conversion has progressively reached the boundary of the forest reserves. Hence, the reserves cannot be managed in isolation of the land use surrounding it. Furthermore, various forms of land use surrounding the intact reserves now threaten the hydrological balance and the ecological integrity of the area. In this respect an attempt was made to integrate management through a multiple stakeholder consultative effort recognising, and focusing on, the need to maintain ecological integrity of the area.

In developing the IMP, a multi-tier approach was initiated through two major stages of consultation: core and broader planning processes. The Project facilitated the process by providing, among others, data, maps, technical knowledge and help in synthesing the various views expressed by the stakeholders. This participatory method provided the avenue for both the “bottom-up” and “top-down” management approaches. The core planning process featured the establishment of the Management Plan Core Team

(MPCT), which developed the draft IMP, while the specialists served as rapporteur. The Core Team comprised representatives from eleven state government agencies including the Department of Land and Mines, State Economic Planning Unit, Pahang State Forestry Department, Department of Agriculture, Department of Drainage and Irrigation, Department of Town and Country Planning, Pekan District and Land Office, Pekan District Council, Department of Orang Asli Affairs, Department of Wildlife and National Parks, and Department of Environment. The Core Team also compiled all relevant data and information; identified key issues, recommended intervention measures, capacity requirements for implementation of the management plan. These recommendations were subsequently forwarded to the respective agencies. The participation of the various state agencies in the planning process enables greater awareness and fosters greater commitment to implement the plan.

Broader stakeholder consultations were undertaken among other relevant agencies; NGOs and private sector, particularly the oil palm companies; and the local communities. The consultations addressed the different needs of the respective stakeholders. An independent communications specialist/sociologist was engaged to assist in facilitating the consultations and to ensure that relevant inputs from the various stakeholders were accommodated in the IMP. The consultations focussed in identifying the essential elements of the IMP. Thirteen Core Team meetings were held during the 16-month preparation of the IMP. The meeting also served as a learning forum, allowing for the establishment of a stronger partnership among the different agencies, thereby enhancing coordination.

The challenge in integrated management is to minimise further impacts through affordable mitigation measures and ensure that land development and stateland logging is controlled ensuring hydrological conservation. The bottom line is one of wise multiple-use supported by sustainable management principles. The balance between use and conservation of the forest reserves is of critical importance. Complete preservation of the forested area will not receive full political commitment; rather in reality, the sustainable management which combine economic, social and environmental aspect will further enhance the conservation and maintain the current delicate hydrological balance of the area.

The management prescriptions in the plan was categorised into enabling macro and time specific actions. The enabling macro actions are based on the broad strategies of firstly consolidating the spatial biophysical component, followed by the administrative and management framework necessary to promote sustainability.

There were two sets of management actions in the SEPPSF IMP. A set of management actions that need to be considered and initiated during the life span of the UNDP/GEF until the end of 2007 and another set of actions over a long term period of 10 years ending in 2015. There were a total of 53 short term management actions (2005-2007). This first set of actions stresses the importance of implementing the actions which are meant to initiate the structure management of the site through multi-stakeholders management synergy. The following 45 medium term actions (2006-2015) subsequently will decide which of the actions need to be followed through as a long term management effort.

8.3.1.1 The management zones

The SEPPSF IMP formulated indicated that for successful management, the SEPPSF had been zone as shown in the Figure 8.5. The SEPPSF has been divided into six proposed management zones which contain different types of sub-ecosystems in a matrix of varying land use. The zonations of the SEPPSF are shown in Table 8.1 below:

Table 8.1 The different management zones for the SEPPSF area

Zonation	System
Zone 1	Permanent Forest Reserves (a) Production forest (b) Protection forest
Zone 2	Proposed Forest Reserve extensions
Zone 3	Forest Reserve buffer (1 km)
Zone 4	Riverine Reserve (200 m on both sides of Sg. Merchong and Sg. Bebar river banks - excluding zone 1 and 2)
Zone 5	Degraded and logged stateland peat areas
Zone 6	Developed and alienated peat land

Zone 1 comprises the four forest reserves located in the core of the project area, namely the Pekan, Kedondong, Nenasi and Resak Forest Reserves. The primary threats are external development activities adjacent to the forest reserves including uncontrolled stateland logging operations and agricultural development with high density of drains and canals construction.

Zone 2 is the proposed forest extension located in between the forest reserves with the aim of creating connectivity between the four forest reserves. It consists of isolated patches of degraded dry forest, degraded peat swamp forest, associated freshwater swamp forests, grasslands and open water. The two major rivers located in this zone are Sg. Bebar in the north and Sg. Merchong in the south. This area is constantly threatened by secondary hazards such as fire and agro-chemical pollution primarily due to land clearing by localised and upstream agricultural activities. Most importantly, the zone has a major hydrological impact on the forest reserves as it contains old logging canals.

Zone 3 is the 1 km wide zone of stateland buffering the forest reserves. This zone consists of both pristine and degraded peat swamp forests surrounding the four forest reserves. It provides primary access into the

more complex and diverse peat swamp forest in the reserves, resulting in uncontrolled and over collection of forest resources by the local communities for sustenance and commercial purposes. This zone also experiences the same threats as in Zone 1 and 2.

Zone 4 is the proposed 200m of river reserve on both major river banks of the Sg. Merchong and Sg. Bebar in areas outside the forest reserves and Zone 2. Its primary objective is to protect the upper reaches of both rivers where development is planned. The ecosystem of this zone varies from developed areas to degraded dry forest; degraded peat swamp and undisturbed peat swamp forest, and most importantly associated freshwater swamps.

Zone 5 is degraded peat on stateland and mangrove forests that is yet to be developed for agriculture. This zone plays an important role as sanctuary for many species of flora and fauna and also for hydrological conservation of the project area as it forms a major component of the SEPPSF system. The major threat to Zone 5 is unplanned and uncontrolled development which will impact the intact and relatively undisturbed forest reserves. The impact would be hydrological in nature. The potential threats such as fire and over-drainage are generically the same for zones outside the forest reserves.

Zone 6 consists of peat land which have been developed and alienated in the past due to agricultural development pressure in the SEPPSF. This zone is dominated by oil palm plantations, horticulture, rice fields and urban and rural settlements. The developed areas adjacent to the swamps, which are within deeper peat areas, pose a threat and thus would require management intervention. The principal threat is from the larger oil palm plantation holdings' conventional management practices, which includes field drains systematically placed to lower the water table, pesticide application, fertilizer application and land clearing using fire.

8.3.1.2 The Management Actions

As prescribed in the SEPPSF IMP, there were two sets of management actions namely the short-term actions that considered and initiated during the life span of the UNDP/GEF (2005 – 2007) project and a medium-term management actions over a period of 10 years (2006 – 2015). The first sets of actions serve to establish a firm management base to allow the subsequent medium term actions to be initiated. There were altogether 53 short-term management actions proposed. Subsequently there were 43 management actions that had been categorised as the medium-term management actions.

A mid-term review was undertaken by an independent consultant in 2011 to gauge and assess the progress of the IMP implementation. The mid-term review report stated that as of 2011 about 96% of the planned short-term management actions had been successfully implemented albeit some not according to the planned time schedule (Pahang FD, 2011). As for the medium-term management action about 80% of the planned actions had been implemented. In general at that time only two management actions planned in the short-term management actions category has yet to be carried out. Major constraints leading to the unimplemented of those management actions were due to the unavailability of financial support.

Appropriate actions have been proposed by the reviewer to overcome the problems as indicated in the mid-term report.

One of the most significant achievements in the implementation of the short-term management actions was on the gazettment of proposed additional forest reserves connecting the initially fragmented four forest reserves. A total of 13,251.2 ha of formerly degraded state land peat swamp forest had been successfully gazetted according to the planned schedule of the IMP (Table 8.2).

