

# BIODIVERSITY ASSESSMENT FOR GAMUDA COVE, SELANGOR

Prepared for

**Gamuda Land (T12) Sdn Bhd**

**GAMUDA LAND**

**28.09  
2018**



# Biodiversity Assessment For Gamuda Cove, Selangor

## For Gamuda Land (T12) Sdn Bhd

For and on behalf of  
EnviroSolutions & Consulting Sdn Bhd,

Approved by,



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Country Director  
28<sup>th</sup> September 2018

Project Number: J18-781-MY-PA  
Report Version: 02

Rev.	Description	Prepared	Reviewed	Approved	Date
00	Draft	TMM /CLM	ZAR	ZAR	20/06/18
01	Draft	TMM /CLM	ZAR	ZAR	25/07/18
02	Final	TMM /CLM	ZAR	ZAR	28/09/18

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## EXECUTIVE SUMMARY

EnviroSolutions & Consulting Sdn Bhd (ESC) - *partner of Inogen Environmental Alliance* - has been engaged by Gamuda Land (T12) Sdn Bhd to conduct a Biodiversity Assessment as to support Gamuda Land's objective which is to conserve and enhance biodiversity as well as raise awareness of the importance of wildlife and ecosystems for Gamuda Cove. This Biodiversity Assessment provides the baseline study in which the report will illustrate current site conditions in which current biodiversity is identified and where species recovery/ retention rate can be monitored.

The aims of the study are as follows:

- Verification of surrounding flora types and conditions (through secondary data and site study of surrounding area);
- Identification of existing wildlife in the area;
- Develop a checklist of the surveyed vertebrates (mammals, birds, amphibians, and reptiles). Insects that were found during the survey are also described in the checklist as additional information to the scope of work;
- Propose strategies and measures that will restore the health of the area which will fortuitously stabilise and encourage the positive return of fauna to the area; and
- Develop a Biodiversity Management Plan on tracking wildlife recovery and restitution rate for the area.

To facilitate the above, ESC conducted The Biodiversity Assessment consists of two main components, namely:

- Field assessment – a survey of the flora and fauna components of the subject site, and
- Data review and assessment.

As this assessment forms the baseline data for future studies, a full flora and fauna survey of the site was undertaken on April 2018. Based on the satellite image and on-site survey, the Project site is dominated by shrubs, secondary forest, wild Acacia forest and oil palm plantation with some part of the area cleared for other development. Meanwhile, the surrounding areas are dominated by agricultural lands, forest reserve and wetland forest. Summary of the biodiversity assessment and its management plan are as follow:

### Flora Assessment

The flora survey was conducted on 4<sup>th</sup>, 7<sup>th</sup> and 12<sup>th</sup> April 2018 by using sampling plot of 0.4 ha (20 x 20 m) to assess the existing conditions; to determine the flora composition of Project site; and to determine the flora composition including undergrowth and non-woody species. In the area where sampling plots are not possible to be established, a 50 m line transect was used to assess the occurrence of the flora species. The flora survey had 37 sampling points within the Project site which consists of 16 sampling plots and 21 lines transects.

A total of 8 species were recorded within the sampling plots while 42 species were found along the line transect. The most dominant species found during the flora survey is *Acacia mangium* followed by *Macaranga pruinosa* and *Melicope lunu-akenda*.

Based on the site survey and IUCN Red List, there are no rare, threatened or endemic species found within the Project site. Most of the species were categorised as Not Evaluated (NE), which means the taxa have not yet been assessed for IUCN Red List and also Least Concern (LC) species. Some of the species were not recorded in the IUCN Red List. Most of the flora species found during the survey are common species which have neither conservation nor high economic value. However, some of the plant species encountered are important species for the birds as they are food sources e.g *Ficus* spp.

### Fauna Assessment

Fauna species associated with the swampy area, oil palm plantations, scrubs, open grasslands and secondary forests area are expected to be found. The fauna assessment for Gamuda Cove was performed based on two data collection methods i.e. primary data collection and secondary data collection. The sampling and inventories of fauna species at the project site were conducted on 12<sup>th</sup> and 14<sup>th</sup> April 2018. The species were observed and recorded via binoculars, animal calling, identification of footprints, nests, scats and faeces. Survey for these species was carried out from day to night (0730 hours until 2230 hours) at 9 different points within the project boundary. Published article on Paya Indah Wetlands was also reviewed to ensure the completeness of the information.

