

ANNEX A EXISTING ENVIRONMENT



A1.1 INTRODUCTION

This Annex includes all the information relates to this EIA such as existing environment (physio, biological and social) at the proposed Oil Palm Plantation (OPP) and Industrial Tree Plantation (ITP) Project which is not included in **Chapter 3** as well as **Chapters 4 to 5**.

A1.2 EXISTING PHYSIO-ENVIRONMENT

A1.2.1 Geology and Slope Stability

The geology of the Project area, described in terms of its geomorphology and lithology, serves as a background to the relationship between the various soil types and their slope stability. Since the project is located in 2 separate blocks, and for convenient description, the Project area is divided into 2 regions, viz. Benta I in the NE and Benta IIC in the SW.

Benta I consist of:

- A YSG consisting of Benta Wawasan Plantations 1,2,& 3; and
- B Yayasan-Melaka JV.

Benta IIC is the Ratus Awansari Sdn Bhd JV plantation area.

The general geology is illustrated in **Figure A1.1**. The Agriculture Department's Soil Map showing various soil types is illustrated in **Figure A1.2**. The geomorphology is presented in **Figure 4.3.1**, which is basically slope gradient distribution map of Benta I and Benta IIC. It illustrates the areas containing steep terrain.

A1.2.2 Geomorphological features *(see Geology Map, Figure 1.1.1)*

The geomorphological features in the two regions are closely tied to the regional geological structures. Based on the regional geology map published by Collenete (1965), there are 2 distinct types of rocks, viz. Chert-Spilite assortment of rocks that include igneous bodies, and sedimentary rocks. Folding and faulting during basin development control the pattern of hill ridges and valleys.

The oldest rock formation is the Chert-Spilite Formation that was intensely folded and slumped. The main structures trend NW-SE. They cover the drainages of Sg. Brantian, and the eastern sub-catchments of Sg. Kalabakan covering the majority of the eastern part of Benta I. Owing to the Formation's varied lithologies (they are described later), irregular low-lying valleys to moderate steep scarps are formed. Ultrabasic rocks extruded this Formation to form high steep hills. Sheared and brecciated zones form topographic lows that becomes conduits for run-off.

To the west of the Chert-Spilite Formation and faulted against it, younger sedimentary rock sequences consisting of SANDSTONE, SILTSTONE and MUDSTONE occur as sub-circular and elongated basin structures.

Relevant to the Project area are four (4) basin-like synclinal structures, namely,

1. The Maliau Basin is a sub-circular basin structure found in the northwest of Benta I and in the north of Benta IIC, and whose centre is in the north outside the boundaries of the Project area.
2. The Luis syncline is an elongated NW to SE trending basin structure in the west of Benta IIC. The eastern flanks of the syncline occur as steep ridge escarpments on the western part of Benta IIC.
3. The Serudong syncline is an elongated structure trending NW-SE, whose eastern escarpment forms a corner of the southwestern border of Benta IIC.
4. The Silimpoon syncline is a broad syncline in the south of Benta IIC opening towards SE. Hogback ridges form a tight arcuate structure that is well illustrated in **Figure A1.1** and **Figure A.1.2**.

The margins of the above-mentioned synclinal structures developed steep ridge-slopes at the crest and escarpments, with gentler dip slopes towards the centers or axis of the synclines. These structures are illustrated in **Figure 4.3.1**.

Developed between the above structures are narrow anticlines forming steep elongated ridges and valleys.

The Project Area is drained by the following river systems.

- A. The Sg. Kelabakan
- B. The Sg. Brantian
- C. The Sg. Kuamut
- D. The Sg. Silimpoon

The Sg. Kelabakan drainage is the dominant river system with the main river flowing SE between Benta I and Benta IIC. The river also flows through the eastern part of Benta IIC. Tributaries join from both Benta I and Benta IIC in dendritic and sub-dendritic patterns and eventually drain SE. Examples of these rivers are Sg. Luasong and Sg. Mawing draining from Benta I and Sg. Anjeranjemut draining across Benta IIC. Alluvial flats are common on the main drainage (out of the Project Areas), and except for the eastern part of Benta IIC, are confined to narrow strips of outwash deposits in the upper tributaries of Benta I and Benta IIC.

Only a small part southeast of Benta I is affected by Sg. Brantian river system, and therefore has only a small influence on the Project.

The tributaries of Sg. Kuamut drain north and northeast. Only the central north of Benta I is affected by this river system.

The headwaters of Sg. Silimpoon drain from the scarps of the Silimpoon basin in dendritic patterns, covering the southern part of Benta IIC.

A1.2.3 Soils & Its General Descriptions

A1.2.3.1 General

In the Project area, a series of sedimentary rock formations overlie a chert-spillite rock assemblage.

The Chert-Spillite Formation rocks are the oldest rocks that cover the major portion of Benta I, and to the east of Sg. Brantian and SE of Sg. Kuamut. The rocks consist of chert, mudstones/sandstones with subordinate limestone, spillite, basalt and tuff. Ultrabasic igneous rocks forming high mountains are scattered within the Chert-Spillite Formation. Residual soils developed from the above-mentioned rocks are classed as dominantly orthic Acrisols, Cambisols and Lithosol. The associated units are classified (by the Agriculture Department) as Kretam (33), Bang (40), Bidu-Bidu (41), Mentapok (42) and Gumpal (46).

Unconformably overlying the Chert-Spillite Formation is the Kuamut Formation and the Tanjung Formation. The Kuamut Formation rocks are exposed mainly to the north of the project area at Sg. Kuamut, and are out of the Project area and are therefore not described here. In the NW of Benta I, the Tanjung Formation sedimentary rocks that occupy the Maliau Basin is dominated with sandstones, siltstones and mudstones, with minor coal and limestone. Residual soils developed were classified as Kalabakan (29), Lokan (39), Crocker (47), and Maliau by the Agriculture Department. The Tanjung Formation did not extend into Benta IIC. Instead, these sub-basins are underlain with the Kapilit Formation.

The Kapilit Formation rocks occupy the Luis Basin and the Silimponon Basin, and are found in Benta IIC only. The sedimentary rock sequence has higher quartz content in the sandstone when compared with the Tanjung Formation. Residual soils developed are classified as Maliau (48), Mawing (30) and Lokan (39). They are mainly orthic Acrisols and Dystric Cambisols. The soils are briefly described in the Legend of **Figure A1.2** and **Table A1.1**.

The Kalabakan Formation occupies the Kalabakan valley and is made up mainly of mudstones with minor sandstones. Most of it is outside the project area between the two regions. Soils developed are classified as Mawing (30).

Alluvium is found in patches in the river valleys, most of it outside the project area. Soils developed from these are classed as Labau (10) and Brantian (12).

A1.2.3.2 Labau Association

The Labau Association is made up of narrow floodplains, with levees and meander cutoffs, backed by low terraces standing about 6m above the floodplains. The terraces have gentle slopes and rounded tops.

The soil texture of this Association is moderately fine to coarse textured alluvium of low base status. The families in this Association, Ferric and Orthic Acrisols are medium to moderately fine textured alluvium and are found on the terraces. The Dystric and Humic Gleysols, Gleyic Acrisols and Gleyic Cambisols found on the narrow floodplains mainly on medium and moderately fine-textured alluvium. As for Dystric Fluvisols and Dystric Cambisols are limited to the levees.

A1.2.3.3 Brantian Association

Brantian Association comprises soils formed on terraces, low hills and minor valley floors. The soils texture is of medium to fine, occasionally coarse-textured alluvium and is

moderately well drained. The soil families of Brantian Association consist of Gleyic, Orthic and Ferric Acrisols.

A1.2.3.4 Kalabakan Association

Kalabakan soil is derived from mudstone, sandstone and alluvium. It is formed on hills which are the remnants of a former erosion surface, the accordant summit levels occurring at between 30 to 60m above sea level. The hills have amplitudes with slopes of 15-20 degree. The Kalabakan Association are moderately fine to finely textured.

The soil families of Kalabakan Association consist of Orthic Acrisols and Orthic Luvisols that formed on mudstone. Gleyic Acrisols and Gleyic Luvisols formed on some lower slopes and Dystric Cambisols that occur infrequently on ridge tops.

A1.2.3.5 Mawing Association

The Mawing Association comprises soils developed on mudstone and sandstone. It occurs on steep hills with amplitudes up to 75m and slopes of more than 25°. The hills are mostly in the form of steep, narrow ridges with deeply incised valleys. Active erosion and landslips are common on hillsides. The majority of soils family from this Associations are Orthic Acrisols and Orthic Luvisols, Dystric Cambisols.

A1.2.3.6 Kretam Association

Kretam Association is normally found on moderate and low hills with elevation of less than 150m but occasionally up to 210-240m in certain areas e.g. Segama watershed. In the watershed areas, the terrain comprises broad radiating ridges with long gentle upper slopes and moderate dissection. The ridges are narrower and slopes are steeper where tributaries are actively cutting back into the hills. The parent materials consist of sandstone, mudstone and miscellaneous rocks. The dominants soil families are orthic acrisols in association with Ferric Acrisols on miscellaneous rocks, Chromic and Orthic Luvisols form on tuffaceous rocks, Orthic Luvisols occur in basic and ultrabasic rocks while Eutric Gleysols occur in mud volcano area.

A1.2.3.7 Lokan Association

Lokan Association is normally found in very high hills with slopes more than 25°. It formed on steep sandstone and mudstone hills with elevation up to 300m. The hills are normally in the form of long, narrow ridges with steep slopes and narrow boulder strewn valleys. Rock outcrops and landslips are normal. Both Orthic Acrisol and Dystric Cambisol are found on ridge tops and unstable steep slopes.

A1.2.3.8 Bang Association

Bang Association is found on steep hills up to 300m amplitude, with slopes averaging between 15° and 25°. Most of the soil families are Orthic Acrisols of Tanjong Lipat and Kumansi Families on sandstone and mudstone, including other rocks which do not look to be as common as in the Rumidi Association. The types of soils that formed on miscellaneous rocks cover Orthic and Chromic Luvisols. Cambisols and Lithosols are normally found in the steep slopes and ridges.

A1.2.3.9 Bidu Bidu Association

Bidu Bidu Association is found on mountainous range e.g. in Gunung Rara region. The main summit of these mountains, in general have a relief amplitude of 300m to 600m and with very narrow ridges, minor peaks and very steep slopes prone to landslides. Rhodic and Orthic Ferralsols are the main soils that dominate this Association and they are formed from

strongly weathered colluvium. On the contrary, Lithosols, Eutric Cambisols and Orthic Luvisols form in close association on areas of rock outcrop and little weathered stony colluvium.

A1.2.3.10 Mentapok Association

Mentapok Association is normally formed on mountainous area and on isolated hills with elevation in the 750 – 900m range. The slopes are steep with sheer cliff faces while ridges and crests are narrow; there are also occasional gently sloping spurs.

Orthic and Chromic Luvisols are the dominant soils. In general, they form the majority of the steep slopes. In area where rock outcrops and very steep slope are found, Chromic and Eutric Cambisols are found. The Orthic Acrisols develop on gentle slopes of ridge crests.

A1.2.3.11 Malubok Association

Malubok is derived from igneous rocks on ultrabasic and chert. It is found on isolated, steep-sided dome like mountain and mountain ranges with major peak at altitudes up to 1,050m.

This Association covers soils in Mentapok Association; Ferralsols, cambisols, Luvisols and Lithosols on ultrabasic rocks (Bidu-Bidu Association): Acrisols, cambisols and Lithosols on Sandstone (Crocker Association) and Lithosols and Chromic Cambisols on Chert.

A1.2.3.12 Gumpal Association

Gumpal Association occurs on hills and mountainous regions with slopes of more than 25°. It derived mainly from the interbedded sandstone and mudstone with minor inclusions of miscellaneous rocks. The common soil family in this Association are Orthic Acrisols of Tanjong Lipat and Kumansi Families. Orthic Acrisols of Kapilit Family is also found in area that has the sandstone deposits. As for soils that formed on miscellaneous rocks, they are similar to that of Bang Association. The Cambisols and Lithosols are common on the higher slope area.

A1.2.3.13 Crocker Association

Crocker Association is formed on mountainous terrain with sandstone and mudstone as its parent material. It occurs on some steepest land and with elevation more than 330m with very high, narrow ridges and long slopes with angles generally between 30 – 40°. The slopes are rocky and prone to landslips, valleys are narrow and boulder strewn, and the rivers are fast flowing. The soils are similar to Lokan Association.

A1.2.3.14 Maliau Association

Maliau Association is formed from the sandstone mountains of Kapilit Formation. It occurs on hills and mountains at from about 150m to 1,650m. These hills and mountains are normally arranged in concentric circles around a central core with an outward facing scarp slopes and inward facing dip slopes. The scarp slopes are generally very steep while dip slopes are moderately steep and long with deeply incised valleys. This Association comprises Orthic Acrisols of Kapilit and Tanjong Lipat Families and Dystric Cambisols of Antulai Family.