Table 8.2 Information on the new additional Forest Reserves gazetted in SEPPSF

	Forest Reserve	Area (ha)	Date of gazettment
a	Hutan Simpan Pekan (Tambahan) (PW 3778)	31.2	23 Nov 2006
b	Hutan Simpan Pekan (Tambahan) (PW 3869)	4410	28 Feb 2007
c	Hutan Simpan Nenasi (Tambahan) (PW 3869)	4750	28 Feb 2007
d	Hutan Simpan Nenasi (Tambahan) (PW 3869)	390	28 Feb 2007
e	Hutan Simpan Resak (Tambahan) (PW 3869)	3670	28 Feb 2007
Total		13,251.2	

Another achievement regarding the SEPPSF IMP implementation is related to the formulation of the Voluntary Carbon Offset Scheme (VCOS) programme. During the project UNDP-GEF had appointed a consultant to develop a Rehabilitation Master Plan for the newly gazetted degraded Forest Reserve Extension between the four FRs. The Master Plan document had been refered and used in determining suitable degraded areas for rehabilitation program under the VCOS programme initiated by the Ministry of Natural Resources and Environment working together with Malaysian Airline System, FRIM and Pahang FD. The VCOS programe is currently being coordinated by the Ministry of Natural Resources and Environment and executed by the Pahang Forestry Department and assisted by FRIM. In 2001 a total of RM 180,000.00 had been collected under the VCOS fund to be used for PSF rehabilitation related activities.

The SEPPSF IMP implementation and the management of the peat swamp forest reserve in the SEPPSF is further strengthened with the preparation of SEPPFS Forest Management Plan for 2008 - 2018. The need to have such a plan was recognised and suggested in the IMP following which a consultant was appointed by UNDP in 2007 to prepare the plan. The plan was ready, accepted and endorsed by the Pahang FD in 2008.

The Pahang FD as a leading and responsible agency in the SEPPSF IMP implementation is continuously monitoring the SEPPSF using IMP as a guide. The Wetland Management Committee established as part of the project output also regularly monitor any development activities in the SEPPSF.

8.3.1.3 IMP Impact and Best Management Practice

The IMP implementation in the SEPPSF is considered as one of the best management practice for PSF. The following are highlighted of some selected features of the IMP implementation and its impact.

a) Maintenance of physical functions – ecological integrity

Ecosystem fragmentation has been identified as a major threat to the SEPPSF biodiversity and it will remain so in the future. The SEPPSF is also under pressure from land development along the east coast and increasing demand for land conversion. Gazettement of new forest reserves as one of management action in the IMP helps in connecting the fragmented peat swamp forests. With the new gazettment of forest reserve (about 13,251 ha) it has promoted the prevention of further forest conversion, expansion of conservation areas, adoption of buffer areas and corridors in order to safeguard the ecosystem integrity of the remaining peat swamp forests.

b) Enhanced the conservation of biological diversity

Throughout the UNDP-GEF Project and the IMP implementation phase, resources in the SEPPSF including the biological diversity had been compiled and documented. The availability of this information helps the state authority in making proper planning to conserve the biological diversity of the SEPPSF.

c) Adoption of Forest Zonation in the SEPPSF by the State Authority

Zonation under the IMP of the SEPPSF has been very useful as a strategy to isolate potential threats to the ecosystem sustainability and to reduce stresses from external and internal anthropogenic activities. Appropriate management actions selected to manage the areas and accommodating the various stakeholder interests had mostly been successfully undertaken. The IMP management actions developed through consultative planning process enhanced the stakeholders understanding of the ecosystem approach concept in managing the peat swamp forest and streamlines the different state agencies perceptions on the best management options of the peat swamp forest resources.

d) Rehabilitation strategy for the degraded peat swamp forest

The acquisition of additional areas as green corridors connecting the fragmented forest reserves included degraded forest areas which need to be rehabilitated. The rehabilitation work is to be coordinated by the Pahang FD and an initiative had been taken under the VCOS programme to get private companies such as Malaysia Airline System (MAS) and partners to participate in the rehabilitation works. It is anticipated that more private companies will participate in the near future.

e) Improvement of sustainable timber harvesting practices

Realising the need to have various guidelines for timber harvesting as highlighted in some of the management actions of the IMP, the Pahang FD with assistance from the UNDP project had developed various guidelines for the SEPPSF including the Agriculture Development and Management Guideline for peat land, the State land Logging Guidelines, and the Reduced Impact Harvesting (RIL) Guidelines for the SEPPSF. At the same time results of the FRIM cutting regime study also contributed to the improvement of the current silvicultural practices in the peat swamp forests. Together all this management actions had resulted in the availability of proper guidelines for peat swamp forest harvesting which will minimize the impact of forest on the residual stands and forest floor. For instance the RIL guideline serves as a manual for operations including timber harvest planning, production supervisions, road network design, and timber transportation in the production forest.

f) Enhanced knowledge of peat swamp forest eco-systems

The management actions prescribed in the IMP contributed immensely to the enhancement of awareness and understanding of the SEPPSF through effort to share and widely disseminate findings and knowledge regarding the flora and fauna species diversity as well as other aspects of the peat swamp forests ecosystem.

8.3.1.4 Conclusion

From the mid-term review, it reveals that the multi-agencies coordination during the IMP implementation is functioning very well. The implementation of the IMP management actions received encouraging response, reflected in the accomplishment of most of the short-term and medium-term management actions prescribed in the IMP document. The participatory approach in making of the IMP promoted a sense of ownership over the plan among the stakeholders particularly the state agencies and this facilitated the coordination and implementation of all IMP management actions.

Overall the IMP was well planned and the management actions are implementable. It main strengths rely on the consultative process undertaken in preparing all the management actions with the involvement of 11 state agencies. It has been presented at various level of consultation process including to the government agencies, local communities, private sectors (plantation owners) as well as NGOs. Hence all aspects had been taken into consideration in planning the management actions and they are doable. The most important aspect was that the IMP was presented and endorsed by the state Executive Council (EXCO) which reflected the state commitment in supporting the implementation of the IMP. All this factors reflected the strength of the IMP and hence facilitated a lot in the implementation of the management actions.

The IMP is an important document being used as a guide for the sustainable management of the SEPPSF complex. Even though it has been more than five years since the completion of the UNDP project, the IMP

is still being referred by the state authorities in any development activities to be carried out within or surrounding of the SEPPSF areas.

Overall, the IMP implementation is regarded as being efficient and contributes to the goal of the management of the globally significant peat swamp forest (PSF) of the SEPPSF for both conservation and sustainable use. The implementation of the IMP is in line with the sustainable forest management (SFM) practices adopted by the Forestry Department in the state of Pahang and in line with the Malaysia Criteria and Indicators (MC&I) requirements. It also in accordance with the National Policy on Biological Diversity and the National Forestry Policy, and also helps meet the country's obligations to the Convention on Biological Diversity (CBD) and the Ramsar Convention. Of significant is that with the IMP, the SEPPSF integrity is being preserved by consolidating existing Forest Reserves areas and, where possible, preserving and gazzeting connections between remaining state land peat swamp forest areas.

No doubt that the implementation of the SEPPSF IMP is something that can be showed case as one of the best management practice for landscape level PSF management in this country in line with the sustainable management concept of forest resources.