Fauna survey conducted at Gamuda Gardens found various species ranging from mammals, birds to insects and herpetofauna. In short, mammals study documented 11 species from 9 different families. Of these, 7 species were found listed under the Wildlife Conservation Act 2010 and 1 species (the Pig-tailed Macaque) was categorised as *Vulnerable* under the IUCN Red List. During the site visit, most wetland species like Red-wattled Lapwing and teal are also found roaming within the project site. Birds study documented 59 species of 27 families at the project site of which 50 birds are resident species, 7 are migratory and 2 are introduced. Of these, 39 are classified as *Totally Protected Species* while the remaining 12 are *Protected species* under the Wildlife Conservation Act 2010.

Based on IUCN Red List there are 3 species that classified under Near Threatened which are the Grey-headed Fish-eagle, Buff-neck woodpecker and the Chestnut-bellied Malkoha. Insects and Herpetofauna study registered at least 6 species of amphibians and reptiles documented during the site visit. Common species like monitor lizard, skink and garden lizard were recorded including venomous species like spitting cobra.

Insects that were observed during the survey consisted of 26 known species and 4 unidentified species. Most of the known species were butterflies then followed by dragonflies and only 1 species of ant, termite and grasshopper was observed during the survey. Unidentified species that were observed during the survey were 3 species of millipedes and 1 species of damselfly.

### **Biodiversity Management Plan**

The baseline study shows that there are no flora species that are considered endangered or threatened in the project area. However, the field assessments revealed a number of important fauna species classified as *Totally Protected* and *Protected* under the Wildlife Conservation Act 2010 and *Near Threatened* under the IUCN Red List. As such the mitigation measures (habitat degradation and pollution; habitat enrichment; and zoonotic disease) to overcome *potential threats* (habitat degradation; human wildlife conflicts especially on wild boars, macaques, rats and snakes; forest fires – South Selangor peat swamp forest; pollution; and zoonotic disease) described in the report concentrates on protection of the fauna species in the area as well as measures to encourage return of the important species identified following completion of the project.

It is recommended that a fauna survey be conducted a year after the first phase of project completion to check and review species onsite. The survey should also focus on whether the identified species of importance are still found onsite. The survey should include plant health and suitability check especially with regards to fauna enhancement.



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## ACRONYMS

amsl	Above mean sea level
API	Air Pollution Index
APMS	Aquatic Plant Management Society
CBD	Convention on Biological Diversity
CBD	Central Business District
dB(A)	Decibel
dbh	Diameter at breast height
DoE	Department of Environment
DOE	Department of Environment
ELITE	Expressway Lingkaran Tengah
ERL	Express Rail Link
ESC	EnviroSolutions & Consulting Sdn Bhd
GPS	Global Positioning System
IUCN	International Union for Conservation of Nature
JLKN	Jabatan Latihan Khidmat Negara
JPV	Jabatan Perkhidmatan Veterinar
KLIA	Kuala Lumpur International Airport
KLIA	Kuala Lumpur International Airport
LC	Least Concern
LMO	Living Modified Organism
MARA	Majlis Amanah Rakyat
NCS	National Conservation Strategy
NE	Not Evaluated
NT	Near Threatened
P	Protected Species either under Schedule 1 or 2
P(I)	Protected Species under Schedule 1
P(II)	Protected Species under Schedule 2
PERHILITAN	Jabatan Perlindungan Hidupan Liar dan Taman Negara
TP	Totally Protected Species
WWF	World Wildlife Fund