Table A1.1: General Characteristics of the Soils Association within the Project Area

Key	Association	Landform	Parent Material	Main Soil Units	Soil Families	Development Limitations
10	Labau	Valley floors and terraces	Alluvium	Dystric Gleysol Gleyic Acrisol Ferric Acrisol Orthic Acrisol Gleyic Cambisol Dystric Fluvisol	Koyah Inanam Lumisir Paliu Luba Tenghilan	Minor nutrients limitations; and Imperfect and poor drainage
12	Brantian	Terraces, low hills and minor valley floors	Alluvium	Gleyic Acrisol Ferric Acrisol Orthic Acrisol	Inanam Lumisir Paliu	Imperfectly or poorly drained; Localized slope limitations; & Minor nutrient limitations
29	Kalabakan	Moderate hills: amplitudes <75m; slopes 10 – 20°	Mudstone and minor sandstone	Orthic Acrisols Orthic Luvisols	Kumansi Lumpangon	Severe slope limitation and erosion control measures is necessary.
30	Mawing	Moderate hills; slopes > 25°	Mudstone and sandstone	Orthic Acrisols Orthic Luvisol Dystric Cambisol	Kumansi Lumpangon Laab	Severe slope limitations. Shallow topsoils
33	Kretam	Moderate hills; slopes >20°	Mudstone, sandstone	Orthic Acrisols	Tanjong Lipat Kumansi	Moderate to severe slope association and localized nutrient limitations.
				Orthic Luvisols	Lumpangon	
			Chert	Chromic Cambisol	Juak	
39	Lokan	Very high hills: slopes > 25°	Sandstone & mudstone	Orthic Acrisol Dystric Cambisol	Tanjong Lipat Kumansi Laab Antulai	Very Severe slope limitations.
40	Bang	Very high hills: slopes 15- 25°	Mudstone, sandstone	Orthic Acrisol	Tanjong Lipa Kumansi	Severe slope limitations.
				Dystric Cambisol	Laab	



Key	Association	Landform	Parent Material	Main Soil Units	Soil Families	Development Limitations
41	Bidu Bidu	Mountains with moderate to very steep slope (25o) and isolated hills of moderate relief and moderate to steep slopes	Ultra basic igneous rocks	Rhodic Ferralsol Orthic Ferralsol Eutric Cambisol Orthic Luvisol Lithosol	Pinianakan Ambun Binuang Tingkayu	Severe slope limitations.
42	Mentapok	Mountains with slopes > 25°	Basic and intermediate igneous rocks	Orthic Luvisol Chromic Luvisol Eutric Cambisol Lithosol	Kobovan Beeston Bombalai	Severe slope limitations.
44	Malubok	Mountains	Igneous rocks, sandstone, mudstone & chert	As for Mentapok and Bidu Bidu Associations		Very Severe slope limitations.
46	Gumpal	Mountains & hills < 25°	Mudstone / sandstone	Orthic Acrisol Dystric Cambisols	Tanjong Lipa Kumansi Kapilit Laab Antuali	
47	Crocker	Mountains	Sandstone & Mudstone	Orthic Acrisol Dystric Cambisols	Tanjong Lipat Kapilit Laab Antulai	Very Severe slope limitations.
48	Maliau	Mountains cuestas	Sandstone & Mudstone	Orthic Acrisol Dystric Cambisols Gleyic Podzols	Kapilit Tanjong Lipat Antulai Pa Sia	Very Severe slope limitations.

Sources: Soils Sheet Tawau NB 50-15 (Scale 1:250,000), 1974 Land Resources Division, Ministry of Overseas Development, U.K.
P.S. Wright, 1975. "The Soils of Sabah – Volume 3 Western Parts of Tawau and Lahad Datu", Land Resources Division, Ministry of Overseas Development, U.K.
L.P. Thomas, F.K.C. Lo and Hepburn, A.J., 1976. "The Soils of Sabah Volume – 2 The Sandakan Residency". Land Resource Div., Ministry of Overseas Development.

Note: The percent estimation is based on computer generation.
This is not a detailed soil survey map.



A1.2.4 Hydrology and Drainage

A1.2.4.1 Drainage Pattern and Water catchment

Three major rivers namely, Sg. Kalabakan, Sg. Brantian and Sg. Kuamut drain the proposed Project site (see **Figure 3.8.1**). Sg. Kalabakan basin encompasses an area of approximately 125,000 ha and Sg. Brantian basin encompasses an area of approximately 52,900 ha. Sg. Kuamut, the longest tributary of Sg. Kinabatangan has a subcatchment area of about 79,100 ha (refer to **Figure 3.8.1**).

Site investigation was carried out for Sg. Brantian and Sg. Kalabakan during May and June 2001. Details of hydrological studies are outlined in **Annex B1.2.3**.

A1.2.4.2 Discharge or Water Quantity

The whole Kalabakan Basin discharges into Sg. Kalabakan (see **Figure 3.8.2**). This river is continuously monitored and recorded at Kalabakan Station by the Department of Irrigation and Drainage, Sabah. Based on discharge records of 13 years, the characteristic of the Sg. Kalabakan can be described as follows:

During wet seasons between May to November, the median total monthly discharge of the Sg. Kalabakan is with 947 cumsec approximately 2.5 times higher as during dry seasons between January and April (**Figure A1.3**).

The same pattern shows the mean total daily discharge, with 33 cumsec between May to November and 17 cumsec between January and April (**Figure A1.4**).

The maximum total daily discharge can increase up to 500 cumsec during rainstorm events (**Figure A1.3**). During draughts the total daily discharge can drop significant and the riverbed can even dry up. For the last thirteen years a minimum total monthly discharge of 32 cumsec was recorded.

No discharged data are available for Sg. Brantian or the tributaries of Sg. Kuamut that may be affected by the Project.

A1.2.4.3 Water Quality

Sg. Kalabakan basin and Sg. Kuamut basin are much-disturbed river basins. Intensive logging activities as well as conversion of forest into agricultural land in the last decade caused siltation of the rivers and decrease in river water quality. High values in Total Suspended Solids (144 mg/l), recorded at Kalabakan indicate high erosion rates of approximately 0.1 kgm⁻²a⁻¹ for the Sungai Kalabakan basin (Refer to **Annex B1.2.2** for baseline water quality analysis).

A1.2.5 Rainfall

Since there is no meteorological station available at the proposed project site, data are obtained from the nearest meteorological stations such as the Kalabakan Town (managed by the Department of Irrigation and Drainage, Sabah), Luasong Forestry Centre (managed by Rakyat Berjaya Sdn Bhd) and Tawau (managed by the Meteorological Department of Malaysia). The average annual rainfall ranges from 2,119 mm (13 years average) in Kalabakan town to 2,782mm in Luasong (6 years average from 1995-2000) and 2,670mm in Tawau (1980-1998) (see **Figure A1.5**).

Generally the rainfall is more or less evenly distributed over the year with a drier period between January to April followed by a wetter period between May to November as recorded in Kalabakan (**Figure A1.5**). Luasong Forestry Centre experiences drier period from April to July and wetter period from August onwards with heavy rainfall recorded in December. Tawau, on the other hand, receives more or less even rainfall distribution throughout the year.

Figure A1.3 Thirteen years median of total monthly discharge, and minimum and maximum monthly discharge recorded at Station Kalabakan by the Department of Irrigation, Sabah.

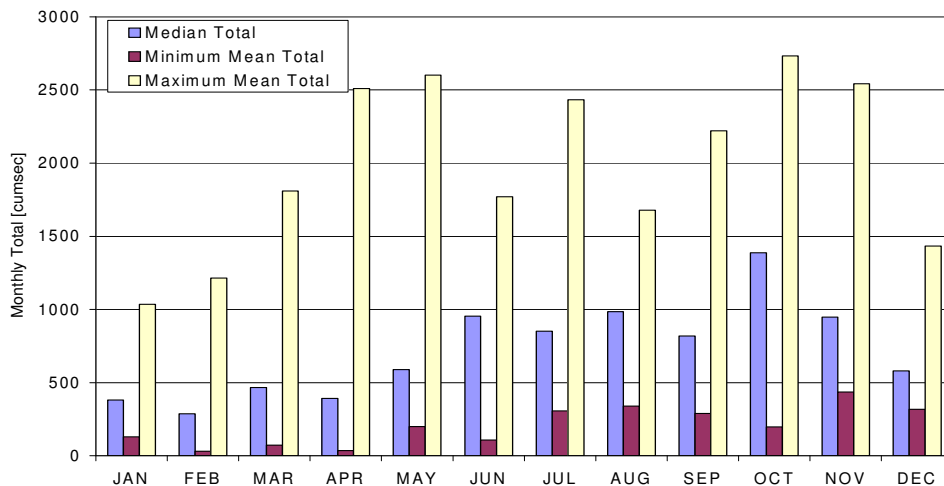
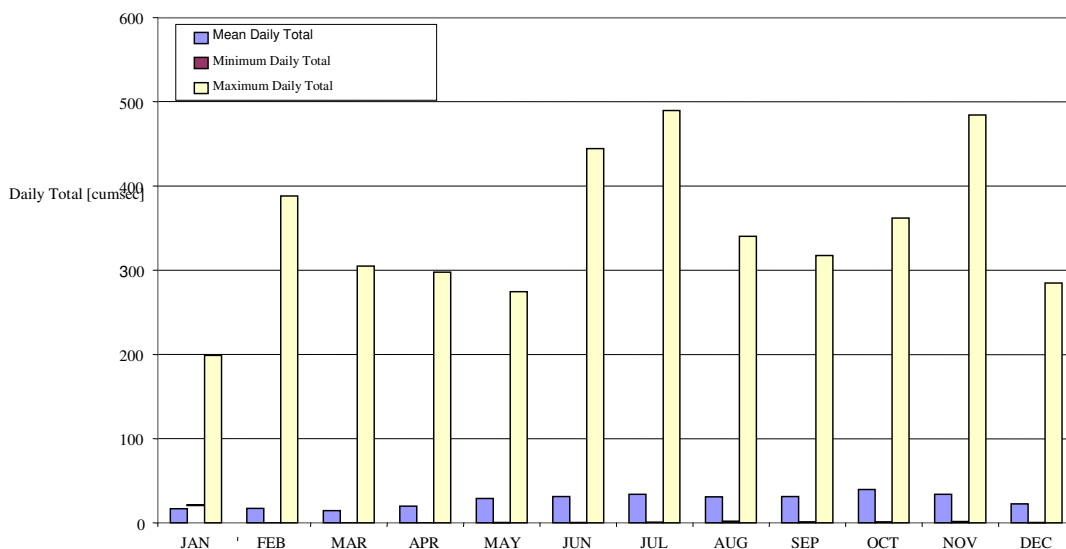
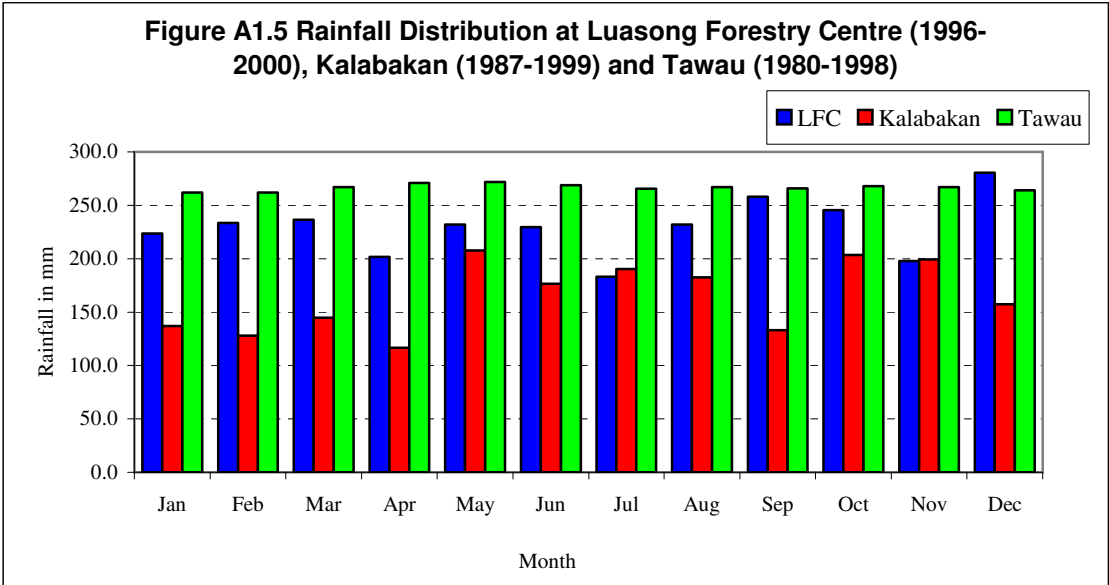


Figure A1.4 Thirteen years average of total daily discharge, and minimum and maximum daily discharge recorded at Station Kalabakan by the Department of Irrigation, Sabah.





A1.3 EXISTING BIOLOGICAL ENVIRONMENT

A1.3.1 Terrestrial Fauna Ecology

The Proposed Project site, which is within the Yayasan Sabah Concession Area (**Figure 4.4.1**) is located within the proposed Wildlife District earmarked by the Wildlife Department Sabah. This Tawau Wildlife District is considered one of the most diverse fauna population district in Sabah. So far, there is a record of at least 189 species of land mammals and of which 42 species are endemic to the State. The birds recorded to be about 540 species (Yasuma & Andau, 1999) representing 60 families. Other species like the snakes, turtles, lizards, frogs and insects are also reported to be quite diverse.

Within the YS Management Area, a record of 86 species of mammals, 306 species of birds, 8 species of amphibia and 7 species of reptiles^{A1} were documented as shown in **Tables A1.2 and A1.3**. Despite the diverse fauna population, the Wildlife Department have not been able to implement the Wildlife programme or management in the District because of certain constraints (as per comm. with Wildlife Department's Officer, Tawau District, January 2001).

For this SEIA, the assessment looks into the existing environment and ground truthings were carried out (see **Annex B1.3.1**) based on the existing information and the impact of landuse changes on the wildlife. Surveys were carried out within and surround the proposed Project site and the findings are shown in **Annex B1.3.1**.

^{A1} The last two has not been fully studied as yet by the Tawau Wildlife Department (as per comm. with Wildlife Department's Officer, Tawau District, Jan 2001).