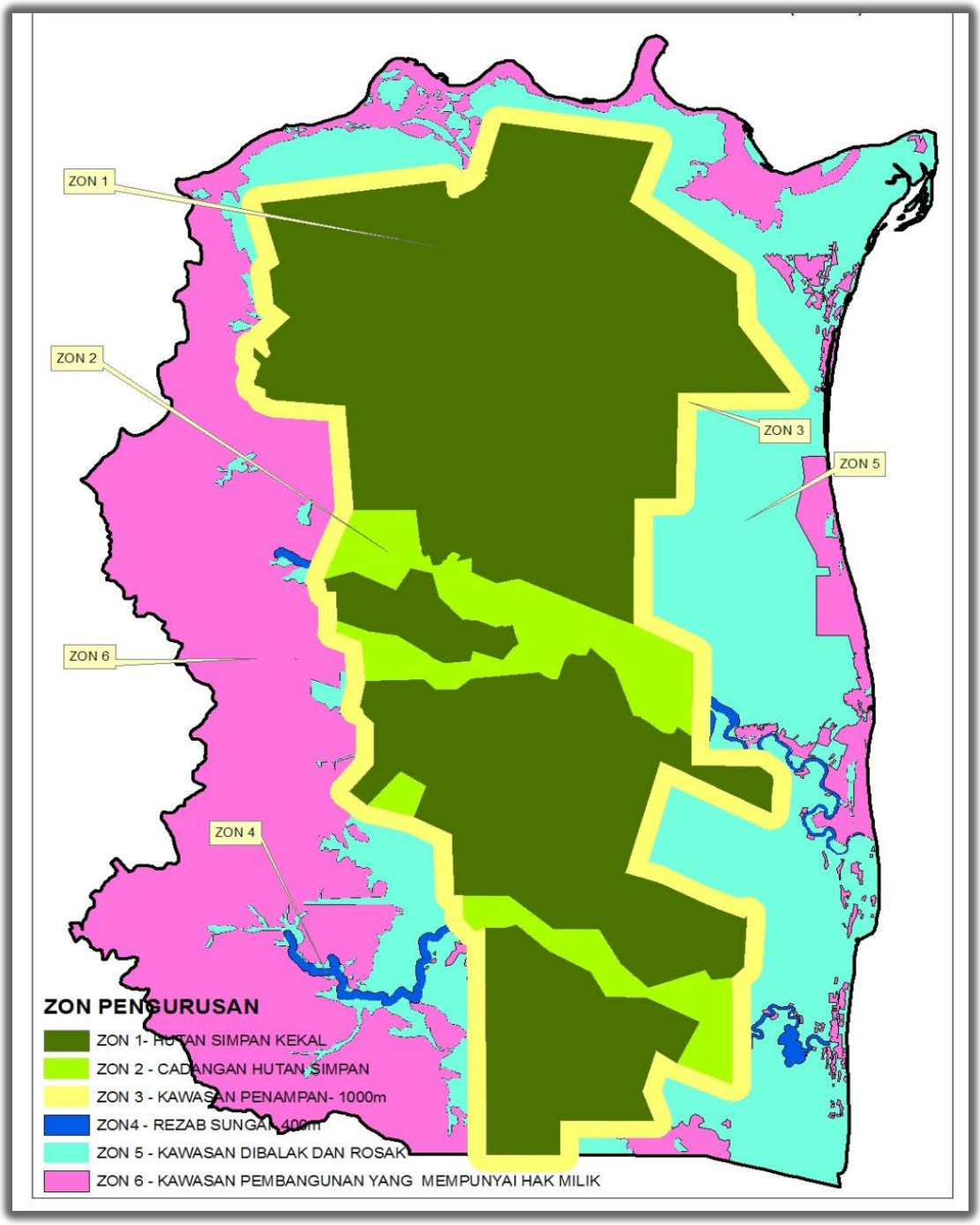


Figure 8.7 The six management zones of the SEPPSF. The entire proposed Forest Reserve (Zone 2) had been gazetted in 2007.

8.3.2 Reduced Impact Logging to Achieve SFM

As stipulated in the SEPPSF IMP document, the PSF reserves have been divided into two broad categories namely production and conservation areas. The production area is basically located at the eastern side of the SEPPSF complex (Figure 8.5), where as the western part is meant for conservation area. As a production forest, harvesting is permitted in the area but strictly to be based on the use of reduced impact logging (RIL) technique as indicated both in the SEPPSF IMP as well as SEPPSF Forest Management Plan (FMP) documents. The use of RIL during timber harvesting in the SEPPSF FR has been practiced after it was first introduced during the UNDP-GEF Project in 2002. This Section highlighted best management practice in relation to forest management particularly on timber harvesting in the PSF reserve in SEPPSF. The implementation of RIL in PSF is to ensure that the SEPPSF is managed in a sustainable manner taking into consideration biodiversity conservation and environmental stability besides economic gain.

8.3.2.1 RIL Guidelines

RIL can be defined as planned and carefully controlled tree felling to minimise its impact on the surrounding environment. RIL aims to help sustain the economic, social and environmental aspects of timber harvesting. Theoretically, RIL systems use an array of best harvesting techniques that reduce damage to residual forests, create fewer roads and skid trails, reduce soil disturbance and erosion, protect water quality, mitigate fire risk and potentially help maintain regeneration and protect biological diversity.

In the case of SEPPSF, only RIL is allowed to be used for timber harvesting in the FR. The UNDP-GEF Project had developed a guideline on how RIL should be used in the SEPPSF based on a Rimbaka RIL technique. The guidelines was published under the title "*Pengusahasilan Berimpak Rendah untuk Hutan Paya Gambut Tropika, Pahang Tenggara, Malaysia – Garispanduan dibangunkan dengan menggunakan teknik Rimbaka*" (Elias and Khali, 2008). The Guidelines were developed using Rimbaka technique and based on the current local available technology, site specific experiences and recorded practices in the field of SEPPSF. The scope of the Guidelines included pre-harvest activities, harvesting operations, post-harvest activities, RIL assessment, uniform safety standards and prescriptions which must be met or follow in any planned logging operations.

RIL techniques and guidelines are not fixed prescriptions, but adapt best harvesting techniques to existing biophysical and economic conditions. As such even though the UNDP-GEF Project had introduced RIL in SEPPSF based on Rimbaka technique, other RIL technique is still being allowed to be used by timber operators. Nonetheless the FAO model code of RIL forest harvesting which forms the basis for RIL system design which includes the following activities should be followed:

i. pre-harvest inventory and mapping of trees,

ii. pre-harvest planning of roads and skidtrails,
iii. pre-harvest vine cutting,
iv. directional felling,
v. cutting stumps low to the ground,
vi. efficient utilization of felled trunks,
vii. constructing roads and skid trails of optimum width,
viii. winching of logs to planned skid trails,
ix. constructing landings of optimal size, and
x. minimizing ground disturbance and slash management.

8.3.2.2 Pre-Harvest Activities

Harvesting Planning

Pre-harvesting activities consist of preparation of harvesting plans. Harvesting plan is one part of overall forest management planning, which is itself a component of comprehensive land-use planning or forest area zoning (timber production zone and exclusion zone).

Exclusion zone of PSF includes the following:-

i. Conservation and Protection Zone,
ii. Community Forests and Local Community Zone,
iii. Scientific Research Zone,
iv. Biological Diversity Conservation Zone,
v. Buffer Zone,
vi. Cultural area,
vii. Shorelines, lagoons, lakes and water storage areas, and
viii. Designated watercourses.

Harvesting plan consist of strategic plan, operational plan and task plan.

a) Strategic Plan

Strategic plan determines the harvesting system required for an entire Forest Management Unit (FMU). It should include the following:-

i. Identification and mapping of areas scheduled for harvesting,
ii. Identification and mapping of exclusion areas,
iii. Identification of areas to be set aside for biodiversity conservation,
iv. The future harvest areas and an approximate harvesting scheduling,
v. The approximate size and boundaries of each harvest area,
vi. Setting the maximum harvesting intensity per hectare,

vii. The approximate volume and types of timber to be produced from each harvest area,
viii. Future road requirements to access the harvest areas,
ix. The approximate road locations and road standards required, and
x. Sustainability criteria for continuity of regeneration.

b) Operational Plan

Operational plan is short-term in nature and associated with the annual coupe. They are called Annual Work Plan. This plan is prepared in a written verbal description of the action plan and on a large scale map (1:10,000, and 1:2,000). Operational plan shall at least contain the followings:-

i. Description of the harvest areas, location, block, sub-block, compartments and boundaries
ii. Forest's potentials,
iii. Excluded areas,
iv. Forest opening up plans,
v. Required harvesting equipment, man power, and harvesting activity schedule, and
vi. Post-harvest rehabilitation plans.

c) Task Plan

Task plan provides details on responsibilities of staff and working groups and details directives on how work is to be undertaken. All crew members involved should know their duties and responsibilities, expected work procedure and standards before the operation start.

The specification for job must be explained to operators:-

i. Construction standard
ii. Felling direction
iii. Felling techniques
iv. Skidding and winching techniques
v. Rehabilitation work
vi. Special considerations e.g. exclusion areas, buffer zones, etc.

The Harvesting Plan should contain map with the following information:-
i. The entire area to be harvested, including its location and borders,
ii. The entire area excluded from harvesting,
iii. Existing and prospective road network,
iv. Temporary landing locations, permanent landing locations, and transportation routes,
v. Skid trail network and skidding direction,
vi. Winching strips and commercial tree locations,
vii. Planned felling directions,

viii. Timber transport system, and
ix. Water course crossing (permanent and temporary).