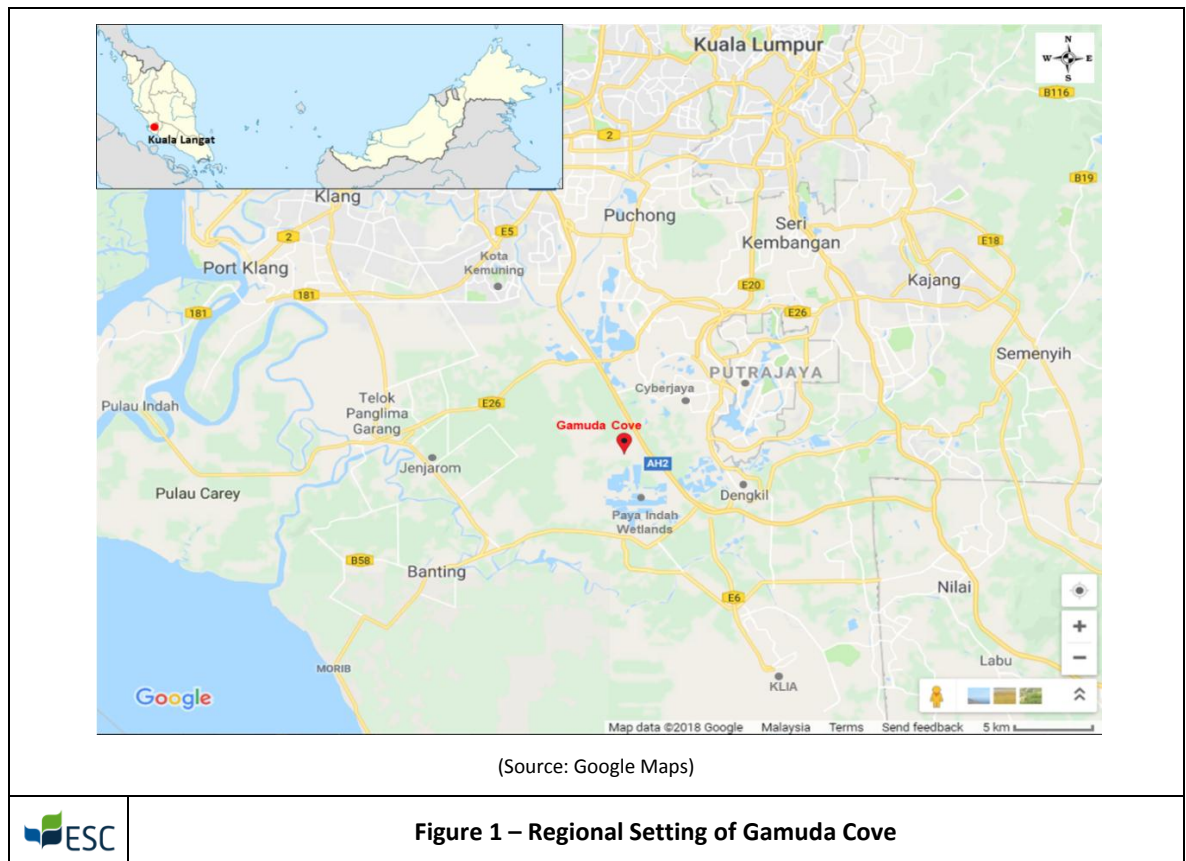
# 1 INTRODUCTION

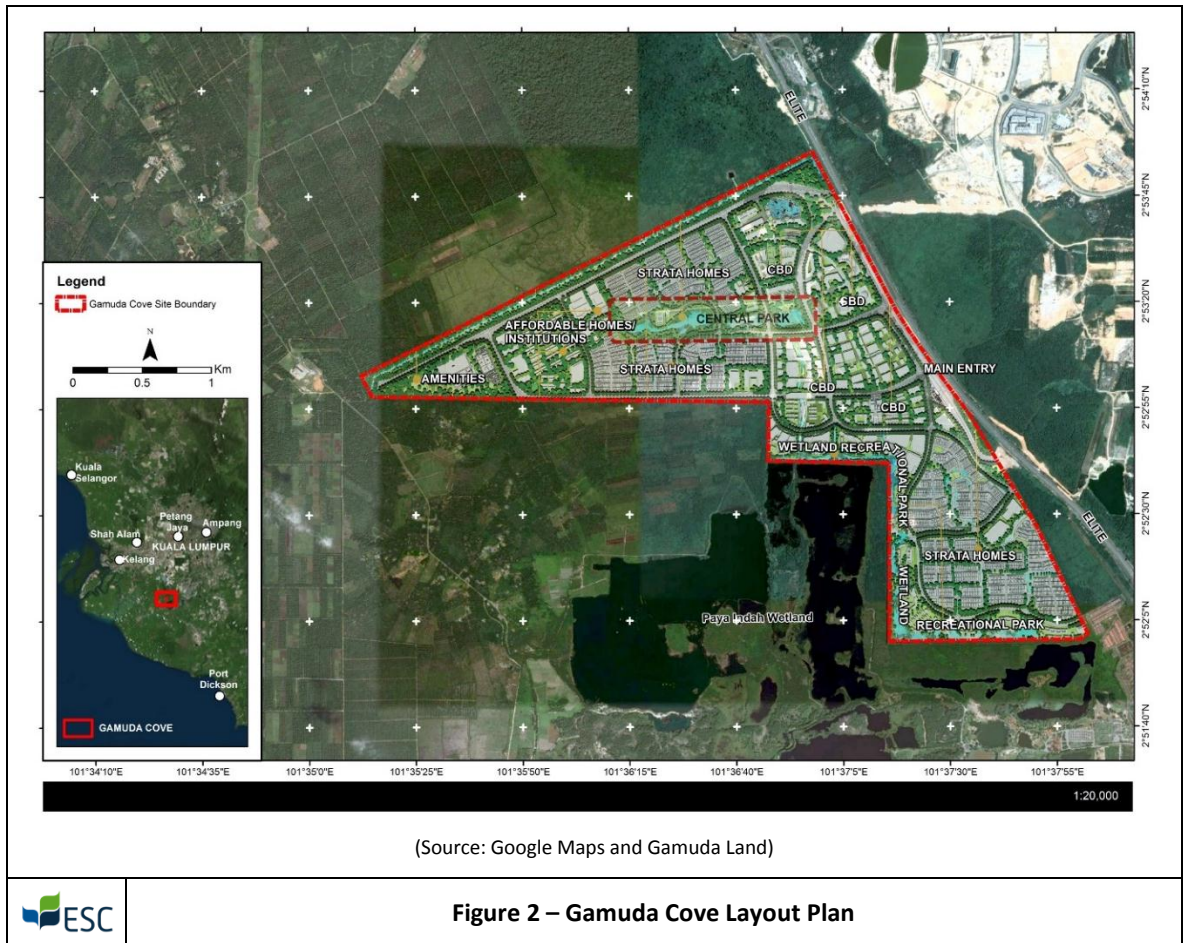
## 1.1 Background

Gamuda Cove development comprises 1,530 acres of leasehold mixed-use development located next to Expressway Lingkaran Tengah, in Kuala Langat, Selangor (*Figure 1*). It is situated within the mukim of Tanjong Dua Belas, 8 kilometres southwest of Cyberjaya/Putrajaya and approximately 34 kilometres and 37 kilometres southwest of Petaling Jaya Town and Kuala Lumpur City Centre respectively. Designed with the idea of “Living close to nature”, Gamuda Cove development incorporates 60 acres of Central Park, a landscape feature which incorporates natural and manmade lakes/wetland. *Figure 2* shows the layout plan for the Gamuda Cove development. Construction will take place in phases. The first phase of construction has started at the site.

Gamuda Cove borders the Paya Indah wetlands to the south and Kuala Langat peat swamp forest to the north. As such, keeping the design philosophy in mind, Gamuda Land is taking steps to ensure that their Gamuda Cove development is congruent with the surrounding environment. Gamuda Land aims to conserve and enhance biodiversity as well as raise awareness of the importance of wildlife and ecosystems. EnviroSolutions & Consulting Sdn Bhd (ESC) has been engaged by Gamuda Land to conduct a Biodiversity Assessment as part as this initiative. Biodiversity was defined by the United Nation Earth Summit in 1992 as “the variability among living organisms from all sources, including, inter alia, terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems.” This Biodiversity Assessment provides the baseline study in which the report will illustrate current site conditions in which current biodiversity is identified and where species recovery/ retention rate can be monitored.