Table A1.2: List of Mammals, Reptiles and Amphibians in Gunung Rara F.R., Brantian F.R., Kalabakan F.R., Imbak, Sapulut, Luasong and Kuamut**Mammals**

Common Name	Scientific Name	GR	B	KB	IM	KB&S	L	KM
Moonrat	<i>Echinosorex gymnurus</i>	1				4		
House Shrew	<i>Suncus murinus</i>					4		
Sunda Shrew	<i>Crocidura monticola</i>	1				4		
South-east White Tooted Shrew	<i>C. fuliginosa</i>					4		
Pentail Treeshrew	<i>Ptilocercus lowii</i>					4		
Common Treeshrew	<i>Tupaia glis</i>	1	2	2				
Mountain Treeshrew	<i>T. montana</i>					4		
Lesser Treeshrew	<i>T. minor</i>					4		
Slender Treeshrew	<i>T. gracilis</i>					4		
Stripe Treeshrew	<i>T. dorsalis</i>					4		
Smooth Tailed Treeshrew	<i>Dendrogale melanura</i>		2					
Large Treeshrew	<i>Tupaia tana</i>	1	2		2	4		
Short Tailed Mongoose	<i>Herpestes brachyurus</i>		2					
Large Flying Fox	<i>Pteropus vampyrus</i>	1						
Greater Sheath-tailed Bat	<i>Embalonura alecto</i>	1						
Lesser -Sheath-tailed Bat	<i>E. monticola</i>	1						
Borneon Horseshoe Bat	<i>Rhinolopus borneensis</i>	1						
Least Horseshoe Bat	<i>R. pusilus</i>	1						
Trefoil Horseshoe Bat	<i>R. trifoliatus</i>	1						
Lesser -Wooly Horseshoe Bat	<i>R. cervinus</i>	1						
Fawn Roundleaf Bat	<i>Hipposideros cervinus</i>	1						
Diadem Roundleaf Bat	<i>H. diadem</i>	1						
Small Wooly Bat	<i>Kerivoulinae intermedia</i>	1						
Least Wooly Bat	<i>K.minuta</i>							
Western Tarsier	<i>Tarsus bancanus</i>	1						
Hose's Langur	<i>Presbytis hosei</i>	1		1				
Maroon Langur	<i>P.rubicunda</i>	3		3	2	4		
Silver Leaf Monkey	<i>P. cristata</i>	1		1		4		
Proboscis Monkey	<i>Nasalis larvatus</i>	1	3	3		4		
Long-tailed Macaque	<i>Macaca fascicularis</i>	1	1	3	3	4	1	1
Pig-tailed Macaque	<i>M. nemestrina</i>	1	3	3	3	4	1	1
Borneon Gibbon	<i>Hylobates muelleri</i>	2	2	3	3	4	1	1
Orang Utan	<i>Pongo pygmaeus</i>	2	3	3		4	1	
Pangolin	<i>Manis javanicus</i>			1		4		
Giant Squirrel	<i>Ratufa affinis</i>	1		2		4		
Prevost Squirrel	<i>Callosciurus prevostii</i>	1		2	2	4		
Bornean Black-banded Squirrel	<i>C. orestes</i>	1						
Plantain Squirrel	<i>C. notatus</i>			2		4		
Ear-Spot Squirrel	<i>C. adamsi</i>			2				
Horse-tailed Squirrel	<i>Sundasciurus hippurus</i>	1						
Low's Squirrel	<i>S. lowii</i>	1		2		4		
Slender Squirrel	<i>S. tenuis</i>			2		4		
Red-Bellied Sculptor Squirrel	<i>Glyphotes simus</i>	1				4		
Four-striped Ground Squirrel	<i>Laricus hosei</i>	1						
Three-striped Ground Squirrel	<i>L. insignis</i>					4		

Common Name	Scientific Name	GR	B	KB	IM	KB&S	L	KM
Bornean Mt Ground Squirrel	<i>Dremomys everetti</i>					4		
Shrew-faced Ground Squirrel	<i>Rhinosciurus laticaudatus</i>	1				4		
Plain Pigmy Squirrel	<i>Exiliciurus exilis</i>	1	3	2		4		
Whitehead's Pygmy Squirrel	<i>Exilisciurus exilis</i>					4		
Black-eared Pygmy Squirrel	<i>Nannosciurus melanotis</i>	1						
Tufted Ground Squirrel	<i>Rheithrosciurus macrotis</i>	1				4		
Thomas' Flying Squirrel	<i>Aeromys thomasi</i>	1						
Jentink's Squirrel	<i>Sundasciurus jentinki</i>	2						
Brown Spiny Rat	<i>Maxomys rajah</i>	1						
Whitehead's Rat	<i>M. whiteheadi</i>	1						
Chestnut-bellied Spring Rat	<i>M. ochraceiventer</i>		2					
Common Porcupine	<i>Hystrix brachyura</i>	1		3			1	
Thick-spined Porcupine	<i>Thecurus crassispinis</i>			2				
Sun Bear	<i>Helarctos malayanus</i>	3	2	3	3	4	1	1
Yellow-throated Marten	<i>Martes flavigula</i>	1		2		4		
Teludu or Malay Badger	<i>Maydaus javanensis</i>	1		2		4		
Hairy-nosed Otter	<i>Lutra sumatrana</i>	1	1					
Oriental Small-clawed Otter	<i>Aonyx cineria</i>	1	3	2		4		
Smooth Otter	<i>Lutra perspicillata</i>				2			
Malay Civet or Tangalung	<i>Viverra zangalunga</i>	3		3		4		
Banded Linsang	<i>Prionodon linsang</i>	1		2		4		
Masked Palm Civet	<i>Paguma larvatus</i>			3				
Binturong	<i>Arctictis binturong</i>			3				
Banded Palm Civet	<i>Hemigalus derbyanus</i>	1						
Hose's Civet	<i>H. hosei</i>	1						
Common Palm Civet	<i>Paradoxurus hermaphroditus</i>			2		4		
Hose's Mongoose	<i>Herpestes hosei</i>							
Short-tailed Mongoose	<i>H. brachyurus</i>					4		
Clouded Leopard	<i>Neofelis nebulosa</i>	1		3		4	1	1
Marbled Cat	<i>Felis marmorata</i>	1						
Bay Cat	<i>F. badia</i>	1						
Leopard cat	<i>F. bengalensis</i>	1		3		4	1	
Asian Elephant	<i>Elephas maximus</i>	3	3	3	3	4	1	1
Asian Two-horned Rhino	<i>Dicerorhinus sumatrensis</i>	1		3		4		
Bearded Pig	<i>Sus barbatus</i>	3	3	3	3	4	1	1
Lesser mouse-deer	<i>Tragulus javanicus</i>	3	3	3	3	4	1	1
Greater Mouse-deer	<i>T. napu</i>	3	3	3	1	4	1	1
Red Muntjac	<i>Muntiacus muntjac</i>	3	3	3	3	4	1	1
Bornean Yellow Muntjac	<i>M. arterodes</i>	1	1	3	1	4	1	1
Sambar Deer	<i>Cervus unicolor</i>	3	3	3	3	4	1	1
Tembadau	<i>Bos javanicus</i>	1	3	1	3	4	1	1
	Total	61	22	39	16	49	16	13

Common Name	Scientific Name	GR	B	KB	IM	KB&S	L	KM
Amphibian								
Long Fingered Slender Toad	<i>Ansonia longidita</i>	2						
Giant River Toad	<i>Bufo juxtasper</i>	2						
Blyth's Frog	<i>Rana blythi</i>	2						
White-lipped Frog	<i>Rana chalconata</i>	2						
Poisonous Rock Frog	<i>Rana hosei</i>	2						
Grass Frog	<i>Rana limnocharis</i>	2						
Rock Skipper	<i>Staurois latopalmtatus</i>	2						
Slender Letter Frog	<i>Leptolata dringi</i>	2						
	Total	8						

Reptiles

Reticulated Python	<i>Python reticulatus</i>	2						
Yellow Ringed Cat Snake	<i>Boige dendrophila</i>	2						
Hamadryad (King Cobra)	<i>Ophiophagus hannah</i>	2						
Asian Leaf Turtle	<i>Cyclemys dentata</i>	2						
Water Monitor Lizard	<i>Varanus Salvator</i>		2		2			
	Total	4	1		1			

Key to Table:

GR: Gunung Rara

B: Brantian

KB: Kalabakan

IM: Imbak

KB&S: Kalabakan and Sapulut

KM: Kuamut

1: Recorded prior to 1996

2: New records between 1996 to Oct 2000

3: Detected both prior to 1996 and also up to Oct 2000

4: Detected during the Wildlife survey FMU 25 in Oct 2000

Table A1.3: List of Birds in Gunung Rara F.R., Brantian F.R., Kalabakan F.R, Imbak, Sapulut, Luasong and Kuamut

Common Name	Scientific Name	GR	B	KB	IM	KB& S	KM	L
Oriental Darter	<i>Anhinga melanogaster</i>	3	2	2	3		1	
Chinese Egret	<i>Egretta eulophotes</i>	1						
Dusky Grey Heron(Great - billed)	<i>Arden sumatrana</i>	3		1			1	
Black Bittern	<i>Dupetor flavicollis</i>	2						
Bat Hawk	<i>Machaerhamphus alcinus</i>	1	1	1			1	
Crested Goshawk	<i>Accipiter trivirgatus</i>			2		4		
Besra	<i>A. virgatus</i>					4		
Jerdon's Baza	<i>Aviceda jerdoni</i>			2				
Brahminy Kite	<i>Haliastur indus</i>	3		3	3			
Grey-headed Fish Eagle	<i>Ichthyophaga ichthyaetus</i>	1						
Lesser Fish Eagle	<i>I. Humilis</i>	1			2			1
Black Eagle	<i>Ictinaetus malayensis</i>			2				
Crested Serpent Eagle	<i>Spilornis cheela</i>	3	1	3	3	4	1	
Blyth's Hawk-Eagle	<i>Spizaetus alboniger</i>	2					1	
Grey-faced Buzzard	<i>Butastur indicus</i>			2				
White-fronted Falconet	<i>Microhierax latifrons</i>	2				4		
Blue-breasted Quail	<i>Coturnix chinensis</i>	1		3			1	
Ferruginous Partridge	<i>Calaoperdix oculea</i>			3			1	
Crested Wood Partridge	<i>Rollulus rouloul</i>	1		1		4	1	
Crimson-headed Partridge	<i>Haematortyx sanguiniceps</i>	1						
Scaly-breasted Partridge	<i>Aborophila charltoni</i>	1		1		4		
Crested Fireback	<i>Lophura ignita</i>	1		1	3	4	1	
Bulwers Pheasant	<i>L. bulweri</i>	1						
Great Argus	<i>Argusianus argus</i>	3	1	3		4	1	
White- breasted Waterhen	<i>Amaurornis phoenicurus</i>	1		3				
Malaysian plover	<i>Charadrius peronii</i>	1		1			1	
Greater Sand Plover	<i>C. leschenaulti</i>	1	1	1				
Wood Sandpiper	<i>Tringa glareola</i>	1		1			1	
Common Sandpiper	<i>T. hypoleucos</i>			1				
Red-necked Phalarope	<i>Phalaropus lobatus</i>			1			1	
Large Green Pigeon	<i>Treron capellei</i>	1	1	3		4	1	
Little Green Pigeon	<i>T. olax</i>	1	1	3				
Green Imperial Pigeon	<i>Ducula aenea</i>	1		3		4	1	
Mountain Imperial Pigeon	<i>D. badia</i>	1		2				
Jambu Fruit Dove	<i>Ptilinopus jambu</i>	1	1	1	3		1	1
Black-naped Fruit dove	<i>P. melanospila</i>	1		1			1	
Emerald Dove	<i>Chalcophaps indica</i>	3		2		4		
Spotted Dove	<i>Streptopelia chinensis</i>	1	2	1				
Red - Cuckoo Dove	<i>Macropygia phasianella</i>			2				
Little Cuckoo Dove	<i>M. ruficeps</i>			2				
Long-tailed Parakeet	<i>Psittacula longicauda</i>				3	4	1	
Blue-crowned Hanging Parrot	<i>Loriculus galgulus</i>	1	2	3				
Blue-rumped Parrot	<i>Psittinus cyanurus</i>			2		4		

Common Name	Scientific Name	GR	B	KB	IM	KB& S	KM	L
Hodgson's Hawk-Cuckoo	<i>Cuculus fugax</i>	1						
Indian Cuckoo	<i>C. micropterus</i>	1		1				
Banded Bay Cuckoo	<i>Cacomantis sonneratii</i>	1		3				
Plaintive Cuckoo	<i>C. merulinus</i>	1		3	2	4		
Violet Cuckoo	<i>Chrysococcyx xanthorhynchus</i>	1						
Drongo Cuckoo	<i>Surniculus lugubris</i>	1		3		4		
Raffle's Malcoha	<i>Phaenicophaeus chlorophaeus</i>	1	2	3		4		
Red-billed Malcoha	<i>P. javanicus</i>					4		
Black-bellied Malcoha	<i>P. diardi</i>	1		2		4		
Chestnut-bellied Malcoha	<i>P. sumatranus</i>	1	2	3	3	4		
Greater Coucal(Common)	<i>Centropus sinensis</i>	3		3	2	4		
Short-toed Coucal	<i>C. rectunguis</i>			1		4		
Lesser Coucal	<i>C. bengalensis</i>			2				
Sunda Ground-Cuckoo	<i>Carpococcyx radiceus</i>	1		3				
Malayan Bronze Cuckoo	<i>Chrusococcyx minutillus</i>			2				
Mountain Scops-Owl	<i>Otus spilocephalus</i>	1		1				
Brown Boobook(B.Hawk Owl)	<i>Ninox scutulata</i>	1						
Brown Wood Owl	<i>Strix leptogrammica</i>	1						
Buffy Fish Owl	<i>Ketupa ketupu</i>	2						
Blyth's(Javan) Frogmouth	<i>Batrachostomus javensis</i>	1		1				
Malaysian Eared Nightjar	<i>Eurostopodus termickii</i>	1						
Savanna Nightjar	<i>Caprimulgus affinis</i>			2				
Black-nest Swiftlet	<i>Collocalia maxima</i>	1	1	1				
Giant Swiftlet	<i>Hydrochous gigas</i>			2				
Glossy Swiftlet(White-bellied)	<i>C. esculenta</i>	1	3	3		4		
Mossy-nest Swiftlet	<i>C. vanikorensis</i>			2				
Brown-backed Neededtail	<i>Hirundapus giganteus</i>	1	2	3		4		
Silver-rumped Swift	<i>Rhaphidura leucopygialis</i>	1		2				
House Swift(Little)	<i>A. afinis</i>	1						
Whiskered treeswift	<i>Hemiprocne comata</i>	1		3				
Grey-rumped Treeswift	<i>H. longipennis</i>	1		3		4		
Diard's Trogon	<i>Harpactes diardii</i>	1		1		4		
Red-naped Trogon	<i>H. kesumba</i>	1		1		4		
Scarlet-rumped Trogon	<i>H. duvaucelli</i>	3		3		4		
Cinnamon-rumped Trogon	<i>H. orrhophaeus</i>	1		3				
Orange-breasted Trogon	<i>H. oreskios</i>		1					
Black-capped Kingfisher	<i>Halcyon. pileata</i>	1	1	1				
Stork-billed Kingfisher	<i>Pelargopsis capensis</i>	1		1	2	4		
Collared Kingfisher	<i>Todirhamphus chloris</i>	1	1	1	3			
Banded Kingfisher	<i>Lacedo pulchella</i>	1			2	4		
Rufous-collared kingfisher	<i>Actenoides conctretus</i>	1		1		4		
Blue-eared kingfisher	<i>Alcedo mininting</i>	3		3		4		
Blue-banded kingfisher	<i>A. euryzona</i>	1		1		4		
Black-backed Kingfisher	<i>Ceyx erithacus</i>	1		3		4		
Rufous-backed Kingfisher	<i>Actenoides rufidorsa</i>	1						
Blue-throated Bee-eater	<i>Merops viridis</i>			2		4		