8.3.2.3 Harvest Operations

a) Controlled Felling

Controlled felling aims at felling trees into position favorable for winching and skidding. Controlled felling implement directional felling plan and proper felling technique. Steps of controlled felling are as follows:-

i. Assess if the tree is healthy or not
ii. Cut climbers attached to the tree
iii. Determine the point of gravity of the tree
iv. Consider the lean of the tree and crown shape
v. Determine the wind direction
vi. Determine the feasible felling sector
vii. Determine the best lay for winching within the feasible felling sector and avoid trees are felled into same gap. Identify obstacles that might be break the tree when it falls
viii. Prepare an escape route at least 15-20 m, going at an angle from the intended felling direction
ix. Make sure not run out of gasoline
x. Directional felling by using proper felling technique and to reduce logging waste by making undercut and back cut as low as possible. If the tree stump is covered by peat, the undercut and back cut are made under the peat surface by digging the peat layer around the tree stump.
xi. If the tree crown fell toward to the winching strip, big branches and major parts of the tree crown should be cross cut to facilitate winching and reduce damage during winching activity

b) Controlled Winching by Rimbaka

Rimbaka is essentially a mobile high lift with an extended boom and powerful winching system (Figure 8.6). It can extend its cable ca. 150 m to the felled logs. The safe operation winching distance is 125 m. A winching strip is opened by clearing the ground vegetation and other obstacles with a maximum of 1m. Winching is conducted by Rimbaka which remain confined to the skid trail. Hence it would result in less residual stand damage and opened areas. Work steps of Rimbaka RIL are as follows:-

i. The assistant installs the choker around the logs
ii. The assistant gives the signal to the Rimbaka operator to take position for winching
iii. The assistant pulls out the winch cable and hooks it to the choker cable
iv. The assistant moves away to a safe place and gives the signal to the Rimbaka operator to start winching in
v. The log is lifted and then winched to the skid trail through the winching strip

vi. The grapple is used to place the logs along the side of the skid trial

c) Controlled Skidding by Excavator

Controlled skidding is conducted by excavator on a planned skid trail to temporary landing, which is established prior to felling and winching. A skid trail is opened by felling trees with Ø ≥ 10 cm on the planned skid trail with a maximum width of 5.0 m through the forest vegetation, so that the skidding pattern is visible throughout the entire harvesting operations. The skid trail density is estimated only about 40 m per ha and the opened area cause by skidding is about 200 m² per ha or 2 %. As a result, the application of the controlled skidding by excavator would reduce the opened areas caused by skid trail construction.

8.3.2.4 Post-Harvesting Activities

After harvesting activities are over, there are two activities that need to be undertaken, namely:-

i. Measures to prevent further environmental damage, e.g. temporary landings closure, temporary camp and workshop closure, and other opened areas closure. Efforts are necessary to help induce regeneration as soon as possible by placing back litter and top soil peeled off from the surface.

ii. RIL Implementation Assessment. RIL implementation assessment is conducted in order to provide feedback to the logging crews and forest managers, and to evaluate the degree to which RIL Guidelines for PSF are successfully implemented.

The criteria, indicators, verifier and measures of RIL implementation assessment for PSF are listed in Table 8.3

8.3.2.5 Conclusions

Peat swamp forests are important not only for timber but also for biological diversity conservation and environmental protection, therefore to ensure the SEPPSF is managed and used in a sustained manner, harvesting practiced in SEPPSF should only be based on RIL technique. The application of the RIL technique in PSF would not only has result in less residual stand damage and less opened areas, but also expected to increase of production volume, hence it contributes to sustainable forest management of PSF. The regulation imposed by the Pahang Forestry Department to use only RIL technique for timber harvesting in the production forest of the SEPPSF is one example of best management practices of peat swamp forest in this country and in line with the SFM concept practices by the Forestry Department in Malaysia.

Table 8.3 RIL implementation assessments after forest harvesting operation completed

Criteria	Indicators	Verifier	Measures
Natural regeneration capacity of residual stand is ensured	Diameter of harvested trees	• Only harvestable trees are harvested	• Harvestable tree and direction felling marking
	Healthy trees after harvesting per ha	• At least 32 potential crop trees (PCT) remained per ha • At least 4 mother trees retained per ha	• Marking of PCT trees • Marking of mother trees • Marking of protected trees
Management of exclusion areas	Exclusion areas	• Buffer zones	• Marking of boundaries • No felling in the exclusion areas
Controlled felling	Stand damage caused by felling	• Damage on the residual stand ≤ 15 %	• Directional felling • Used of felling technique
	Stump height	• Stump height ≤ 50 cm	• Used of felling technique
Controlled skidding	Opened areas cause by skidding	• Opened areas ≤ 10 % of harvest areas	• Development of temporary landing locations, skid trail network and winching strips on a map and in the field • Use of winching and skidding technique
	Stand damage caused by skidding	• Damage on the residual stand ≤ 15 %	• Directional felling • Use of winching techniques
No further environmental damage	Avoidance of further damage	• Preventive measures of environmental damage	• Temporary landing closure • Temporary camp and workshop closure

Figure 8.8 Rimbaka RIL machine (left) during timber extraction and the forest condition after logging (right)

8.3.3 ASPA Best Management Practice for Oil Palm Plantation

8.3.3.1 Oil Palm on Peatland

It was reported that due to population pressure, the need to produce more food and to eradicate rural poverty, in 1960's government has developed substantial forest area including peat swamp forest (peatland) for plantation crop such as rubber and oil palm. At the early stage many failures in planting oil palm on peatlands have been reported due to the lack of understanding of the structure and hydrology of these peatlands. At that time those peatlands were treated as any other waterlogged mineral swamp and large drains were dug to remove excess water. This has resulted in the subsidence and sometimes decomposition of the organic materials. However, in 1986, the pioneering work of United Plantations (Gurmit et al., 1986) introduced water control and nutritional management, significantly increasing the successful cultivation of oil palms on peat. To date about 666,038 ha of peat lands in Malaysia have been developed for oil palm planting (Haniff et al, 2011). In the Peninsular, oil palm on peat is currently in its third generation.

In general the cost of establishing oil palm plantation is higher on peat land compared to that on mineral soil, but the practice is still economical if best management practice including good technique of land preparation and planting, good water management system, optimum planting density, efficient fertiliser application and suitable mechanisation be adopted (Haniff et al. 2011). The Malaysian Palm Oil Board (MPOB) had developed guidelines for preparing Standard Operating Procedure (SOP) for oil palm cultivation on peat, focusing on topics such as planning for new plantings, land preparation and planting, water management, fertiliser management, managing leaning palms, management of weeds, pests and diseases, and mechanisation (Haniff et al, 2011).

8.3.3.2 ASPA Oil Palm Plantation

Amanah Saham Pahang Berhad (ASPA) is a Pahang state owned company having its office at Teruntum Complex in Kuantan. ASPA was formed on 21 January 1974 under the 1965 Company Act with the main aim of undertaking business related to various field including agriculture such as oil palm plantation.

In 2005 ASPA for the first time ventured into an oil palm plantation industry on peat land by opening new plantation in Sungai Miang, Pekan Pahang (Figure 8.7). The 1515 ha area was a degraded peat land adjacent to the Pekan Forest Reserve. The first phase of the oil palm was planted in 2005 with a total area of about 625 ha, followed by another 879 ha as a second phase planted in 2006. Only D x P species with planting density of about 160 trees/ha was planted in the entire plantation. In term of yield, there is an increase of production from 14.4 cubic meter per ha in 2011 to 16.8 cubic meter per ha in 2013. The harvest cycle is twice a month.