A management plan with pro-active approach for areas within the project boundaries with an aim to contribute to the maintenance and protection of existing biodiversity values and minimise the potential long-term effects will also be included.





**Figure 2 – Gamuda Cove Layout Plan**

## 1.2 Scope and Objectives

The main scope of the project is to assess the current status of ecological conditions at Gamuda Cove and develop a plan which will enable the Gamuda Land to monitor the rehabilitation status. The aims of the study are as follows:

- Verification of surrounding flora types and conditions (through secondary data and site study of surrounding area);
- Identification of existing wildlife in the area;
- Develop a checklist of the surveyed vertebrates (mammals, birds, amphibians and reptiles). Insects that were found during the survey are also described in the checklist as additional information to the scope of work;
- Propose strategies and measures that will restore the health of the area which will fortuitously stabilise and encourage the positive return of fauna to the area; and
- Develop a Biodiversity Management Plan on tracking wildlife recovery and restitution rate for the area.

## 1.3 Methodology

The Biodiversity Assessment consists of two main components, namely:

- Field assessment – a survey of the flora and fauna components of the subject site; and
- Data review and assessment.

As this assessment forms the baseline data for future studies, a full flora and fauna survey of the site was undertaken. Due to Gamuda Cove’s location, i.e. nestled between Paya Indah Wetlands and Kuala Langat



Peat Swamp Forest Reserve, the study paid close attention to peat swamp species of flora and fauna as well as possible movements of migratory birds.

The species found within the site are checked against the Malaysian Wildlife Conservation Act 2010 and the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN Red List) to establish conservation status.