Common Name	Scientific Name	GR	B	KB	IM	KB& S	KM	L
Red-bearded Bee-eater	<i>Nyctyonis amictus</i>	1		3		4		
Dollarbird	<i>Eurystomus orientalis</i>	1		1		4		
White-crown Hornbill	<i>Aceros comatus</i>	1	1	2		4		
Bushy-crested Hornbill	<i>Anorrhinus galeritus</i>	1	1	3		4		
Wrinkled Hornbill	<i>Aceros corrugatus</i>	1	3	3		4		
Wreathed Hornbill	<i>A. undulatus</i>	1	1	3				
Black Hornbill	<i>Anthracoceros malayanus</i>	3	3	3	3	4		
Pied Hornbill	<i>A. coronatus</i>	1	1	3		4		
Rhinoceros Hornbill	<i>Buceros rhinoceros</i>	3	3	3	3	4		
Helmeted Hornbill	<i>B. vigil</i>	3	2	3	3	4		
Gold-wiskered Barbet	<i>Megalaima chrysopogon</i>	1		3		4	1	
Brown Barbet	<i>Calorhamphus fuliginosus</i>	1		2		4		
Red-crowned Barbet	<i>Megalaima rafflesia</i>	3	2	3		4	1	
Golden naped Barbet	<i>M. pulcherrima</i>	2		2				
Yellow-crowned Barbet	<i>M. henricii</i>	3		3		4	1	
Mountain Barbet	<i>M. monticola</i>	1		2				
Black-throated Barbet(Bornean)	<i>M. eximia</i>	1						
Blue-eared Barbet	<i>M. australis</i>	1	2	2		4		
Red-throated Barbet(Gaudy)	<i>M. mystacophanos</i>		2	3	2			
Many-coloured Barbet	<i>M. rafflesii</i>			2			1	
Rufous Piculet	<i>Sasia abnormis</i>	1		3		4	1	
Speckled Piculet	<i>Picumnus innominatus</i>	1		1		4		
White-bellied Woodpecker	<i>Drycopus javensis</i>	1		3		4		
Crimson-winged Woodpecker	<i>Picus puniceus</i>	1		3		4		
Checker-throated Woodpecker	<i>P. mentalis</i>			2				
Olive-backed Woodpecker	<i>Dinopium refflesii</i>	1	1	1		4	1	
Banded Woodpecker	<i>Picus miniaceus</i>	1		3			1	
Grey-capped Woodpecker	<i>Dendrocopus canicapilus</i>	1	1	2		4	1	
Buff-rumped Woodpecker	<i>Meiglyptes tristis</i>	1		3		4	1	
Buff-necked Woodpecker	<i>M. tukki</i>	1		2		4		
Grey-and-Buff-Woodpecker	<i>Hemicircus concretus</i>	1		1		4		
Great Salty Woodpecker	<i>Mulleripicus pulverulentus</i>	1		3		4		
Orange-backed Woodpecker	<i>Reinwardtipicus validus</i>			3		4	1	
Rufous Woodpecker	<i>Celeus brachyurus</i>		1	2	3	4	1	
Maroon Woodpecker	<i>Blythipicus rubiginosus</i>			2		4	1	
Black-and-red Broadbill	<i>Cymbirhynchus macrorhynchus</i>		1	3		4	1	
Green Broadbill	<i>Calyptomena viridis</i>	1	1			4	1	
Hose's Broadbill	<i>C. hosei</i>			2				
Black-and-Yellow Broadbill	<i>Eurylaimus ochromalus</i>	1	1	3	2			
Banded Broadbill	<i>E. javanicus</i>	1	1	2		4	1	
Dusky Broadbill	<i>Corydon sumatranus</i>	1		3		4		1
Giant Pitta	<i>Pitta caerulea</i>	1		1				
Blue-banded Pitta	<i>P. arquata</i>			1		4		
Garnet Pitta	<i>P. granatina</i>			3				
Blue-winged Pitta	<i>P. moluccensis</i>	1		1			1	

Common Name	Scientific Name	GR	B	KB	IM	KB& S	KM	L
Banded Pitta	<i>P. gaujana</i>					4		
	<i>P. baudii</i>			1				
Pacific Swallow	<i>Hirundo tahitica</i>			3		4		
Large Wood-Shrike	<i>Tephrodornis virgatus</i>	1				4		
Bar-winged Flycatcher-Shrike	<i>Hemipus picatus</i>	1		2		4		
Black-winged Flycatcher Shrike	<i>Hemipus hirundinaceus</i>			2		4	1	
Black-faced Cuckoo Shrike	<i>Coracina larvata</i>			2				
Bar-bellied Cuckoo- Shrike	<i>C.striata</i>					4		
Lesser Cuckoo-Shrike	<i>C.fimbriata</i>					4		
Brown Shrike	<i>Lanius cristatus</i>					4		
Tiger Shrike	<i>Lanius tigrinus</i>			1			1	
Mountain Minivets (Grey-chinned)	<i>Pericrocotus solaris</i>		2	2				
Fiery Minivet	<i>Pericrocotus igneus</i>	1		2		4	1	
Scarlet-Minivet	<i>P.flammeus</i>					4	1	
Green lora	<i>Aegithina viridissima</i>	1		3		4		
Common lora	<i>A. tiphia</i>	1		2			1	
Lesser Green Leafbird	<i>Chloropsis cyanopogon</i>	1	2	2		4		
Greater Leafbird	<i>C. sonnerati</i>	1		2		4		
Blue-winged Leafbird	<i>C. cochinchinensis</i>			2				
Puff-backed Bulbul	<i>Pycnonotus eutilotus</i>			2		4		
Black and White Bulbul	<i>P. melanoleucos</i>			3			1	
Black-headed Bulbul	<i>P. atriceps</i>	1	2	3		4		
Grey-bellied Bulbul	<i>P. cayniventris</i>	1		3			1	
Olive-winged Bulbul	<i>P. plumosus</i>	1		3	2		1	
Spectacled Bulbul	<i>P. erythroptalmos</i>		2	2	2	4		
Red-eyed Bulbul	<i>P. brunneus</i>	2		2		4		
Straw-headed Bulbul	<i>P. zeylanicus</i>			2	2			
Pale-faced bulbul(Flavescent)	<i>P. flavescens</i>			2				
Scaly-breasted Bulbul	<i>P. squamatus</i>			2		4		
Cream-vented Bulbul	<i>P. simplex</i>			2		4		
Yellow-vented Bulbul	<i>P. goiavier</i>			2		4		
Black-crested Bulbul	<i>P. melanicterus</i>			2				
Nieuwenhuis's Bulbul	<i>P. niewenhuisi</i>			2				
Grey-cheeked Bulbul	<i>Alophoixus bres</i>	1				4		
Hairy-backed Bulbul	<i>Tricholestes criniger</i>	1		2	3	4	1	
Streak Bulbul	<i>Ixos malaccensis</i>	1	2	3	3	4		
Buff-and-Vented Bulbul	<i>Iole olivacea</i>	1		2		4		
Ashy Bulbul	<i>Hypsipetes flavala</i>			2				
Hook-billed Bulbul	<i>Setornis criniger</i>		2	2				
Ochraceous Bulbul	<i>Alophoixus ochraceus</i>			2				
Finsch's Bulbul	<i>Criniger finschii</i>			2		4		
Yellow-bellied Bulbul	<i>Alophoixus.phaeocephalus</i>					4		
Crow-billed Drongo	<i>Dicrurus annectans</i>	3		3		4	1	1
Bronze drongo	<i>D. aeneus</i>			3		4		
Spangle Drongo(Hair-crested)	<i>D. hottentottus</i>	1		2				
Greater Racket-tailed Drongo	<i>D. paradiseus</i>	3		3		4	1	
Ashy Drongo	<i>D. leucophaeus</i>			2				
Black-hooded Oriol	<i>Oriolus xanthornus</i>	1		3			1	

Common Name	Scientific Name	GR	B	KB	IM	KB& S	KM	L
Dark-throated Oriole	<i>O. xanthonotus</i>	1		3		4	1	
Black-and-Crimson Oriole	<i>O. cruentus</i>			2				
Asian Fairy-Bluebird	<i>Irena puella</i>			3	3	4	1	
Crested Jay	<i>Platylophus galericullatus</i>		1			4	1	
Black Magpie	<i>P. leucopterus</i>					4		
Large-Billed Crow	<i>Corvus macrorhyncos</i>	1	1	1				
Slender-billed Crow	<i>C. enca</i>	3	2	3		4		
Bornean Bristle-Head	<i>Pityrasis gymnocephala</i>	1		1	3	4	1	
Velvet-fronted Nuthatch	<i>Sitta frontalis</i>	1				4	1	
Black-capped Babbler	<i>Pelloreneum capistratum</i>		1	3		4	1	
Short-tailed Babbler	<i>Malacocincla malaccense</i>	1		3		4		
White-chested Babbler	<i>T. rostratum</i>	1	1	3		4		
Ferruginous Babbler	<i>T. bicolor</i>	1		3		4	1	
Abbott's Babbler	<i>Malacocincla abbotti</i>			2				
Horsefield's Babbler	<i>Malacocincla separium</i>			1		4		
Rufous-crowned Babbler	<i>Malacopteron magnum</i>	1		2		4	1	
Scaly-crowned Babbler	<i>M. cinereum</i>	1		2		4	1	
Moustached Babbler	<i>M. magnirostre</i>			3		4		
Sooty-capped Babbler(Plain)	<i>M. affine</i>	1		2		4		
Chestnut-backed Babbler	<i>Pomatorhinus montanus</i>			3		4		
Grey-throated Babbler	<i>Stachyris nigriceps</i>	1		3		4		
Black-throated Babbler	<i>S. nigricolis</i>	1		3			1	
Grey-headed Babbler	<i>S. poliocephala</i>	1		3		4		
Chestnut-winged Babbler	<i>S. erythroptera</i>	1		3	3	4	1	
Chestnut-rumped Babbler	<i>S. maculata</i>			2				
Rufous-fronted Babbler	<i>S. rufifrons</i>			1		4	1	
White-necked Babbler	<i>S. leucotis</i>	1					1	
Bornean Wren-babbler	<i>Ptilocichla leucogrammica</i>	2		1		4		
Striped-wren Babbler	<i>Kenopia striata</i>	1		3		4		
Black-throated Wren Babbler	<i>Napothera afrigularis</i>	1		1		4		
Eye-browed Wren Babbler	<i>N. epilepidota</i>	1		1				
Stripe-tit Babbler	<i>Macronous gularis</i>	1		3		4		
Fluffy-backed Tit Babbler	<i>M. ptilosus</i>	1	1	2		4		
Brown Fulvetta	<i>Alcippe brunneicauda</i>	1		2		4		
Chesnut-crested Yuhina	<i>Yuhina everetti</i>	1		1				
White-bellied Yuhina	<i>Y. zantholeuca</i>	1		1		4		
Black Laughingthrush	<i>Garrulax lugubris</i>	1		1			1	
Sunda Laughingthrush	<i>G. pilliatus</i>	1		3				
Chestnut-capped Laughingthrush	<i>G. mitratus</i>	1		3			1	
White-browed Shrike Babbler	<i>Pteruthius flaviscapis</i>			3			1	
Rufous-tailed Shama	<i>Trichixos pyrroppygus</i>			3		4	1	
Magpie robin	<i>Copsychus saularis</i>	1	2	2	2		1	
White-rumped Shama	<i>C. malabaricus</i>	3	2	3	3	4	1	
White-browed Shama	<i>C. stricklandi</i>					4		
White-crowned Forktail	<i>Enicurus leschenaulti</i>	1	2	3		4	1	