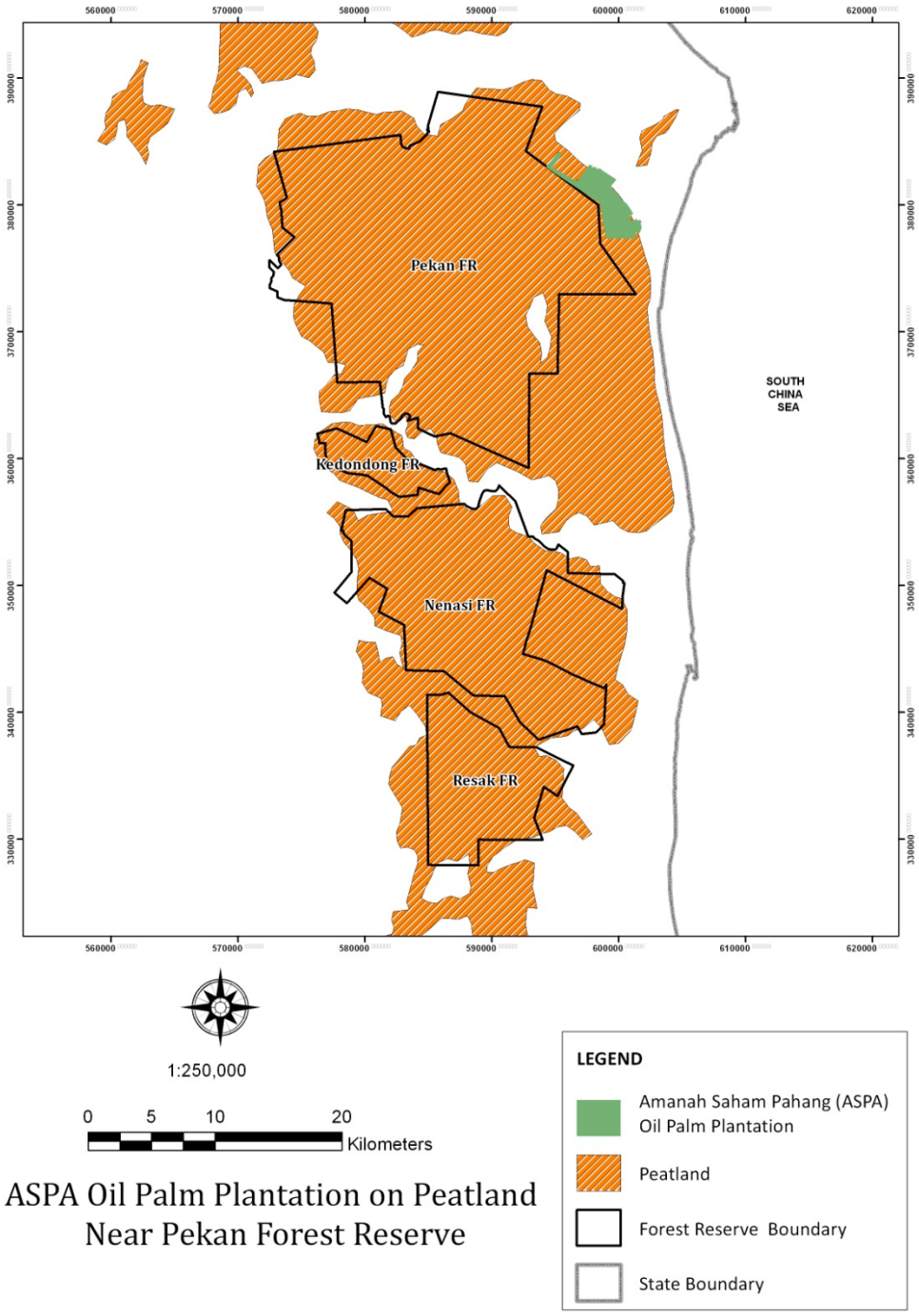


Figure 8.9 ASPA oil palm plantations on peat land adjacent to Pekan peat swamp forest

8.3.3.3 ASPA Best Management Practice

Start from the beginning, ASPA had adopted best management practices for oil palm plantation development on the peat land. Various experiences and good lesson on how to establish plantation on peat land from other established plantation were studied and adopted. In order to achieve sustainable oil palm yield on peat, ASPA realised the important of having good planning and implementation of development works.

8.3.3.3.1 Land preparation and planting

This involves clearing of under-brush and trees, felling of trees, lining, pruning, stacking and path clearing. Trees are felled into the block to ensure that roads and drains are clear of debris. Lining for the stacking of vegetation debris was done in rows. The trunks, branches, stumps, roots and other woody materials are stacked on the pre-lined stacking rows between the field drains. All protruding tree stumps along the harvesting paths are removed or cut.

8.3.3.3.2 Residue Management

ASPA adopted a zero burning technique for residues during land preparation particularly for environmental reason. Open burning will also result in uneven subsidence of the peat surface that will lead to difficulties in soil compaction and water management.

8.3.3.3.3 Drain Construction

The prime requisite for oil palm development on peatland is their long-term drainability on a sustainable basis. This is assured if the level of the underlying mineral subsoil is at a positive gradient compared to the water levels in the adjacent drainage systems. When drainability is not sustainable, the area will become waterlogged, oil palm growth seriously affected, and the development will have to be abandoned. As such it is important to study the hydrological system and to understand the water flow of the area for better water management. Lining for the drains were carried out prior to drain construction. The types and orientation of drains include field drains (parallel to oil palm planting rows), collection drains (parallel to collection roads) and main drains (perpendicular to collection drains). All obstructions were removed during drain construction (tree stumps, logs etc). A shallow drain was recommended to get rid of excess water and to keep a high groundwater table. The size for outer boundary drain adopted by ASPA is 3.3 x 2.4 x 2 m, where as for the drains within the planting block is 2.4 x 2 x 1.3 m. Water control gate at the main drain was constructed to stabilise water table and prevent flowing out excess water especially during dry season.

8.3.3.3.4 Road construction

There are several types of roads in oil palm plantation. All weather main roads are essential for effective fresh fruit bunch (FFB) evacuation and other estate operations. The main roads for regular heavy traffic were constructed with strong foundation up to 5.5 m wide, properly cambered and compacted. Where the main roads cross drains, proper bridges of concrete were constructed. Collection or field roads were also constructed possibly in the East – West direction to facilitate more rapid drying of the road surface during rainy seasons. The collection road is about 4 m wide and properly connected to the harvesting paths to facilitate evacuation of harvested bunches and loose fruits.

8.3.3.3.5 Mechanical Peat Compaction

The purpose is to consolidate the peat soil and minimise subsequent leaning and toppling of palms. This is done using tracked excavator. All tree stumps and logs along the planting rows are removed before compaction. Compaction also will reduces fertilizer leaching, increase nutrient supply (more nutrient per unit volume) and help to provide better root anchorage and can lead to higher yields (Gurmit et al, 1986; Mohd Tayeb, 2005).

8.3.3.3.6 Planting

Lining for planting is done after surface compaction. It is important to ensure that the planting points are as triangular as possible. The planting densities adopted by ASPA is 160 palms/ha (distance between palms = 8.5 m and between rows = 7.36 m). The hole-in-hole planting system or deep planning was adopted to prevent the palm roots from being exposed when peat subsides. The planting depth adopted is about 15 cm from the peat surface to seedling bole. Shallow planting is avoided as this will lead to early palm leaning that will adversely affect yield.

8.3.3.3.7 Water Management

The main objective of water management is to prevent irreversible peat drying by ensuring sufficient soil moisture. It is also to prevent flooding and to control soil water quality by removing excess water during high rainfalls period. Proper water management is the key to high oil palm productivity on peatland. Good water availability is important for healthy palm growth and high yield. Too little or too much water in the palm rooting zone will adversely affect nutrient uptake and fruit production. Most palms roots are concentrated in the top 50 cm of the peat, hence this zone must not be water-logged.

A good water management system for oil palm on peat such as in ASPA plantation is one that can effectively maintain optimum water-level of 50-70 cm from the peat surface for as long as possible. It should be able to remove excess surface and sub-surface water quickly during wet seasons and retain

water for as long as possible during dry spells. The moist peat surface at this water level will help to minimise the risk of accidental peat fire.

A well planned and executed drainage system with water control structures (water-gates and stop-offs using sand bags) are used by ASPA for drainage and effective water management (Figure 8..8). ASPA also carried out drain maintenance regularly to keep the drainage system working properly. Poor maintenance of the drain system is often the main cause of flooding in peat estates.

Figure 8.10 A control gate (left) and sand bags stop-offs (right) to prevent flooding & prevent water loss

8.3.3.3.8 Fertilizer Management

Adequate and balanced fertilization is vital for sustainable high productivity of oil palm on peat. Due to the high porosity and infiltration rate of deep peat, minimising fertiliser leaching is vital for cost efficiency. This is especially important in areas with high and frequent rainfalls. In view of the escalating fertilizer prices, it is useful to maximise nutrient recycling as practices by ASPA through pruned fronds by placing them between the palms, just outside the palm circles. Where available, bunch ash at 6 kg per palm per year applied on the outer zone of the palm circle, will be very beneficial for mature areas as it is a good source of K and can also significantly improve soil pH.