### 1.3.1 Flora Assessment

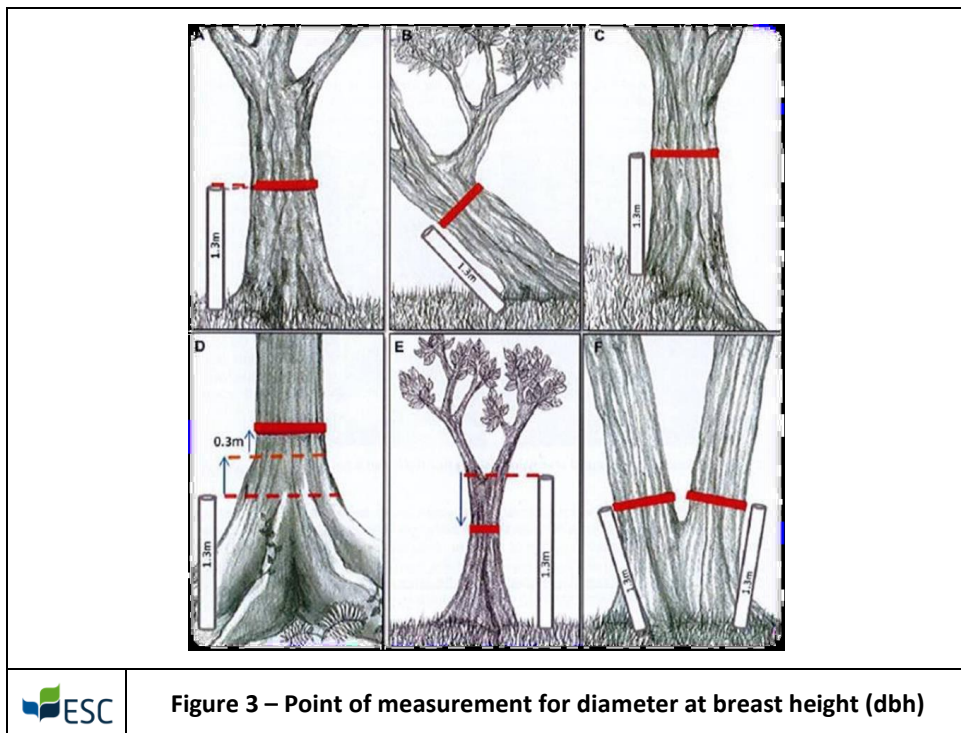
#### Sampling plot establishment

Fixed-area square sampling plot of 0.4 ha (20 x 20 m) was established to assess the existing flora within the Project Site. The location of sampling plots was predetermined based on the existing land use of the Project Site, which can be categorised as *Acacia* plantation/forest, secondary forest (*Macaranga* spp.) and wetland secondary forest. Laser range finders, global positioning system (GPS) and clinometer were used to set up the sampling plot. Amongst the parameters recorded during plot establishment were altitude, coordinate (x,y) and overall condition inside/surrounding the sampling plot. In the area where sampling plots are not possible to be established, a 50 m line transect was used to assess the occurrence of the flora species.

In the sampling plot, all individual trees of 10 cm diameter at breast height (dbh) were measured. The species was identified and its diameter (dbh) and total tree height were recorded. However, when transect method was applied only species name was identified and recorded. Undergrowth or non-woody species such as bamboo, rattan and medicinal plant were also recorded both in sampling plot and transect.

#### Diameter measurement

Tree diameter was measured at 1.3 m above ground level and referred to as diameter at breast height (dbh). A 1.3 m stick was used and placed against the tree to indicate the point of measurement and the dbh was measured using a calibrated tape measure known as diameter tape. However, placement of the stick depends on the ground slope, leaning angle and tree bole shape as shown in Figure 3. Tree diameter was recorded to the nearest one decimal places (e.g.: 10.2 cm instead of 10 cm).



### *Total tree height measurement*

Total tree height is the distance along the axis of the bole of the tree from the ground to the uppermost point of the tree and it was measured using a laser range finder (i.e. trupulse). Total tree height was recorded to the nearest one decimal places.

### *Species identification*

Vegetative characteristics of the tree were used to determine the species. It includes tree stem, buttress, root, bark texture, canopy form, canopy colour, leaf arrangement and leaf form. As to the identification of ferns, the examination was made to the stem of the plant, leaves and its shapes.

Species characteristics as listed in several publications such as the 'Pocket Checklist of Timber Trees'<sup>1</sup> and the 'Tree Flora of Malaya'<sup>2&3</sup>, Flora of Peninsular Malaysia, Series I: Ferns and Lycophytes, Volume 2<sup>4</sup> and Ferns of Malaysia in Colour<sup>5</sup> were used as a guide. Name of each individual tree was recorded and identified up to species level, however, some of the species was identified only up to genus level because of insufficient sample characters for identification. Due to this incompleteness of sample on site, no voucher specimens were collected for all sampling plots and transect lines in this survey.

### *Tree Density*

A number of individual measured in the flora survey is not representing majority species on site. The most dominant species found during the flora survey was determined by using tree density per hectare formula<sup>6</sup> as below:

$$\text{Tree density per hectare} = \frac{\text{Number of trees}}{\text{Plot size}}$$

## **1.3.2 Fauna Assessment**

The fauna assessment for Gamuda Cove was performed based on two data collection methods i.e. primary data collection and secondary data collection.