Common Name	Scientific Name	GR	B	KB	IM	KB& S	KM	L
Chestnut-naped Forktail	<i>E. ruficapillus</i>		2	2		4	1	
Chestnut-capped Thrush	<i>Zoothera interpres</i>					4		
Sunda Whistlingthrush	<i>Myophonus glaucinus</i>			2				
Flyeater(Golden-bellied Greygone)	<i>Greygone sulphurea</i>	1	1	1		4	1	
Oreintal Reed Warbler	<i>Acrocephalus orientalis</i>					4		
Arctic Warbler	<i>Phylloecopus borealis</i>	1		2		4		
Mountain-leaf Warbler	<i>P. trivirgatus</i>			3			1	
Yellow-bellied Warbler	<i>Abroscopus superciliaris</i>	1		3	3	4		
Yellow-breasted Warbler	<i>Seicercus montis</i>			2				
Yellow-bellied Prinia	<i>Prinia flayiventris</i>	1	3	3		4	1	
Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>	1	3	3		4		
Rufous tailed Tailorbird	<i>O. sericeus</i>	1	2	2		4		
Ashy Tailorbird	<i>O. ruficeps</i>	1	1	3	3	4		
Mountain Tailorbird	<i>O. cuculatus</i>			2				
Grey-headed Flycatcher	<i>Culicicapa ceylonensis</i>	1		1		4	1	
Dark-sided Flycatcher	<i>Muscicapa sibirica</i>	1	1	2		4	1	
Ferruginous Flycatcher	<i>M. furruginea</i>	1	2				1	
Verditer Flycatcher	<i>Eumyias thalassinia</i>			1			1	
Indigo Flycatcher	<i>E indigo</i>	1		1				
Asian Brown Flycatcher	<i>M. dauurica</i>					4		
Mangrove Blue Flycatcher	<i>Cyornis rufigastra</i>		2					
Blue and White Flycatcher	<i>Cyonoptila cyanomelana</i>		2	1			1	
Sunda Blue Flycatcher	<i>Cyornis caerulatus</i>		1	1				
Bornean Blue Flycatcher	<i>C.superba</i>	1					1	
Little Pied Flycatcher	<i>Ficedula westermanni</i>			2			1	
Mugimaki Flycatcher	<i>F. mugimaki</i>	1	1	1			1	
Rufous-chested Flycatcher	<i>F. dumetoria</i>	1			2		1	
Narcissus Flycatcher	<i>F. narcissina</i>	1		1			1	
Rufous-tailed Flycatcher	<i>Rhinomyias ruficauda</i>	1		1			1	
Maroon-breasted Flycatcher	<i>Philentoma velatum</i>	1		1				
Asian Paradise Flycatcher	<i>Tersiphone paradisi</i>	3	2	3	2		1	
White-tailed Flycatcher	<i>Cyornis concretus</i>			3			1	
Pale Blue Flycatcher	<i>C. unicolor</i>			2				
White-throated Fantail	<i>Rhiphidura albicollis</i>			3			1	
Spotted Fantail	<i>R. perlata</i>			3		4		
Pied Fantail	<i>R. javanica</i>			2				
Black-naped Monarch	<i>Hypothymis azurea</i>	1		3				
Grey Wagtail	<i>Motacilla cinerea</i>			1		4	1	
Yellow Wagtail	<i>M. flava</i>	1		1		4	1	
Richard's Pipit(Common)	<i>Anthus novaesslandiae</i>	1		1				
Philippine Glossy Starling	<i>Aplonis panayensis</i>				3	4	1	
Hill Myna	<i>Gracula religiosa</i>	3	3	2	2	4	1	
Plain-throated Sunbird	<i>A.anthreptes</i>	1		3				
Ruby-cheeked Sunbird	<i>A. singalensis</i>	1		3		4		
Purple-naped Sunbird	<i>Hypogramma hypogrammicum</i>	3		3		4	1	
Purple-throated Sunbird	<i>Nectarinia separata</i>					4		
Olive-backed Sunbird	<i>N. jugularis</i>	1		2			1	

Common Name	Scientific Name	GR	B	KB	IM	KB& S	KM	L
Crimson Sunbird	<i>Aethopyga siparaja</i>	1		3	2	4	1	
Temminck's Sunbird	<i>A. temminckii</i>					4		
Plain Sunbird	<i>Anthreptes simplex</i>			2		4		
Scarlet Sunbird	<i>Aethopyga mystacalis</i>			2				
Red-throated Sunbird	<i>A. rhodolaema</i>			2		4		
Little Spiderhunter	<i>Arachnothera longirostra</i>	3	2	3	3	4		
Whitehead's Spiderhunter	<i>A. juliae</i>			2				
Thick-billed Spiderhunter	<i>Arachnothera crassirostris</i>		2	2		4		
Grey-breasted Spiderhunter	<i>A. affinis</i>	1		2		4	1	
Long-billed Spiderhunter	<i>A. robusta</i>			2				
Spectacled Spiderhunter	<i>A. flavigaster</i>			2		4		
Yellow-eared Spiderhunter	<i>A. chrysogenys</i>			2		4		
Yellow-rumped Flowerpecker	<i>P. xanthopygius</i>	1		3		4	1	
Crimson-breasted Flowerpecker	<i>P. percussus</i>	1		3			1	
Scarlet-breasted Flowerpecker	<i>Prionochilus thoracicus</i>			2			1	
Yellow-breasted Flowerpecker	<i>P. maculatus</i>	1		3		4	1	
Yellow-vented Flowerpecker	<i>Dicaeum chrysorrheum</i>	1		3			1	
Plain Flowerpecker	<i>D. concolor</i>	1		2			1	
Black-sided Flowerpecker	<i>D. monticulum</i>	1		3			1	
Scarlet-backed Flowerpecker	<i>D. cruentatum</i>	1		1				
Brown-backed Flowerpecker	<i>D. everetti</i>			2				
Orange-bellied Flowerpecker	<i>D. trigonostigma</i>	1				4		
Thick-billed Flowerpecker	<i>D. agile</i>					4		
Oriental White Eye	<i>Zosterops palperbrosa</i>		2					
Black-capped White-eye	<i>Z. atricapilla</i>	1		2			1	
Everett's White eye	<i>Z. everetti</i>			2		4		
Pigmy White eye	<i>Oculocinta squimifrons</i>	1		1				
Eurasian Tree Sparrow	<i>Passer montanus</i>					4		
Dusky Munia	<i>Lonchura fuscans</i>			3		4	1	
Chestnut Munia	<i>L. ferruginosa</i>	1	1	3			1	
White-bellied Munia	<i>L. leucogastra</i>					4		
Tawny-breasted Parrot Finch	<i>Erythrura hyperythra</i>			2				
	Total	193	69	255	37	165	102	4

Key to Table:

GR: Gunung Rara	1: Recorded prior to 1996
B: Brantian	2: New records between 1996 to Oct 2000
KB: Kalabakan	3: Detected both prior to 1996 and also up to Oct 2000
IM: Imbak	4: Detected during the Wildlife survey FMU 25 in Oct 2000
KB&S: Kalabakan and Sapulut	
KM: Kuamut	

A1.3.2 Flora Ecology and Forest Resources

A1.3.2.1 Flora Ecology

Methodology

The Project Site had been exposed to different regimes of logging at different times with the exception of the very steep ridges. Owing to these different logging intensities different vegetation types remained. At the heavily logged sites, especially on gentle slopes, most of the big trees had been removed with the dominance of the secondary species of *Macaranga gigantea* where in some sites these trees form a pure stand. The ridges and steep slopes are sites still with the original vegetation.

To assess the types of residual vegetation, a ground inspection and aerial survey was carried out in the last week of November 2004 to all the coupes within the Project site (**Figure A1.6**) and this was followed by an aerial survey carried out with a helicopter at 3,000 ft on 29 November 2004 (**Figure A1.7**). To determine the location of each site inspected GPS readings were recorded. The survey information was supplemented with harvesting plans, records and information provided by the field staffs of Yayasan Sabah at Luasong Field Centre. Records from the previous two EIAs carried out in the same region in 2001 were also used for reference after being updated (Chemsain Konsultant Sdn Bhd, 2002).

Existing Environment

The forest within the Project site can be defined mainly as Lowland Mixed Dipterocarp Forest Formation following definition of Ashton (1995) with the exception of the high ridges of G. Nakopan (BW9/00) at 1333m and G. Tampilat at 1083m (BW 9/02) and G. Tembuku at 1021m in Brantian Tatulit VJR, which fall into the Montane Forest. Although generally below the 700m elevation the project site has many hilly areas with terrains of over 25 degrees in addition to being dissected by many rivers. The steeper slopes are of sandstone outcrops that are characterised by narrow ridges (Williams, Talhar & Wong, 1995). With the many rivers there are the riparian vegetation belts within the Project area with their unique set of flora. These variations of habitat types have resulted in specific niches for different plant communities. In addition to these edaphic features, the previous logging history has also created different habitats allowing specific floristic variations. With the many rivers there are the many riparian vegetation belts within the Project area with their unique set of vegetation. See vegetation distribution in **Figure A1.8**.

Members of the Dipterocarpaceae, which are most important commercially, form the dominant species of this forest type. This is supported by the data collected by the Linear Regeneration Sampling Reports of 1984 to 1991 conducted by the Forestry Division of Innoprise Sendirian Berhad in the Project site (Rakyat Berjaya Sdn Bhd 1989, 1992). In Kalabakan Forest Reserve, which covers most part of the Project site, there were 37.1 trees per hectare of advance growth (10<60cm dbh) two to three years after harvesting (Anon 1992). Of these 28.6 trees were within the Regenerating Sampling List and 23.7 trees were from the Dipterocarpaceae. In the blocks marked as YT A2/87 and YT 2/87 under the first logging exercise in the 1980s, which are now located within Coupe BW 12/02 in the present harvesting, 77.74% of the total volume of remaining timber trees with diameter over 30cm are from the members of the Dipterocarpaceae (**Table A1.4**). Many residual trees from this family were recorded in the field inventory carried out for the SEIA for the industrial tree plantation project of 2002. Members of the Euphorbiaceae and Leguminosae are also common. A list of the common trees recorded in the SEIA 2002 is in **Table A1.10**.

Table A1.4: Inventory of residual trees over 30cm diameter in logged over forest BW12/02

Species group	Coupe no.	
	YT A2/87	YT 2/87
Coupe area	1,536 ha	960 ha
Total stand >30cm	31.4 m3/ha	44.71 m3/ha
Red seraya (<i>Shorea leprosula</i> and <i>S. smithiana</i>)	21.90%	17.72%
White seraya (<i>Parashorea malaanonan</i> and <i>P. tomentella</i>)	14.80%	15.41%
Yellow seraya (<i>Shorea acuminatissima</i> , <i>S. gibbosa</i> , <i>S. faguetiana</i> and other <i>Shorea</i> with yellow wood)	4.55%	8.17%
Kapur (<i>Dryobalanops</i> species)	9.92%	15.48%
Keruing (<i>Dipterocarpus</i> species)	12.21%	8.45%
Selangan Batu (Heavy Hopea species and heavy and medium density <i>Shorea</i> species)	17.52%	5.45%
Melapi (<i>Shorea bracteolata</i> , <i>S. smingtonii</i> and other species of <i>Shorea</i> having whitish wood)	3.47%	0.43%
Belian	0.19%	0.00%
Binuang	0.00%	0.13%
Nyatoh	0.04%	0.04%
Sepitir	0.46%	1.23%
Kembang	2.59%	0.80%
Merbau	0.27%	0.47%
Other timber species	12.07%	26.20%

Although the project area lies mostly within the lowland forest its various topographic features together with the previous logging history have created different habitats allowing specific floristic variation within the project area. The different logging regimes determined various harvesting intensities at different terrain types leaving different amount of residual trees. Very intensive logging activities conducted in the 1970s and 80s resulted in massive opening of the forest canopy along gentle slopes and undulating areas resulting in the absence of many commercial trees. Following logging the number of big trees remaining within a hectare of Kalabakan Forest Reserve was 19.1 individuals and only 23% were of quality 1 (Anon, 1992). Re-entry logging and fire had further reduced the density of large trees (**Plate A1-1 in Figure A1.9**). Secondary forest species dominate some of the coupes examples in BW 12/01 (**Plate A1-2 in Figure A1.9**) and BW2/00(1) (**Plate A1-3 in Figure A1.9**). Recent logging carried out for the establishment of the proposed industrial tree plantation has further reduced the forested areas.

Owing to the reduced intensity of harvesting along steep ridges, a number of large trees are left behind. In a rich forest on ridges of BW1/00 the volume of trees with diameters above 60 cm is given in **Table A1.5**. There is a good dominance of Dipterocarpaceae in the coupe.

TABLE A1.5: Net volume per ha by species group in the different forest strata of BW 1/00

Species	Volume per hectare (Trees >60cm dbh)			
	Class 1 460 ha	Class 2 210 ha	Class 3 1210 ha	Class 4 210 ha
Red seraya (<i>Shorea leprosula</i> & <i>S. smithiana</i>)	13.34	26.34	22.01	no data
White seraya (<i>Parashorea malaanonan</i> & <i>P. tomentella</i>)	4.21	2.89	9.21	no data
Yellow seraya (<i>S. accuminatissima</i> , <i>S. gibossa</i> , <i>S. faguetiana</i> and other species of <i>Shorea</i> with yellow wood)	9.47	4.660	14.64	no data
Oba suluk (<i>S. pauciflora</i>)	5.60	0	0	no data
Kapur (<i>Dryobalanops</i> spp.)	0	1.19	0	no data
Keruing (<i>Dipterocarpus</i> spp.)	0.90	1.71	0	no data
Selangan batu (Heavy Hopea and <i>Shorea</i> spp. Medium heavy <i>Shorea</i>)	2.78	5.28	8.28	no data
Other Dipterocarps	1.2	2.28	0	no data
Merbau (<i>Intsia palembanica</i>)	0	1.19	0	no data
Other Non-Dipterocarps	0	1.71	1.71	no data
Fruit trees	0	5.18	6.36	no data

Forest strata classification based on Timber Volume 1995/1996 aerial photographs

Class 1: Low timber stand logged heavily with remnant trees

Class 2: Medium timber stand. Remnant of timber stands in steep terrain

Class 3: Very high timber stand. Steep terrain and high elevation. In this coupe confined to riparian reserve

Class 4: Very low timber stand

Pre reentry harvesting assessment carried out in 1990s by Innoprise Sdn Bhd. for this coupe showed that 57.9% of the 2,090ha have timber volume of 60 m³ /ha. In BW4/00(A) and BW4/0(B) covering an undulating 13,882 ha, only 4.1% of the area have timber volume of 60 m³ /ha while in the very gentle coupe, BW3/00, the volume of residual trees was very low with nothing above 60 m³ /ha while only 4.7% of its 1,708ha have volume of 20 m³ /ha. The low volume of large trees in some coupes resulted from the dominance of secondary tree species especially *Macaranga gigantea* which had invaded openings created during harvesting. The large forest fire of Borneo in 1980s further aggravated the situation resulting in pure stands of this species within some coupes. The distribution of these vegetation types is presented in **Figure A1.8**.