8.3.3.3.9 Weed Management

The moist environment in peat favors the growth of weeds. It is important to carry out weed control without delay on the harvesting paths and palm circles of 2.5 m radius, to ensure good accessibility and crop recovery especially loose fruit collection. Weed should be managed either through manual circle weeding or chemical spraying at regular interval. Choice of spray equipment and herbicides must be based on cost-effectiveness and labour productivity as well as safety to workers and minimal impact to the environment.

8.3.3.3.10 Pest and Disease Management

Pest and disease need to be properly controlled to prevent outbreaks which may result in economic losses. Common pests such as termites, *Tirathaba* bunch moth, leaf eaters, *Oryctes rhinoceros,* and rat infestation can be controlled using the existing standard infestation control. Among those, termite species *Coptotermes curvignathus* is a very important pest of oil palm planted on peat, causing death to numerous palms if not properly controlled. Negligence in termite control can lead to failure in a peat planting. For effective termite control, monthly census on every palm is required. Infested palms should be treated immediately using fipronil (5% a.i) at 5 ml/5 litres water, sprayed to wet the trunk and spear, plus palm base drenching.

8.3.3.3.11 Environmental Management

Although development of peatland for oil palm cultivation is feasible, it is critical to incorporate a sensible environmental management plan to ensure sustainable practices are adopted to conserve the peat resource for long term gains. Oil palm plantation owners should also plays their role in minimizing greenhouse gas (GHG) emissions. As part of this effort it is recommended for oil palm plantations to increase their carbon stock. Carbon stocks can be increased through maintenance and rehabilitation of buffer zones and High Conservation Value areas (Parish et al 2012). In this respect ASPA is making necessary effort to maintain and conserve the natural forest vegetation within their plantation buffer zones and adjacent to the PSF. Adoption by a plantation of an adjacent peat swamp forest area can reduce the net GHG emission profile and so can be a useful part of any GHG emission reduction strategy (Parish *et al*, 2012).

8.3.3.4 Conclusion

The cultivation of oil palms on peatland is not only a significant challenge from an agronomic perspective. There are also wide potential impacts that can result from the development of oil palms on peat. These impacts are often specific to the peatland environment or ecosystem. However, with best management practices as being done by ASPA, especially effective water management, adequate and balanced fertilization, timely pest control, good transportation and crop evacuation systems are key success factors to achieve sustainable high yields on peat.

8.4 LOAGAN BUNUT NATIONAL PARK, SARAWAK

8.4.1 National Park Management

For the LBNP, one of the main outputs of the UNDP/GEF Peat Swamp Forest Project concluded in 2007 is the 10-year Integrated Management Plan (IMP) named the *Loagan Bunut National Park Management Plan*. The plan was developed through a collective, multi-sectoral planning process, which examined management options for issues both inside and outside the Park. The agencies involved were the Departments of Forestry, Land and Surveys, Irrigation and Drainage, Natural Resources and Environment Board, Ministry of Resource Planning and Management, State Planning Unit, Majlis Adat Istiadat, Ministry of Land Development, Ministry of Urban Development and Tourism. During the Plan development process over a period of almost two years involving 10 meetings, the team applied the 'ecosystem' approach to the conservation and sustainable use of the peat swamp forest resources, functions and services. This multi-agencies consultative approach in developing the LBNP plan aimed at maintaining ecological integrity, generate social acceptance and ensure economic progress for the stakeholders.

Currently the plan is being implemented in order to address the biodiversity conservation and management of the National Park. The management objective of the Park is to realise the legal objectives for its creation including conserving its ecosystems' functions and biodiversity as well as creating opportunities for public use. Supporting the objectives of the National Parks and Nature Reserves Ordinance, the immediate objectives also include that:

- the biological value of the Park at the regional level (located at the PSF/ MDF ecotone) is conserved;
- the process of self-restoration of disturbed areas is allowed to proceed and approach the 'original' ecology of the site;
- opportunities are taken to provide greater public access to the Park's; and
- the park management has the support of the local community.

For management purposes, the park is divided into zones which include an ecotourism zone, a core zone reserved for research and education, areas of High Conservation Value Forest, areas for special protection (e.g. spawning areas, salt-licks, and a sacred burial ground) and for potential community use to encourage sustainable resource management and utilisation.

Seven sources of stress to the conservation targets were identified and being addressed in the IMP, namely local community settlement and cultivation, land development and operations, commercial logging, non-timber forest product harvesting, road and infrastructure development, park management and development activities, and recreational, research and educational use. The stress sources originate from both within and outside the Park. Efforts to contain and manage these stresses, therefore, require not only

the efforts from Sarawak Forestry Corporation (SFC), which is the management and operation arm of the Sarawak Forest Department, but also that of other agencies especially in dealing with stresses from outside.

Current management of the park is based on the fourteen strategies and fifty-nine management actions described in the IMP. The strategies include general enabling strategies intended to improve relations with stakeholders or promote Park interests as well as specific strategies for specific objectives. The former category includes strategies such as acquisition of resources for effective and efficient management, development of local community recognition and ownership of Park ideals and promotion of biodiversity conservation objectives while specific strategies include promotion of environmental quality management in the Sg. Teru catchment, development of Standard Operating Practices and marking and maintaining the Park boundary. Each action is being initiated and led by an agency directly related to the strategy with the SFC appeared in the team for each Action to be taken. For example a land matter is headed by the Land and Survey Department as this is under their jurisdiction with the other forming agencies including SFC form part of the team. The same is true for matters related to water pollution, which is being led by the Natural Resources and Environment Board.

The IMP focuses on the following main aspects in managing the LBNP:

i. Conservation of the ecosystem and biological diversity

ii. Water quality and hydrology of the lake ecosystem

iii. Mechanisms to regulate sustainable resource use with the local communities

iv. Visitor Use Management Strategy (eco-tourism)

v. Develop local community recognition and ownership of Park ideals

To date the park is successfully being managed for both conservation and eco-tourism attraction purposes in line with the strategies outlined in the IMP which can be said as a showcase of best management practices of peat land surrounding a natural lake. It helps in creating better awareness and understanding of the relationships between biodiversity conservation, sustainable resource use, economic returns from harvesting and cultivation efforts both within and outside the park. In-terms of eco-tourism related activities, the park is currently provides among others boat ride etc.

8.4.2 Management for Community Use

One of the main concerns in the LBNP is the involvement of local community in managing the Park. Support and participation of local communities especially Berawan as original inhabitants, are prerequisites to conservation and sustainability of park. The UNDP/GEF Project assisted the authority in resolving Non-Customary Right (NCR) of original Berawan in Long Teru longhouse. The UNDP/GEF Project also formed the *LBNP Special Park Committee (SPC*) in 2004 to allow participation of local community in management of park. This is in line with the Parks & Nature Reserves Ordinance & Wildlife Protection Ordinance regarding locals' traditional rights & privileges. The Committee provides platform for collaboration in managing protected area & serves as mechanism where benefits can be channeled to locals. The members are all stakeholders' including park management, local leaders, government agencies, NGOs and representatives of nearby estates. This is part of an effort to promote a co-management of park involving local community and the park authority.

Another interesting best management practices in relation to the community use is with regard to the *Community Fishery Regulation*. During the UNDP/GEF Project, the Park authority facilitated intensive consultations with Berawan community to revive their traditional fish harvesting regulations as a way of preventing any further decline in fish population. The Berawan community of Long Teru had been fishing in Loagan Bunut Lake for many generations (Sayok et al., 2011). In an effort to have equitable distribution of fish among themselves, they had set-up a local regulation to manage the fishery in 1969. After the area was gazetted as a national park in 1990, the Sarawak state government continued the rights of this tribe to use the resources including the fishing in the area. However, with time the regulation was ignored such that in 2004 survey, fish population declined to more than 50%. In 2005 the UNDP/GEF Project worked closely with Berawan and the park authority to mitigate the situation. A Berawan Fishery Committee and The Berawan Fishery Management Regulation 2006 (Peraturan Berawan Loagan Bunut Menangkap Ikan 2006) were formed. This new regulation takes into account their traditional regulations of 1969 as well as incorporated new ones to suit prevailing condition aiming towards reviving the fish populations as well as to ensure the sustainable management of the fishery. The Berawan traditionally uses Selambau to catch fish as shown in Figure 8.9. It is a unique fishing method only found at Loagan Bunut, in which huge scoop nets mounted on large rafts are used to catch migrating fish, which are kept alive in submerged bamboo cages until they can be transported to market.