### *Primary Data Collection*

The species were observed by using a line transect method and recorded via binoculars, animal calling, identification of footprints, nests, scats and faeces. Survey for these species was carried out from day to night (0730 hours until 2230 hours) at nine different points within the project boundary. At each point, a group of three persons will walk along the transect line (with binoculars) length 250-400m for about 45-60 minutes as to record sign from mammals, birds, and herpetofauna. Insects are not formally included in the survey, however, any insects that are easily identified will be recorded.

### *Secondary Data Collection*

Published articles and reports were also reviewed to ensure the completeness of the information. For this assessment, research paper on Paya Indah Wetlands was referred for identifying the fauna species<sup>7</sup>.

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<sup>1</sup> Wyatt-Smith, J., & Kochummen, K. M. (1999). Pocket Check List of Timber Trees (4<sup>th</sup> ed.). Malayan Forest Record's 17, Forest Research Institute Malaysia

<sup>2</sup> Whitmore, T.C. (Ed.). (1973). Tree Flora of Malaya (Vol. 2), Malayan Forest Records, 26. Forestry Department Peninsular Malaysia

<sup>3</sup> Ng, F.S.P. (Ed.). (1989). Tree Flora of Malaya (Vol. 4), Malayan Forest Records, 26. Forestry Department Peninsular Malaysia

<sup>4</sup> Parris, B.S.(Ed.), Kiew, R. (Ed.), Chung, R.C.K.(Ed.), Saw, L.G. (Ed.).(2013). Flora of Peninsular Malaysia, Series I: Ferns and Lycophytes (Vol.2). Forest Research Institute Malaysia

<sup>5</sup> Piggott, A.G., & Piggott, C. J. (1996). Ferns of Malaysia in Colour. Kuala Lumpur: Tropical Press

<sup>6</sup> Husch, B., Beers. T. W., & Kershaw Jr. J. A. (2003). Forest Mensuration (4<sup>th</sup> ed.). John Wiley and Son, Hoboken, New Jersey

<sup>7</sup> Rajpar, M.N., & Zakaria, M. (2010). Density and diversity of water birds and terrestrial birds at Paya Indah Wetland Reserve, Selangor Peninsular Malaysia. Journal of Biological Sciences, 10 (7), pp. 658 – 666.

## 1.4 Document Structure

The report is structured as follows:

- *Section 1* – Introduction
- *Section 2* – Legal Framework
- *Section 3* – Site Description
- *Section 4* – Baseline Flora and Fauna Assessment
- *Section 5* – Biodiversity Management Plan
- Appendix

## 2 LEGAL FRAMEWORK

The following are short summaries of the key legislations which are related to Biodiversity Management in Malaysia.

- National Policy on Biological Diversity 2016 – 2025

The National Policy on Biological Diversity 2016-2025 provides the direction and framework for Malaysia to conserve their biodiversity. The Policy has five overarching goals encompassing stakeholder empowerment, reducing pressures on biodiversity, safeguarding ecosystems, species and genetic diversity, ensuring fair and equitable sharing of benefits from the utilisation of biodiversity, and building the capacity of all stakeholders. This Biodiversity Assessment is in line with the government's policy on conserving biodiversity in Malaysia. In particular, the assessment fulfils Goal 1 which seeks to encourage and empower all stakeholders to conserve our biodiversity and Goal 2 which aims to ensure that all sectors of the economy are planned and managed in a manner that does not impose pressures on our biological resources. The following are 3 national biodiversity targets that become the concerns of this study as to support the Convention on Biological Diversity (CBD) implementation for Malaysia:

- Target 1: By 2025, more Malaysians are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.
- Target 2: By 2025, the contributions of indigenous peoples and local communities, civil society and the private sector to the conservation and sustainable utilisation of biodiversity have increased significantly
- Target 3: By 2025, biodiversity conservation has been mainstreamed into national development planning and sectoral policies and plans.

- Wildlife Conservation Act 2010

This Act provides for the regulation, protection, conservation and management of wildlife in Malaysia and applies to Peninsular Malaysia and the Federal Territory of Labuan. The Act stipulates that any no person shall (a) hunt or keep any protected wildlife; (b) take or keep any part or derivative of any protected wildlife; (c) collect birds' nests; (d) carry on the business of dealing; (e) carry on the taxidermy business; or (f) import, export or re-export any protected wildlife or any part or derivative of any protected wildlife, less they have a license or permit. This Act also provides a list of certain animals and birds as totally protected wildlife. The list is used to compare species found at the site in Chapter 4.