The Project area is divided into two main blocks with the bigger block in the east while the smaller one is located in the south-west. There are 43 coupes in the eastern block stretching from the main Tawau-Luasong main road at the south and Sg. Kuamut in the north with Sabah Softwoods Berhad plantation on the east. This portion is also the first site to be converted into Industrial Tree Plantation with planting of *Acacia mangium* beginning 2000 in six of the coupes. The other block has 8 coupes stretching north and south of the main Kalabakan-Keningau road. It is bordered at the north-west by INIKEA Project with Luasong Forestry Project to the north and Sabah Softwoods Berhad at the east. Both these blocks proposed for the Project were harvested under the North Borneo Company mainly during mid 1970s to mid 1980s (**Table A1.6**).

Table A1.6 Logging history of some of the coupes within the Project area

Coupe No.	Area (ha)	Originally logged
BW1/98	1,615	1975
BW2/98	1,875	1975
BW3/98	1,560	1975
BW4/98	2,885	1984
BW 5/98	1,445	1983
BW2/00	5,462	mid 1970s
BW3/00	1,708	mid 1970s
BW4/00(A)	7,302	1978
BW4/00(B)	6,580	1975
BW5/00	1,763	mid 1970s
BW9/00	4,803	1988, 1989, 1991 & 1993
BW10/00	2,865	mid 1970s
BW11/00	2,500	1984
BW1/00	2,090	Part in 1980s
BW1/01	1,213	mid 1970s
BW2/01	4,208	mid 1970s
BW3/01	1,907	mid 1970s
BW9/01	5,000	1985
BW11/01	2,500	1983

Within the Project area there are coupes that have been cleared of all original vegetation and some were planted. In the first block, 12 coupes had been cleared of vegetation and 7 had been established with *Acacia mangium* trees (**Table A1.7**).

Table A1.7 Coupes that have been planted with *Acacia mangium* or cleared of all vegetation

Coupe No.	Area (ha)	Existing condition
BW1/98	1,615	Established with <i>Acacia mangium</i>
BW1/99	2,230	Established with <i>Acacia mangium</i>
BW2/98	1,875	Established with <i>Acacia mangium</i>
BW2/00(II)	2,410	All vegetation cleared
BW3/99	1,713	All vegetation cleared
BW3/98	1,560	Established with <i>Acacia mangium</i>
BW4/98	2,885	Established with <i>Acacia mangium</i>
BW4/00(B1)	3,170	Established with <i>Acacia mangium</i>
BW4/99	2,140	All vegetation cleared
BW5/98	2,115	Established with <i>Acacia mangium</i>
BW5/99	1,445	All vegetation cleared
BW5/00	1,494	All vegetation cleared
Total	24,652	

Plate A1-4 in Figure A1.9 shows BW 3/99 where all vegetation had been cleared and an older area in BW1/99 that was cleared in 2002 and planted with *Acacia mangium* is shown in **Plate A1-5 in Figure A1.9**.

For the remaining coupes, salvage logging are now in progress within those shown in **Table A1.8**.

Table A1.8 Coupes that are now undergoing salvage logging

Coupe No.	Area (ha)	Existing condition
BW2/99	2,280	Salvage logging in progress
BW9/99	5,306	Salvage logging in progress
BW1/00	1,407	Salvage logging in progress
BW2/00(1)	2,971	Salvage logging in progress
BW4/00(A)	5,772	Salvage logging in progress
BW4/00(BII)	2,537	Salvage logging in progress
BW9/00	4,045	Salvage logging in progress
BW10/00	2,843	Salvage logging in progress
BW11/00	2,011	Salvage logging in progress
BW1/01	1,008	Salvage logging in progress
BW2/01	3,739	Salvage logging in progress
BW3/01	1,804	Salvage logging in progress
BW5/01	1,907	Salvage logging in progress
BW9/01	3,040	Salvage logging in progress
BW14/01	1,079	Salvage logging in progress
BW2/02	534	Salvage logging in progress
BW10/02	1,220	Salvage logging in progress
Total	43,503	

This form of logging is intensive with all trees with diameter of 25cm and above, are removed exposing barren areas and extensive network of roads as seen in BW9/00 (**Plate A1-6 in Figure A1.9**).

Relogging is now being carried out in another 8 coupes as shown in **Table A1.9**.

Table A1.9 Coupes that are now being relogged

Coupe No.	Area (ha)	Status
BW5/01	2,096	Relogging in progress
BW10/01	1,533	Relogging in progress
BW11/01	2,140	Relogging in progress
BW9/02	4,784	Relogging in progress
BW11/02	2,121	Relogging in progress
BW12/02	2,993	Relogging in progress
BW9/03	2,305	Relogging in progress
BW10/03	1,820	Relogging in progress
Total	19,492	

There are another 11,695 ha that are waiting to be harvested in the near future.

Table A1.10: List of common tree species within the Project site

Family	Species	Local names	Habitat
Alangiaceae	<i>Alangium javanicum</i>	Kondolori	Primary Forest
Anacardiaceae	<i>Koordersiodendron pinnatum</i>	Renggu	Primary Forest
Annonaceae	<i>Polyalthia sumatrana</i>	Karai putih	Primary Forest
Apocynaceae	<i>Alstonia angustifolia</i>	Pulai bukit	Secondary forest
Apocynaceae	<i>Alstonia angustiloba</i>	Pulai bukit	Secondary forest
Bombacaceae	<i>Durio kutejensis</i>	Durian merah	Primary forest

Family	Species	Local names	Habitat
Burseraceae	<i>Dacryodes rostrata</i>	Kedondong	Primary forest
Ctenolophonaceae	<i>Ctenolophon parvifolius</i>	Besi besi	Primary forest
Datisceae	<i>Octomeles sumatrana</i>	Binuang	Riverine forest
Dilleniaceae	<i>Dillenia indica</i>	Simpoh	Forest edge
Dilleniaceae	<i>Dillenia suffruticosa</i>	Simpoh gajah	Secondary forest
Dipterocarpaceae	<i>Dipterocarps caudiferus</i>	Keruing putih	Primary forest
Dipterocarpaceae	<i>Dipterocarpus acutangulus</i>	Keruing merkah	Primary forest
Dipterocarpaceae	<i>Dipterocarpus caudiferus</i>	Keruing putih	Primary forest
Dipterocarpaceae	<i>Dipterocarpus gracilis</i>	Keruing kesat	Primary forest
Dipterocarpaceae	<i>Dipterocarpus kerrii</i>	Keruing gondol	Primary forest
Dipterocarpaceae	<i>Dipterocarpus kunstleri</i>	Keruing rapak	Primary forest
Dipterocarpaceae	<i>Dipterocarpus oblongifolius</i>	Keruing neram	Riverine forest
Dipterocarpaceae	<i>Dryobalanops beccarii</i>	Kapur merah	Logged over
Dipterocarpaceae	<i>Dryobalanops keithii</i>	Kapur gumpait	Primary forest
Dipterocarpaceae	<i>Dryobalanops lanceolata</i>	Kapur paji	Primary forest
Dipterocarpaceae	<i>Hopea beccariana</i>	Selanan penak	Primary forest
Dipterocarpaceae	<i>Hopea nervosa</i>	Selangan jankang	Primary forest
Dipterocarpaceae	<i>Parashorea malaanonan</i>	Urut mata daun licin	Primary forest
Dipterocarpaceae	<i>Parashorea smythesii</i>	Urut mata batu	Primary forest
Dipterocarpaceae	<i>Parashorea tomentella</i>	urut mata beludu	Primary forest
Dipterocarpaceae	<i>Shorea argentifolia</i>	Seraya kuning bukit	Primary forest
Dipterocarpaceae	<i>Shorea dasyphylla</i>	Seraya batu	Primary forest
Dipterocarpaceae	<i>Shorea fallax</i>	Seraya daun kasar	Primary forest rare
Dipterocarpaceae	<i>Shorea johorensis</i>	Seraya majau	Primary forest
Dipterocarpaceae	<i>Shorea laevis</i>	Selangan batu kumus	Logged over
Dipterocarpaceae	<i>Shorea laevis</i>	Selangan batu kumus	Logged over
Dipterocarpaceae	<i>Shorea leprosula</i>	Seraya tembaga	Primary forest
Dipterocarpaceae	<i>Shorea macrophylla</i>	Kawang jantung	Riverine forest
Dipterocarpaceae	<i>Shorea mecistopteryx</i>	Kawang burung	Primary forest
Dipterocarpaceae	<i>Shorea ovalis</i>	Seraya kepong	Primary forest
Dipterocarpaceae	<i>Shorea parvifolia</i>	Seraya punai	Primary forest
Dipterocarpaceae	<i>Shorea pauciflora</i>	Oba suluk	Primary forest
Dipterocarpaceae	<i>Shorea platyclados</i>	Seraya bukit	Primary forest
Dipterocarpaceae	<i>Shorea seminis</i>	Selayan batu terendak	Primary forest
Dipterocarpaceae	<i>Shorea smithiana</i>	Seraya timbau	Primary forest
Dipterocarpaceae	<i>Vatica dulitensis</i>	Resak bukit	Primary forest
Ebenaceae	<i>Diospyros levigata</i>	Kayu malam	Primary forest
Elaeocarpaceae	<i>Elaeocarpus stipularis</i>	Kungkurad	Primary forest
Euphorbiaceae	<i>Baccaurea macrocarpa</i>	Tampoi merah	Primary forest
Euphorbiaceae	<i>Bridelia penangiana</i>	Obas	Forest edge
Euphorbiaceae	<i>Cleistanthus megacarpus</i>	Baubo	Forest edge
Euphorbiaceae	<i>Endospermum diadenum</i>	Senduk-senduk mata	Forest edge
Euphorbiaceae	<i>Glochidion rubrum</i>	Obah nasi	Secondary forest
Euphorbiaceae	<i>Homalanthus populneus</i>	Ludai susu	Secondary forest
Euphorbiaceae	<i>Macranga gigantea</i>	Merkubong	Secondary forest
Euphorbiaceae	<i>Macranga cornifera</i>	Mahang	Secondary forest
Euphorbiaceae	<i>Macranga gigantifolia</i>	Telinga gajah	Secondary forest
Euphorbiaceae	<i>Macranga hypoleuca</i>	Sedaman putih	Secondary forest
Euphorbiaceae	<i>Macranga triloba</i>	Sedaman putih	Secondary forest
Euphorbiaceae	<i>Macranga winkleri</i>	Sedaman rimba	Secondary forest

Family	Species	Local names	Habitat
Euphorbiaceae	<i>Mallotus caudatus</i>		Secondary forest
Euphorbiaceae	<i>Mallotus macrostachyus</i>	Mallotus daun	Secondary forest
Fagaceae	<i>Castanopsis densinervia</i>	Berangan	Primary forest
Fagaceae	<i>Lithocarpus sp.</i>	Mempening	Primary forest
Fagaceae	<i>Lithocarpus gracilis</i>	Mempening	Primary forest
Fagaceae	<i>Lithocarpus leckii</i>		Primary forest
Fagaceae	<i>Lithocarpus nieuwenhuisii</i>		Primary forest
Flacourtiaceae	<i>Hydnocarpus borneensis</i>	Karpus tulang	Primary forest
Flacourtiaceae	<i>Hydnocarpus woodii</i>	Karpus wood	Primary forest
Flacourtiaceae	<i>Ryparosa nuttettii</i>	Giewei	Forest edge
Guttiferae	<i>Mesua macrantha</i>	Bintanggor batu	Primary forest
Hypericaceae	<i>Cratoxylum cochinchinense</i>	Geronggang bogoi	Primary forest
Lauraceae	<i>Actinodaphne glomerata</i>	Medang Serai	Primary forest
Lauraceae	<i>Litsea accidens</i>	Medang	Primary forest
Lauraceae	<i>Litsea garciae</i>	Pengolaban	Primary forest
Lecythidaceae	<i>Barringtonia lanceolata</i>	Tampalang	Primary forest
Lecythidaceae	<i>Barringtonia sarcotheceus</i>		Primary forest
Leeaceae	<i>Leea indica</i>	Mali-mali	Forest edge
Leguminosae	<i>Caesalpinia sp.</i>	Climber and abundant	Forest edge
Leguminosae	<i>Derris sp.</i>		Primary forest
Leguminosae	<i>Dialium indum</i>	KerANJI	Primary forest
Leguminosae	<i>Intsia palembanica</i>	Merbau	Primary forest
Leguminosae	<i>Koompassia excelsa</i>	Mengaris	Primary forest
Leguminosae	<i>Parkia javanica</i>	Kupang	Primary forest
Leguminosae	<i>Saraca declinata</i>	Gapis	Primary forest
Leguminosae	<i>Sindora sp.</i>		Primary forest
Leguminosae	<i>Sindora irpicina</i>	Sepetir	Primary forest
Leguminosae	<i>Sympetalandra borneensis</i>	Merbau lalat	Primary forest
Loganiaceae	<i>Fagraea cuspidata</i>	Todopon puak	Primary forest
Melastomataceae	<i>Pternandra cogniauxii</i>		Primary forest
Meliaceae	<i>Aglaia ribuoralis</i>		Primary forest
Moraceae	<i>Artocarpus anisophyllus</i>	Terap	Forest edge
Moraceae	<i>Artocarpus elasticus</i>	Terap togop	Forest edge
Moraceae	<i>Artocarpus lanceifolius</i>		Primary forest
Moraceae	<i>Ficus racemosa</i>		Primary forest
Moraceae	<i>Ficus treubii</i>		Primary forest
Moraceae	<i>Ficus uncinata</i>		Primary forest
Moraceae	<i>Prainea limpato</i>		Primary forest
Myristaceae	<i>Horsfieldia grandis</i>	Darah darah	Primary forest
Myrtaceae	<i>Syzygium barringtonia</i>		Primary forest
Myrtaceae	<i>Tristaniaopsis teponusis</i>	Pelawan pelawan	Primary forest
Palmae	<i>Arenga undulatifolia</i>		Primary forest
Palmae	<i>Oncosperma horridum</i>	Bayas	Primary forest
Rhizophoraceae	<i>Carallia brachiata</i>	Meransi	Primary forest
Rosaceae	<i>Peranneri oblongifolia</i>		Primary forest
Rubiaceae	<i>Neolamarckia cadamba</i>	Laran	Forest edge
Rubiaceae	<i>Neonauclea gigantea</i>	Bangkal merah	Forest edge
Rubiaceae	<i>Timonius villamii</i>		Primary forest
Rutaceae	<i>Melicope luna-akenda</i>	Pauh-pauh	Primary forest