The initiatives mentioned above showed that resolving problems related to management and sustainable use of natural resource in the lake within the peat swamp forest should involve local communities who are directly affected in terms of their well-being and livelihood. The UNDP/GEF Project at Loagan Bunut National Park had taken this approach to facilitate active participation among the various stakeholders in managing the natural resources in the Park and this is a good showcase as the best management practices for peatland in Sarawak.

Figure 8.11 Selambau (right) is a popular traditional fishing method practices by the Berawan

8.5 KLIAS FOREST RESERVE SABAH

8.5.1 Management for Conservation of Biodiversity

The management of Klias FR is under the jurisdiction of the Sabah Forestry Department. Through a fund from the UNDP/GEF Project which was completed in 2007, the Klias Forest Reserve Conservation Plan had been developed and currently being used in managing the peat swamp forest. Managing of the area is based on zones as prescribed in the Conservation Plan. The main objective of Klias Conservation Plan is to ensure the conservation of biological diversity and sustainable use of the forest resources while maintaining the ecological integrity and hydrological functions. In this respect the authority had made attempt to integrate the management planning through a multi-stakeholder consultative approach focusing on stabilizing the threats and harmonizing co-existence requirements among the stakeholders.

Within a particular zone, specific actions for conserving the ecological integrity and maintaining the hydrology of the Klias peatlands were prescribed. Six zones were identified within the Klias FR and its surrounding area. The corresponding actions which formed the basis to address the specific strategies inherent to each zone, were formulated as follows (Abdul Rahim et al, 2007):

Zone 1: Total protection

The zone for total protection includes the three key forest reserves in the area: Klias, Nabahan and Kg. Hindian. Only Klias Forest Reserve is a Class 1 (i.e Protection Forest) forest reserve. Research Centre, Environmental Education, Genetic Reserve, and Rehabilitation sub-zones also included in this zone. Key actions for this zone are:

Initiate conservation monitoring programme.
Monitor water-table fluctuations and peat subsidence.
Explore the possibility of elevating Kg. Hindian and Nabahan to Class One forest reserves.
Enhance the fire protection around the periphery of the forest reserve.
Enhance research on the conservation targets

Zone 2: Extending the protected area

The area identified is to be included as an extension of the Klias Forest Reserve. Key actions include:

Submission of a formal proposal paper to State Cabinet for approval.
Develop support from local leaders for this proposal.
Enhance research on the conservation targets.

Zone 3: Controlling the flow (major landowners)

This zone marks the land area that is owned by large landowners. The main aim of this zone is to ensure that the landowners cooperate to promote peatland conservation on their own land and to ensure that their activities do not negatively affect the Klias Forest Reserve. Key actions are:

To explore the potential of this land to be known as a Water Conservation Area under State legislation.
To develop specific awareness campaigns targeting the large landowners.
To identify ways in which the outflow from the Klias peat swamp forests could be controlled.
To engage landowners to participate in the Klias monitoring programme.

Zone 4: Controlling the flow (small-holders)

This zone is loosely defined but includes the peatland on smallholdings within the Klias peat deposit. The landownership is largely held by local villages. The main aim of this zone is similar to zone 3, but the management strategy is neared towards the smallholders. The key actions are:

To explore the potential of this land to be known as a Water Conservation Area under State legislation.
To develop an awareness campaign targeting villagers, to guide them towards the issues they face when developing peatlands.

Zone 5: Stopping the flow

To prevent continued outflow from the Klias Forest Reserve, the infilling of the abandoned log-transport canal on the western-edge of the forest reserve is proposed. Key actions are:

Initiate pilot studies to minimise the impact of the existing drains on the hydrology of the Klias Forest Reserve.
Develop a technical assessment for managing water levels within the Forest Reserve and adjacent peatland.

Zone 6: Grassroots initiatives

Winning the support of the local communities is essential for the long-term conservation of the area. Key actions are:

To conduct an awareness campaign targeting villagers, to guide them towards the issues they face when developing peatlands.

Initiate pilot studies to develop commercially-viable activities on peatlands without having to compromise peatland conservation.

8.5.2 Community Participation

8.5.2.1 Boat Cruise

In the vicinity of the Klias peat swamp forest there are many natural attractions waiting to be explored by adventures tourists and visitors. The local communities with support from the local government have taken initiatives to provide eco-tourism related package (including boat cruise as shown in Figure 8.10) for visitors. Looking for an abundance of wildlife, particularly monkeys one may join Klias River Cruise, the best spot in Sabah to see Proboscis monkeys in their natural habitat. Besides having the opportunity to see the Proboscis Monkey in the wild, one may also get the chance to see a variety of birds, common Macache monkeys in large numbers, large groups of water buffalo, the rare Silver Langour, and possibly even a crocodile along the river bank.

Mr. Ag Masis b Ahmad is an owner of four boats in Garama Village, Klias who provides tourist packages to see the wildlife through river cruise. In average he is capable of getting about 30 tourists per month and increase up to 300 tourists per month during peak seasons which stars normally from June to August. About 70% of the tourists are foreigners mostly from Japan. Besides Masis, there are many other boat operators who provide similar services to cater for the demand.

Figure 8.12 Boat Cruise facilities owned by local community in Garama Village

8.5.2.2 Pineapple Cultivation

Crop choice on peatland area dependent upon many factors of which suitability of soil is but one. For most farmers profitability is the overruling factor, but in the case of reclaimed peat swamp there are a number of factors which influence or limit the freedom of choice and which are beyond the control of the farmer. Of these pineapple has a very good potential, because it both flourishes in the acid conditions prevalent in peat soils, and it is relatively low growing and not susceptible to being uprooted at maturity.

A Pineapple farm nearby Klias FR in Kg Luagan was cultivated since 2010 under the Commodity Crop Development Programme.The farm is owned by En Kurus bin Isy with a total area of about 60 acres located nearby Klias FR. Species planted are dominantly *Mauritius* and others include *nenas daun, nenas pisang and nenas madu* (local name). The production is up to 10 tons per month. The wholesale price is depending on grade in which grade A is RM1.70/kg, Gred B RM 1.20/kg and Gred C RM 0.70/kg.

Pineapple planted on peatland requires good water management system. It grows well in well-drained and rich organic soils. Therefore, drainage is required in pineapple cultivation. Land preparation involves drainage, clearing, road and path construction. Drains or canals have to be dug to maintain the water table at the depth of 70 – 90 cm. One important aspect in best management practices of planting pineapple on