"Protected Wildlife" is defined as any wildlife specified in the First Schedule of the Wildlife Conservation At 2010; while "Totally Protected Wildlife" means any wildlife specified in the Second Schedule of the Wildlife Conservation At 2010. No one is permitted to hunt or keep any "Protected" wildlife with a licence while hunting or keeping "Totally Protected" wildlife requires a Special Permit granted under this Act.

- National Conservation Strategy 1993

Developed by the Economic Planning Unit, with technical input from the World Wildlife Fund (WWF), the National Conservation Strategy (NCS) aim to contribute to the various aspects of planning for effective holistic resource management and to contribute to sustainable development. The objectives of the NCS are conservation of natural resources, sustainable development and improved efficiency in resource use and management.

- Pesticides Act 1973

This Act covers the management of all pesticides and other chemicals used in agriculture. It regulates the labelling, registration, importation, manufacture, advertising, sale and storage of pesticides; controls the presence of pesticide residues in food, and the reporting and investigation of accidents and injuries caused by pesticides.

According to the Department of Agriculture, the list of banned pesticides include Binapacryl, Butaclor, Dicofol, Methomyl, Monocrotophos, Dinoseb, HCH (mixed isomers), Aldrin, Chlordimeform, Dieldrin, Ethylene dibromide, Heptachlor, Mercury compounds, Chlordane, Captafol, Chlorobenzilate, 2,4,5-T Herbicide, Folpet, DDT, Sodium pentachlorophenate, DNOC, Ethylene dichloride, Ethylene oxide, Lindane, Fluoroacetamide, Hexachlorobenzene, Parathion, Calcium cyanide, Toxaphene, Phosphamidon, Methyl-parathion, Methamidophos, Endosulfan, Acephate, Mixture of benomyl, carbofuran and thiram, Tributyltin compound, Aldicarb, Alachlor, and Azinphos-methyl.

- National Forestry Act 1984

The Act provides for the administration, management and conservation of forests and forestry development within the States of Malaysia and for connected purposes. It provides for the gazettement of forest reserves, their use and management as well as for control of cutting and removal of forest.

- National Forestry Policy 1992

The National Forestry Policy was passed in 1978 and was later revised in 1992 to take into consideration matters relating to biological diversity conservation and sustainable utilization of genetic resources, as well as the role of local communities in forest development. The Policy makes provisions for managing Permanent Forest Estates, for maximising social, economic and environmental benefits, for implementing a planned programme of forest development, promoting efficient harvesting and utilisation within the production forest, increasing the production of non-wood forest products and providing for the conservation of biological diversity.

- National Strategy for Plant Conservation 2009

The Malaysian National Strategy for Plant Conservation is an initiative to consolidate past and existing efforts towards biodiversity conservation. The strategy has 5 objectives with 17 targets, which outlines a systematic approach to put into action and an indication of organisations that would be relevant to take the target forward.

- Biosafety Act 2007

The objective of the Biosafety Act is to protect human, plant and animal health, the environment and biological diversity by regulating the release, importation, exportation and contained the use of LMOs (Living Modified Organism), and the release of products of such organisms. The Biosafety Act 2007 establishes a process to vet all applications for the direct release of LMOs into the environment to ensure that the particular LMO is safe.

LMO is any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology.

- Environmental Quality Act 1974

An act relating to the prevention, abatement, control of pollution and enhancement of the environment. It controls all activities relating to the discharge of wastes into the environment and for preventing or controlling pollution and protecting and enhancing the quality of the environment.

- Water Quality Standards

Water quality data were used to determine the water quality status whether it is clean, slightly polluted or polluted category and to classify the rivers in Class I, II, III, IV or V based on the Water Quality Index (WQI) and National Water Quality Standards for Malaysia (NWQS).

- Access to Biological Resources and Benefit Sharing Act 2017

An act to implement the Convention on Biological Diversity and any protocol to the Convention dealing with access to biological resources and traditional knowledge associated with biological resources and the sharing of benefits arising from their utilisation and for matters connected therewith. The Convention enjoins Parties to take legislative, administrative or policy measures, as



appropriate, to implement the provisions relating to access to genetic resources and the fair and equitable sharing of benefits arising from their commercial and other utilisation. Data from this biodiversity assessment study will support this act as the basis of or by sharing the information in the web-based application used by residences.

- International Union for Conservation of Nature Red List of Threatened Species

The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on plants, fungi and animals that have been globally evaluated using the IUCN Red List Categories and Criteria (Figure 4). This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red List is to catalogue and highlight those plants and animals that are facing a higher risk of global extinction. IUCN Red List can be accessed at <http://www.iucn.org>.