Family	Species	Local names	Habitat
Sapindaceae	<i>Nephelium costatum</i>		Primary forest
Sapindaceae	<i>Nephelium cuspidatum</i>		Primary forest
Sapindaceae	<i>Nephelium eriopetalum</i>		Primary forest
Sapindaceae	<i>Nephelium rambotan-ake</i>	Meritam	Primary forest
Sapindaceae	<i>Paranephelium xestophyllum</i>	Membuakat	Primary forest
Sapindaceae	<i>Pometia pinnata</i>	Kasai	Primary forest
Sapindaceae	<i>Xerospermum laevigatum</i>		Primary forest
Simaroubaceae	<i>Eurycoma longifolia</i>	Pahit-pahit	Primary forest
Simaroubaceae	<i>Irvingia malayana</i>	Pauh kijang	Primary forest
Sonneratiaceae	<i>Duabanga moluccana</i>	Magas	Secondary forest
Sterculiaceae	<i>Sterculia cordata</i>	Kelumpang	Primary forest
Styraceae	<i>Bruinsmia styracoides</i>	Tingo-tingo	Primary forest
Symplocaceae	<i>Symplocos fasciculata</i>	Jiak	Primary forest
Theaceae	<i>Adinandra dumosa</i>	Bawing	Secondary forest
Tiliaceae	<i>Microcos reticulata</i>		Primary forest
Ulmaceae	<i>Gironniera nervosa</i>	Ampas tebu	Forest edge
Ulmaceae	<i>Trema orientalis</i>	Randagong	Secondary forest
Urticaceae	<i>Dendrocnide elliptica</i>	Anjarapai	Primary forest
Verbanaceae	<i>Vitex pubescens</i>	Kulimpapi	Forest edge and secondary forest

A1.4 SOCIO ENVIRONMENT

The proposed Project may directly and indirectly influences the socio-economic characteristics in Kalabakan area, Tawau District, and the State (see general land use map in **Figure 3.8.3**). Although major project activities of the Project can have socio-economic impacts in neighbouring districts, Tawau District will receive most of the effect. The following sections describe the existing social condition of the area and its surrounding.

A1.4.1 Regional

Population

The proposed Project sites are located in Tawau District, the southern most district of Sabah east coast. Tawau Town, which is located approximately 100 km southeast of the sites is the major town and serves as the administrative, commercial and residential centre for the District. According to the latest census statistics^{A2}, the total population for Tawau was estimated to be 305,080 or 12% of Sabah population of 2,468,246.

Between the period of 1991 and 2000, the population of Tawau has increased from 244,728 people in 1991 to 305,080 people in 2000 (**Table A1.11**). This is about 25% increase in a period of 9 years. The annual average growth between 1991 and 2000 for Tawau is 2.74%. The average growth rate was below the Sabah average of 4.7%. Between the same periods, its urban population has increased from 51% to 70%.

High population increase experienced by Tawau is most likely due to in-migration of population from the neighbouring country in search of employment and economic activities made available in the District and State.

^{A2} Department of Statistics Malaysia. 2001. Yearbook of Statistics

Table A1.11: Population by Sex and Administrative District, Tawau, 1991 & 2000

	Gender	Sabah	Tawau
1991	Male	909,141	130,312
	Female	825,544	114,416
	Total	1,734,685	244,728
2000	Male	1,270,537	157,302
	Female	1,197,709	147,778
	Total	2,468,246	305,080
Percentage increase		42%	25%
Average Growth Rate		4.70	2.74
Sex Ratio	1991	110	114
	2000	106	106
Area (Km ²)		73,997	5,994
Population Density	1991	23	41
	2000	33	51

Source: Department of Statistics, Yearbook of Statistics Malaysia, 2001.

Gender Distribution (Sex Ratio)

The gender distribution of the population is shown in **Table A1.11**. Males slightly outweigh females in 1991 and 2000.

Population Density

The population density for Tawau in 2000 is 51 persons/km², a slight increase from 41 persons/km² in 1991. The State of Sabah population density is currently at 33 person/km² (**Table A1.11**).

Households

Tawau reported a total household of 59,689 in 2000. From **Table A1.12**, it can be seen that the average household size is 5.1 persons/household.

Table A1.12: Average Number of Persons per Household, Tawau, 2000

	Population	Households	Average No of Person/Household
Tawau	305,080	59,689	5.1

Source: Department of Statistics, Yearbook of Statistics Malaysia, 2001.

Ethnic Groups

The 2000 census figures indicate that the Malays (21%) are the main ethnic group in Tawau followed by Others (14%), Chinese (12%), Other Bumiputera (11%), and Bajau (9%). See **Table A1.13**.

Table A1.13: Population by Ethnic Group, Tawau, 2000

Population	Malaysian							Non Malaysian
	Bumiputera (BP)					Non-BP		
	Malays	Kadazan D	Bajau	Murut	Other BP	Chinese	Others	
305,080	64,475	5,931	26,990	2,466	33,141	36,687	42183	93207
100%	21%	2%	9%	1%	11%	12%	14%	31%

Source: Department of Statistics, Yearbook of Statistics Malaysia, 2001.

Age Group

Approximately 38% of the population of Tawau fall into the age group 15 and below (**Table A1.14**). The district has higher proportion of persons between age 15-64 age group (60%) while only 2% fall within the age group above 65 year old.

Table A1.14: Population by Age Group, Tawau, 2000

Age Group	Total	%
0-4	39,451	13%
5-9	41,331	14%
10-14	36,404	12%
15-19	33,878	11%
20-24	26,925	9%
25-29	26,432	9%
30-34	24,435	8%
35-39	21,981	7%
40-44	18,847	6%
45-49	12,257	4%
50-54	7,976	3%
55-59	5,665	2%
60-64	4,043	1%
65-69	2,272	1%
70-74	1,568	1%
75+	1,615	1%
Total	305,080	100%

Source: Department of Statistics, Yearbook of Statistics Malaysia, 2001.

Economic Activities

Agriculture is the most important economic sector in terms of the size of land usage as shown in **Table A1.15**. Almost 23% of the Tawau total land area is used for agriculture. Approximately 159,328 of the district's land have been identified as suitable for agriculture purposes while about 139,000 hectares has been planted commercially with various crops including oil palm plantation being the largest which is about 98,000 hectares or 71% of the total planted area. The rest are mainly planted with cocoa, coconut, vegetables and fruits. Initially, Tawau economic growth has been stimulated by timber exports.

Table A1.15: Agricultural Land Usage (Hectare)

Crop	Small-holder	LKTNS	KPD	FELDA	KOPERASI	Private	Govt. Agency	Total
Oil Palm	9,241	2,877	616	17,813	2,059	61,642	4,309	98,557
Cocoa	6,260	-	1,447	-	7,306	16,659	117	31,789
Rubber	94	-	-	-		1,282	-	1,376
Coconut	2,802	-	-	-		264	3	3,069
Coffee	1,009	-	-	-		89	-	1,098
Fruits	1,545	-	-	105		28	66	1,744
Pasture	-	-	-	-		529	408	937
Others	166	-	-	-		44	5	215
Total	21,117	2,877	2,063	17,918	9,365	80,537	4,908	138,785

Source: *Jabatan Pertanian & Majlis Perbandaran Tawau, 2005.*

In the fisheries sector, Tawau is known for its abundant supplies of fish and shrimp that the prices are cheapest in Sabah. The abundance in supply not only fulfill the needs of local demand but also enable the fish and shrimp farmers in the district to export their sea products to other countries such as Japan, Hong Kong, United States, Singapore and West Malaysia.

Of late, the aquaculture sector is gaining importance as a major contributor towards the District's economy whereby about 4,785 hectares of land has been identified as potential aquaculture area in addition to the existing 44 operating Tiger Prawn farms.

In line with the Government's development policies to encourage downstream processing of timber product rather than direct export of round logs, the District of Tawau is now experiencing rapid development in this sector. There are currently 41 sawmill/plymill that produce and export timber related products in the form of sawn timber and plywood.

A1.4.2 Description of the Communities

Settlements Within the Project Area

The Project area is largely inhabited. The only known settlements are a number of logging camps scattered within the logging coupes. These camps are only temporary mobile camps, moving to a new site when they are done with one logging area. They are generally built on stilts (wooden) and provided with the most basic facilities and amenities such as water supply, electricity supply and medical facility. In smaller camps, most of the time sanitary facility, power or water supply is not provided. This is mainly due to the temporary nature of such camps.

There are at least nineteen timber camps with a total population of about 1,300 people within the Project sites. Details of the logging camps are available in **Table A1.16**.

Table A1.16: Logging Camps Within the Project Sites

Company	Coupe	No. of Workers		
		Bumi	Non-Bumi	Total
Syt Atur Maju	BW1/00	12	23	35
Jalur Kinabalu	BW2/99	5	15	20
Aktib Syabas	BW2/00 (1)	35	16	51
Borneo Aktib	BW2/01	6	8	14
Usaha Jaya Kurnia	BW2/02-NFM & BW2/02-ITP	72	40	112
Wawasan Lumayan	BW4/00 (A)	41	95	136
Ivory Bay	BW4/00 (BII)	21	42	63
Pentas Jaya	BW5/01	10	10	20
Wawasan Gunung Emas	BW6/01	6	20	26
Kump Kinabatangan Timber	BW9/00 (N)	10	10	20
Syt Sabtra	BW9/99 (3)	20	65	85
Asiatik Lumber	BW9/00 (2)	14	42	56
Syt Sabtra	BW9/00 (3)	10	35	45
Asiatik Lumber	BW9/01 (1)	14	18	32
Kump Kinabatangan Timber	BW9/02 BW9/03	138	71	209
Syt Kinacerah	BW10/02 BW11/00 (2)	42	41	83
Sabtra	BW10/03-ITP & BW10/03-NFM	42	91	133
Seraya Permai	BW11/02	19	48	67
Syt Peluamas	BW12/02 BW12/03	105	20	125
TOTAL		622	710	1332

The surrounding land uses comprise mainly secondary forest subject to re-entry logging activities, some virgin forest reserves, conservation areas, YS's international collaborative projects and tree plantation, oil palm plantations and farm lands further south, southeast and east.

Like 3 years ago, the population concentration are still found at Luasong Forestry Centre (LFC), Kpg. Fajar Harapan Luasong (formerly known as Kpg. Harapan Baru Mukandut), Kalabakan, Kpg. Brantian, SSSB Camps (including Brumas, Dumpas, Sg. Udin Camp and Mawang), Felda Umas-Umas and a number of logging camps scattered at the surrounding area. **Figure 3.8.3** (*General Surrounding Land Use*) shows the location of these settlements in relation to the project sites. These settlements are all accessible by gravel road and logging roads.

Many of these small communities had been experiencing population decline as local employment opportunities declined and people moved away in search of better economic opportunities elsewhere (**Table A1.17**).

Table A1.17: Population of Settlements at the Surrounding of the Project sites

Settlements	Year		Remarks
	2001	2005	
Luasong Forestry Centre	1800	1093	Population decline
Kpg Fajar Harapan Luasong	250	150	Population decline
Kalabakan*	2241	1993	Population decline
Kpg Brantian	439	150	Population decline
SSSB Camps*	2184	3145	Population Increase
Mawang (SSSB)	-	1558	-
Felda Umas-Umas	2200	-	-
Total	11,115	10,094	

* Including Rancangan Kalabakan, Pekan Kalabakan, Kg. Murut Kalabakan (Batu 2.5) and Kg. Murut Ulu Kalabakan.

** including Brumas, Dumpas and Sg. Udin Camp

Source: LFC, social survey and Tawau Municipal Council, 2001 and 2004.

A1.4.2.1 Luasong Forestry Centre (LFC)

LFC is a self-contained settlement that houses YS staff (consisting of RBJ/YS staff, INIKEA staff and Silviculture Unit Staff) and their dependants. As of early 2005, there approximately 1,093 person (mainly Sabahans except where intermarriages with foreign nationals take place) living in this centre. Infrastructure and amenities provided in this centre include treated water supply, (with 2 storage tanks and capacity of 150,000 gallons), electricity, access road, staff houses, shops, primary school, mosque, chapel, community hall, workshop, plant nursery, rest house, medical clinic, swimming pool, football field and tennis court.

The centre is about 5 km from Benta I boundary and is about 100 km northwest of Tawau and is accessible by gravel road from Tawau, Keningau or Telupid. The centre originally belonged to The North Borneo Timber Company before it was officially handed over to Yayasan Sabah in late 1987. It was officially named as Luasong Forestry Centre in 1989. Currently, LFC main function is to serve as a centre for controlling general activities (management and monitoring) of logging in the YS Concession area.

A1.4.2.2 Kg. Fajar Harapan Luasong (formerly known as Kg. Harapan Baru Mukandut or locally known as Kg. Luasong)

This village is located just outside the LFC' gate on the north western side. The population of this village has declined by about 100 people from 250 in year 2001. The majority of the population is of the Orang Sungai ethnic group and a small number of Bugis, Murut and Dusun. The infrastructure and amenities available are still the same as back in 2001 which are very basic including a church, balairaya, and no electricity or treated water supply. The villagers collect rainwater in tank or drums, while water from the stream is use for bathing and washing. Sewage disposal is through pour flush toilets. Villagers obtain medical attention from the clinic at LFC. Children attend primary school at LFC.

Apart from a few (7 persons) who are employed by LFC, the main economic activity of the population is subsistence farming of vegetables, cassava, maize and some fruits. The main cash crops are coffee and fruits, which are sold to logging camp workers and LFC employees nearby. The estimated income of the residents is between RM200-300 per

month. Apart from farming, the villagers also earn extra money from bird nest collecting. This activity is however seasonal.