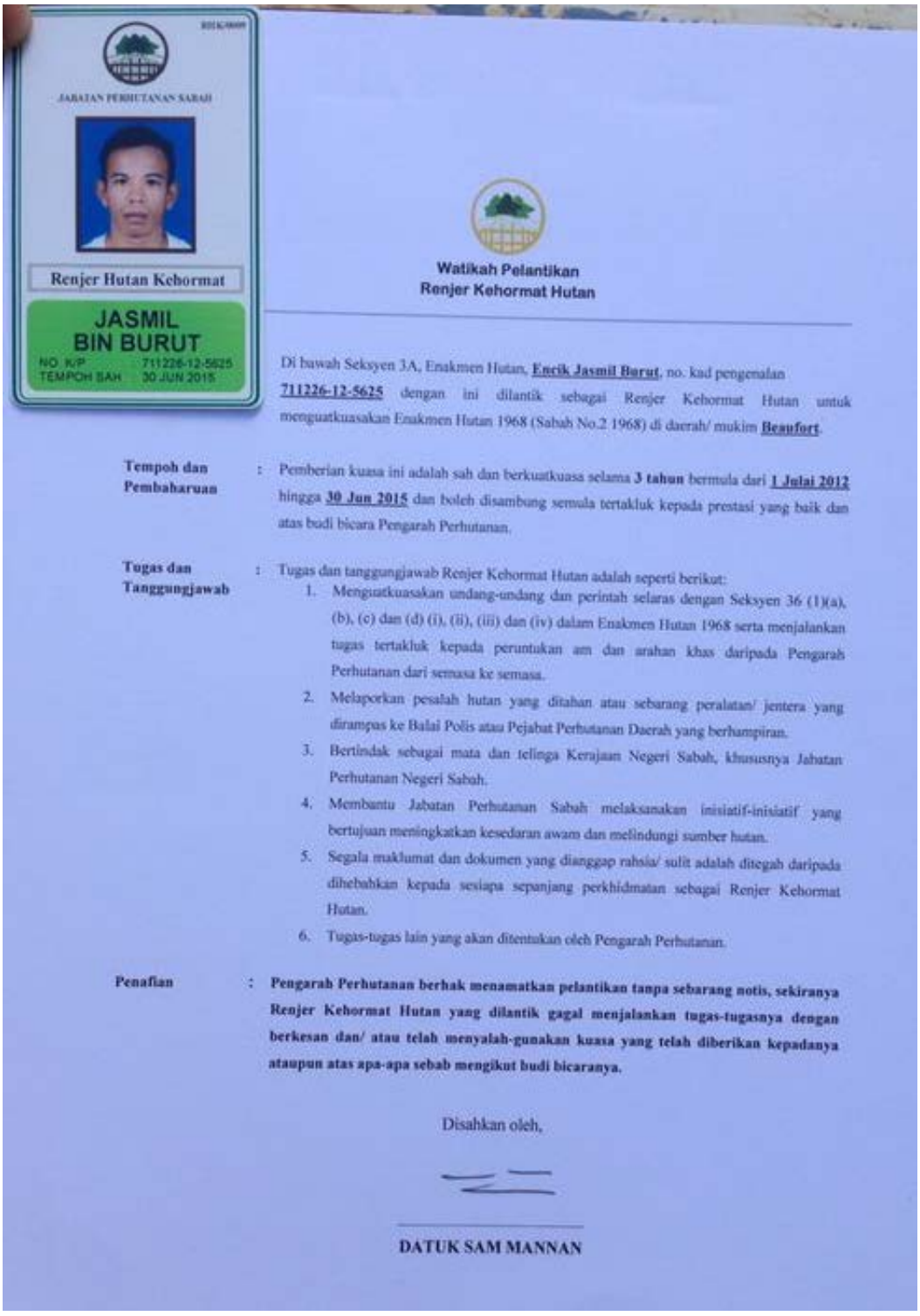
peatland include to have good control of water level to avoid flood during the rainy season as pineapple can only tolerate flooding for a maximum of 1 day. Figure 8.11 shows a good drainage system being practices in the Kurus's pineapple farm.

Figure 8.13 A good drainage system of a pineapple farm owned by a local villager on Klias peatland, Sabah

8.5.2.3 The Honorary Forest Renjer

The Sabah Forest Enactment 1968, allows the Director of Forestry to appoint qualified local community as Honorary Forest Rangers (Renjer Hutan Kehormat – RHK) – a voluntary post. In 2012 two RHKs were appointed for a period of three years (1st July 2012 to 30th June 2015) and posted in surrounding villages nearby Klias PSF. They are both from Bukau and Suasa villages and one of them is Mr. Jasmil Bin Burut (Figure 8.12). Part of their duty is to assist the authority to monitor and manage the PSF by alerting the government of any irregularities in the PSF such as fire breaks and illegal forest activities. At the same time they also will assist government in creating awareness to the local villages on the important of conserving and protecting the PSF.

The appointment of local villagers as volunteer of RHK in Klias PSF is a good example on how the local community can play their role in helping the government to protect and conserve the PSF. It is also can be recognised as one example of best management practices of peatland (PSF) that should be followed by other states in Malaysia.



JABATAN PERHUTANAN SABAH

Renjer Hutan Kehormat

JASMIL
BIN BURUT

NO. K/P 711226-12-5625
TEMPOH SAH 30 JUN 2015

Watikah Pelantikan
Renjer Kehormat Hutan

Di bawah Seksyen 3A, Enakmen Hutan, **Encik Jasmil Burut**, no. kad pengenalan **711226-12-5625** dengan ini dilantik sebagai Renjer Kehormat Hutan untuk menguatkuasakan Enakmen Hutan 1968 (Sabah No.2 1968) di daerah/ mukim **Beaufort**.

Tempoh dan Pembaharuan : Pemberian kuasa ini adalah sah dan berkuatkuasa selama **3 tahun** bermula dari **1 Julai 2012** hingga **30 Jun 2015** dan boleh disambung semula tertakluk kepada prestasi yang baik dan atas budi bicara Pengarah Perhutanan.

Tugas dan Tanggungjawab : Tugas dan tanggungjawab Renjer Kehormat Hutan adalah seperti berikut:

1. Menguatkuasakan undang-undang dan perintah selaras dengan Seksyen 36 (1)(a), (b), (c) dan (d) (i), (ii), (iii) dan (iv) dalam Enakmen Hutan 1968 serta menjalankan tugas tertakluk kepada peruntukan am dan arahan khas daripada Pengarah Perhutanan dari semasa ke semasa.
2. Melaporkan pesalah hutan yang ditahan atau sebarang peralatan/ jentera yang dirampas ke Balai Polis atau Pejabat Perhutanan Daerah yang berhampiran.
3. Bertindak sebagai mata dan telinga Kerajaan Negeri Sabah, khususnya Jabatan Perhutanan Negeri Sabah.
4. Membantu Jabatan Perhutanan Sabah melaksanakan inisiatif-inisiatif yang bertujuan meningkatkan kesedaran awam dan melindungi sumber hutan.
5. Segala maklumat dan dokumen yang dianggap rahsia/ sulit adalah ditegah daripada dihebahkan kepada sesiapa sepanjang perkhidmatan sebagai Renjer Kehormat Hutan.
6. Tugas-tugas lain yang akan ditentukan oleh Pengarah Perhutanan.

Penafian : **Pengarah Perhutanan berhak menamatkan pelantikan tanpa sebarang notis, sekiranya Renjer Kehormat Hutan yang dilantik gagal menjalankan tugas-tugasnya dengan berkesan dan/ atau telah menyalah-gunakan kuasa yang telah diberikan kepadanya ataupun atas apa-apa sebab mengikut budi bicaranya.**

Disahkan oleh,

DATUK SAM MANNAN

Figure 8.14 Mr. Jasmil Bin Burut - Honorary Forest Ranger (Renjer Hutan Kehormat – RHK) appointed in 2012

CHAPTER 9

9.0 CONCLUSIONS

Most of the peatlands in Malaysia are still cover with peat swamp forests. Peat swamp forests in this country are the largest wetland types accounting for more that 75% of the country's total wetlands. Most of the peat swamp forest has been gazetted as Permanent Reserve Forest manages under the jurisdiction of the respective state's forestry department, strictly in line with the sustainable forest management (SFM) concept. Managing this peat swamp forest is crucial not only to ensure sustainable use of the resources and protection of endangered species, but also to maintain environmental stability. Peat swamp forests act as a carbon sink, helping to slow down global warming. It also plays a critical role in regulating water over vast areas, supporting agriculture by reducing the impact of floods, revitalising the soil and providing a limited source of water during droughts.

Peatland is a very fragile soil type and requires special management scheme. In term of characteristics, peat is highly acidic by nature and has an ash content of below 2%. Peat soil, also known as organic soil, is composed of at least 65% organic matter, thus less than 35% mineral material. It possesses a low mineral content and is therefore classed as oligotrophic (low fertility). In this report examples on the best management practices of peatland in this country are highlighted. It ranges from managing peat swamp forests for sustainable timber harvesting, biological conservation, environmental protection as well as sound peatland management for agriculture crop production such as for oil palm, pineapples and other cash crops. The involvement of local communities in managing the peatland in particular the peat swamp forests is also highlighted. The submission of this report has fulfilled objectives and the requirement of the task on the assessment of BMP which among others to document experiences and lessons learned of the best management practices for sustainable peatland management in Malaysia.

CHAPTER 10

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