A1.4.2.3 Kalabakan

Kalabakan is about 12 km east of Benta IIC and 18 km south of Benta I. Not much change has taken place in this community for the last 3 years. The community is a complex of villages collectively known as Kalabakan. These comprise 2 separate communities:

- Muslim Community consisting of Kg. Rancangan Kalabakan, Pekan Kalabakan, Kg. Mangga, and Kg. Sg. Tuda mostly belong to the Tidong ethnic group;
- Christian Community consisting of Kg. Murut Ulu Kalabakan and Batu 2.5 mostly belonging to the Dusun ethnic group.

The centre of the settlement is located at the bank of Sg. Kalabakan. The surrounding vegetation is a mosaic of cultivated areas: oil palms; SSSB plantation; and fallow areas of secondary growth). Patches of hill paddy farm can also be seen to the west of the Sg. Kalabakan, at Kg. Murut Ulu Kalabakan.

Sabah Softwoods Sdn. Bhd maintains the gravel surface road that connects to this settlement. The community still depends on collected rainwater and water from Sg. Kalabakan for drinking, washing and bathing. The water quality of Sg. Kalabakan is still reported to be poor due to pollution from the nearby wood based factories, log ponds and their workers quarters as well as land development upstream.

The community still depends on individual generator set for power supply. Other facilities available include rural clinic and private clinic (owned by FELCRA), mosques, church, community hall, primary school (SK Kalabakan), secondary school (SMK Kalabakan - up to Form 3 and Sekolah Agama Rakyat), police station, Forestry Department, petrol station and shops. There is no proper waste disposal site therefore rubbish can be seen floating in the river.

Villagers identify themselves as farmers (fruit trees and oil palm smallholders). Shifting cultivation of hill paddy is the traditional form of agriculture in Kg. Murut Ulu Kalabakan together with various vegetables, cassava and bananas. A number of villagers are involved in oil palm planting (smallholder). Coffee is cultivated as cash crops in smaller gardens.

Fishing is carried out as a secondary income source. However, years of pollution and illegal fishing practices (bombing and poisoning) has resulted in decrease fish and prawn catches.

Off-farm work is common and people are employed in many different sectors. A number of people are employed as sawmill workers and wood processing plants in Kalabakan, SSSB, YS, oil palm mill, as well as oil palm plantation workers.

Out migration to other towns in Sabah or outside Sabah is still common, contributing to population decline of this community due to the fact that income generating activities are rare in the area.

A1.4.2.4 Kg. Brantian

Kg. Brantian is located at the bank of Sg. Brantian, about 6 km to the south of Benta I. In the last three years this village experienced the highest population decline from 439 in 2001 to 150 in 2004. It is a small fishing community with a mixture of Tidong, Bugis, Jawa, Murut,

Sungai and Bisaya ethnic groups. The surrounding vegetation consists of cultivated areas: oil palms; SSSB plantation; and fallow areas of secondary growth.

The village is accessible by road passing through Kompleks Perhutanan Daerah Kalabakan to its north. Availability of basic infrastructure in the village is minimal. Houses are mostly wooden and built on stilt. Collected rainwater is still the main source of water supply for drinking and cooking while washing and bathing is by use of water from Sg. Brantian. Genset (sponsored by UMNO) provide power supply to the village between 6 pm to 12 pm. Sewage disposal is through pour flush toilets. There is no proper disposal of domestic wastes. Villagers either burn or dispose them into Sg. Brantian. As there are no school and medical clinic in the village, villagers sent their children and the sick to the school and clinic at FELDA Umas-Umas, about 10 km away.

The main environmental concerns with regards to logging operation are related to water pollution due to erosion and sedimentation as well as illegal practice of fish bombing and poisoning. The villagers also reported the deterioration of Sg. Brantian water quality due to chemical pollution from oil palm plantation upstream. This has resulted in skin rashes/itchiness as well as diarrhoea cases in the village.

A1.4.2.5 Sabah Softwood Camps

Sabah Softwood's Plantations are located adjacent to Benta I and Benta IIC. It has 4 camps (Brumas, Dumpas, Sg. Udin Camp and Mawang) with a total population of about 4,700 people. They are mostly involved in tree plantation management and planting, agriculture crop management as well as those working in the SSSB Chip Mill and loading area. There are approximately 320 units of houses in the three main camps (Brumas Camp, Dumpas Camp and Kg. Sg. Udin). Houses are mostly wooden and provided with basic infrastructure such as water and power supply and sanitary facility. Other infrastructure and amenities include access road, staff houses, shops, primary school, mosque, chapel, community hall, water treatment plant, workshop, plant nursery, rest house, medical clinic, and recreational facilities.

A1.4.3 International Collaboration Projects Near to the Project Boundary

There are number of renowned international collaboration projects found near to the proposed Project site (see **Figure 3.8.3**). The history and status of these projects are briefly summarized below:

A1.4.3.1 Luasong Forestry Centre (LFC) (Refers to A1.4.2.1)

Luasong Forestry Centre (LFC) was established in 1987(see **Figure A1.10**), on the site of the former North Borneo Timbers logging camp, about 100km northwest of Tawau. The LFC project area covers a total of 44,190 ha, of which 4,150 ha is a water catchment area. Most of the remaining forest was logged 15 - 20 years ago by North Borneo Timbers and occurs within the Kalabakan Forest Reserve, part of which is in the Yayasan Sabah Management Area. LFC, which is managed by RBJ, is one of Yayasan Sabah's major commitments to sustainable forest management, ensuring long-term research and development and continued generation of income from forestland.

As part of its intensive forest management efforts, in 1988, RBJ embarked on a high value timber species and rattan planting programme at LFC, with the aim of aiding regeneration of logged over forest, and at the same time, maximizing productivity and value per unit area. To date, the total area planted is about 10,200 ha. Activities carried out at LFC include enrichment planting of rattan and high value timber species, research into line planting and

open planting conditions, trial planting of different species, investigations into pest resistance, nursery propagation techniques, plant selection and vegetative propagation, seed production, in-vitro tissue culture, forest inventory and silviculture and research into forest management (source: ICSB webpage 2001).

A1.4.3.2 INIKEA Project

The Innoprise Corporation and Sow-A-Seed Foundation, Sweden project on Forest Rehabilitation started in June 1998. The aim of the project is to assist forest recovery in a reserve part of the Kalabakan Forest Reserve totalling 14,300 ha which suffered severe forest degradation by fires in the early in 1980s. The Sow-A-Seed Foundation (IKEA) contributes through a financial assistance while Innoprise Corporation manages and implements the project. The work target for the Project is 5,000 ha in 5 years from May 1998 to May 2003 (Garcia & Falck, 2000).

A1.4.3.3 SUAS Project

In 1990, a 3-year agreement was signed between SUAS and RBJ, the forest management arm of ICSB, to undertake operational experiments on directional felling and pre-felling climber cutting as a means of reducing damage to the residual forest stand during harvesting. Trials have been carried out in the Kalabakan Forest Reserve, near Luasong Forestry Centre until today.

A1.4.3.4 RBJ/NEP RIL Project

The RBJ/NEP RIL Project is an international collaboration project between RBJ and the New England Power [NEP] Company. The later seeks to offset CO₂ production from its coal-fired power stations through absorption of CO₂ during photosynthesis by tropical forests. The approach by which NEP had invested is "Reduced Impact Logging" [RIL], rather than replanting. Under a 3-year pilot scheme contract signed in 1992 and worth US\$500,000, NEP pays the marginal cost of logging a 1,415 ha trial area to a set of high environmental standards. This involves climber cutting prior to harvesting, careful planning of skid trails and directional marking and felling of trees, so as to reduce damage and soil disturbance to a minimum.

An extension Memorandum of Understanding for RIL II was signed on July 25, 1995.

A1.4.3.5 Maliau Basin Conservation Area

The Maliau Basin Conservation Area, which is commonly known as the 'Lost World', is about 58,480 ha. It is located on the western part of the proposed Project. The Basin is almost circular perimeter has very steep slopes up to 1,500 m in height. The enclosed Basin is about 390 sq. km with a maximum diameter of 25 km (Yayasan Sabah 2002).

This Basin consists of exceptionally deep (12,000 m) sedimentary beds of gently inclined sandstones and mudstone strata of lower to middle Miocene Age. It is drained by the tributaries of Sg. Maliau, one of which descends a series of waterfalls known as the Maliau Falls (see **Figure 4.4.1** and **Plate A1-7**).

A1.4.3.6 Danum Valley Conservation Area

The Danum Valley Conservation Area covers an area of about 43,800 ha and is situated on the northeast direction of the proposed Project site (see **Figure 4.1.4**). The area is dominated by lowland dipterocarp tree species and is recognized for its outstanding wildlife value. There are at least 235 bird species recorded in Danum, including 10 of Borneo's 35 endemics. All of Sabah's 10 species of primate reside here, from the diminutive Western

Tarsier, to the 'man of the forest', the Orang-Utan, which outside Borneo, is only present in northern Sumatra. Other mammals include tree-shrews, flying squirrels, civets, deer, Asian Elephant, Bearded Pig, the scarce and rarely seen Sumatran Rhinoceros, Clouded Leopard and Leopard Cat.

A1.4.4 Existing Road Network

The Project area is linked to the major town by roads and is accessible from several directions (see **Figure 2.2.2**). On the north side, the logging road is leading to Telupid (onward to Sandakan) and in the eastern side is heading towards Lahad Datu. Leading to the west and south, the roads are heading towards Keningau and Tawau respectively. Currently, most of these existing roads are not accessible due to the collapse of bridges and culverts, especially the Lahad Datu sector.

At the moment, Yayasan Sabah and its contractors maintain the roads within its Licence area; Sabah Softwoods Bhd. maintains roads within its plantation areas while the local authority maintains road beyond these areas, which is in the process of upgraded to tar-sealed road. At the time of this study, the Public Works Department is in the process of alienating and upgrading part of the road within the project area as one of the trunk road from Tawau to Keningau.

A1.4.5 Economic Activity Downstream of the Site

A1.4.5.1 Prawn Farming

There are two major prawn farms at the delta area of Sg. Brantian and Sg. Kalabakan.

- o Sg. Brantian: 130 acres of Production Ponds with Prawn Hatchery.
- o Sg. Kalabakan: 60 acres of Production Ponds.

There are also smaller farms comprising two to five acres of Production Ponds in the other estuaries near the Cowie Bay (see **Plates A-8**).

A1.4.5.2 The Mangrove Swamp

Along the banks of all the rivers where there is tidal influence and where conditions are favourable, mangrove Swamps extend from a few meters to a few kilometers out in width from the edge of the major riverbanks. These swamps are very importance to the whole fisheries in the area (see **Plates A-9**).

A1.4.5.3 The Fishing Industry

The commercial fishing in the area can be divided into two groups namely the artisan and commercial fishing. The artisan-fishing group are those that use small boats either with out boat engines of less then 25 Hp or paddles. Their method of fishing is by cast nets, gill nets, long liners, traps (bubu), hook and lines and other traditional methods. They usually fish upriver and along the coast for the day or night returning with their catches almost daily.

The commercial fishermen use trawlers and usually they are out in the sea for a few days. Large in-board boats are used with bottom trawling equipment. Their main target is the prawn catch.

A1.5 LETTER FROM THE SABAH FORESTRY DEPARTMENT (SFD)

See following pages for the letter issued by the Sabah Forestry Department.

A1.1	Introduction.....	1
A1.2	Existing Physio-Environment.....	1
A1.2.1	Geology and Slope Stability.....	1
A1.2.2	Soils & Its General Descriptions.....	3
A1.2.2.1	General	3
A1.2.2.2	Labau Association	3
A1.2.2.3	Brantian Association	3
A1.2.2.4	Kalabakan Association.....	4
A1.2.2.5	Mawing Association.....	4
A1.2.2.6	Kretam Association	4
A1.2.2.7	Lokan Association.....	4
A1.2.2.8	Bang Association.....	4
A1.2.2.9	Bidu Bidu Association	4
A1.2.2.10	Mentapok Association.....	5
A1.2.2.11	Malubok Association.....	5
A1.2.2.12	Gumpal Association	5
A1.2.2.13	Crocker Association	5
A1.2.2.14	Maliau Association.....	5
A1.2.3	Hydrology and Drainage.....	8
A1.2.3.1	Drainage Pattern and Water catchment.....	8
A1.2.3.2	Discharge or Water Quantity.....	8
A1.2.3.3	Water Quality	8
A1.2.4	Rainfall.....	8
A1.3	Existing Biological Environment	11
A1.3.1	Terrestrial Fauna Ecology	11
A1.3.2	Flora Ecology and Forest Resources.....	22
A1.3.2.1	Flora Ecology	22
A1.4	Socio Environment.....	29
A1.4.1	Regional	29
A1.4.2	Description of the Communities	32
A1.4.2.1	Luasong Forestry Centre (LFC)	34
A1.4.2.2	Kpg Fajar Harapan Luasong (formerly known as Kg. Harapan Baru Mukandut or locally known as Kg. Luasong).....	34
A1.4.2.3	Kalabakan.....	35
A1.4.2.4	Kg. Brantian	35
A1.4.2.5	Sabah Softwood Camps	36
A1.4.3	International Collaboration Projects Near to the Project Boundary.....	36
A1.4.3.1	Luasong Forestry Centre (LFC) (Refers to A1.4.2.1).....	36
A1.4.3.2	INNIKEA Project	37
A1.4.3.3	SUAS Project	37
A1.4.3.4	RBJ/NEP RIL Project.....	37
A1.4.3.5	Maliau Basin Conservation Area	37
A1.4.3.6	Danum Valley Conservation Area	37
A1.4.4	Existing Road Network	38
A1.4.5	Economic Activity Downstream of the Site.....	38
A1.4.5.1	Prawn Farming	38
A1.4.5.2	The Mangrove Swamp	38
A1.4.5.3	The Fishing Industry	38