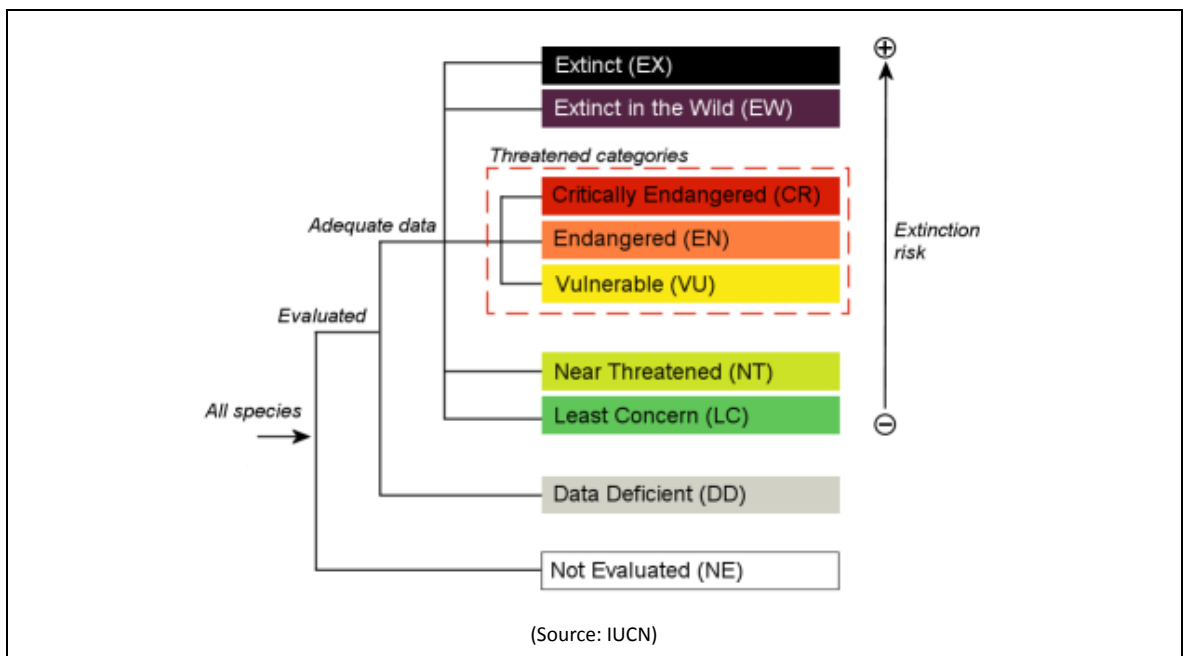


Figure 4 – IUCN Red List Classification

### 3 SITE DESCRIPTION

The data in the following subsections were gathered from site survey, remote sensing and desktop research. Data from this study provides the site setting for the flora and fauna assessment in Chapter 3.

#### 3.1 Site Setting

The project site of Gamuda Cove is located at Tanjung Dua Belas within the Kuala Langat District in Selangor. The site comprises 1,530 acres for the leasehold mixed-use development located adjacent to the Expressway Lingkaran Tengah (ELITE highway) (*Figures 5 and 6*). The site is bounded by the Northern Kuala Langat Forest Reserve on the north and northwest, Paya Indah Wetlands to the south, ELITE highway and palm tree plantation to the east and west respectively.

Cyberjaya is the closest town to Gamuda Cove situated approximately 5 km northeast of the site. Other towns surrounding the site are Putrajaya (9 km northeast), Kota Kemuning (14 km northwest), Dengkil (8 km southeast) and Jenjarom (13 km west). The Kuala Lumpur International Airport (KLIA) is also situated 18 km southeast of the site and the nearest railway station, Putrajaya Express Rail Link (ERL), is approximately 8 km northeast of the site.

##### 3.1.1 Site Access

Gamuda Cove is accessible through the main roads of Jalan Banting and ELITE highway as illustrated in *Figure 5*. Other major cities within Selangor are also connected to the project site via interconnecting routes as shown in *Table 1*. Currently, roads within Gamuda Cove are unpaved as Phase 1 of the construction has commenced and is still on-going (*Figure 6*).

**Table 1 – Interconnecting Routes from Major Cities in Selangor**

Cities	Routes
Cyberjaya	Route 29 → Jalan Putrajaya-Dengkil → Jalan Baru → Jalan Banting → site
KL	KL-Putrajaya highway →Lingkaran Putrajaya → Route 29 → Jalan Putrajaya-Dengkil → Jalan Baru → Jalan Banting → site
Petaling Jaya	Lembah Klang highway → ELITE highway → Lingkaran Putrajaya → Route 29 → Jalan Putrajaya-Dengkil → Jalan Baru → Jalan Banting → site
KLIA	Route 182 → Route 32 → Route 31 → site

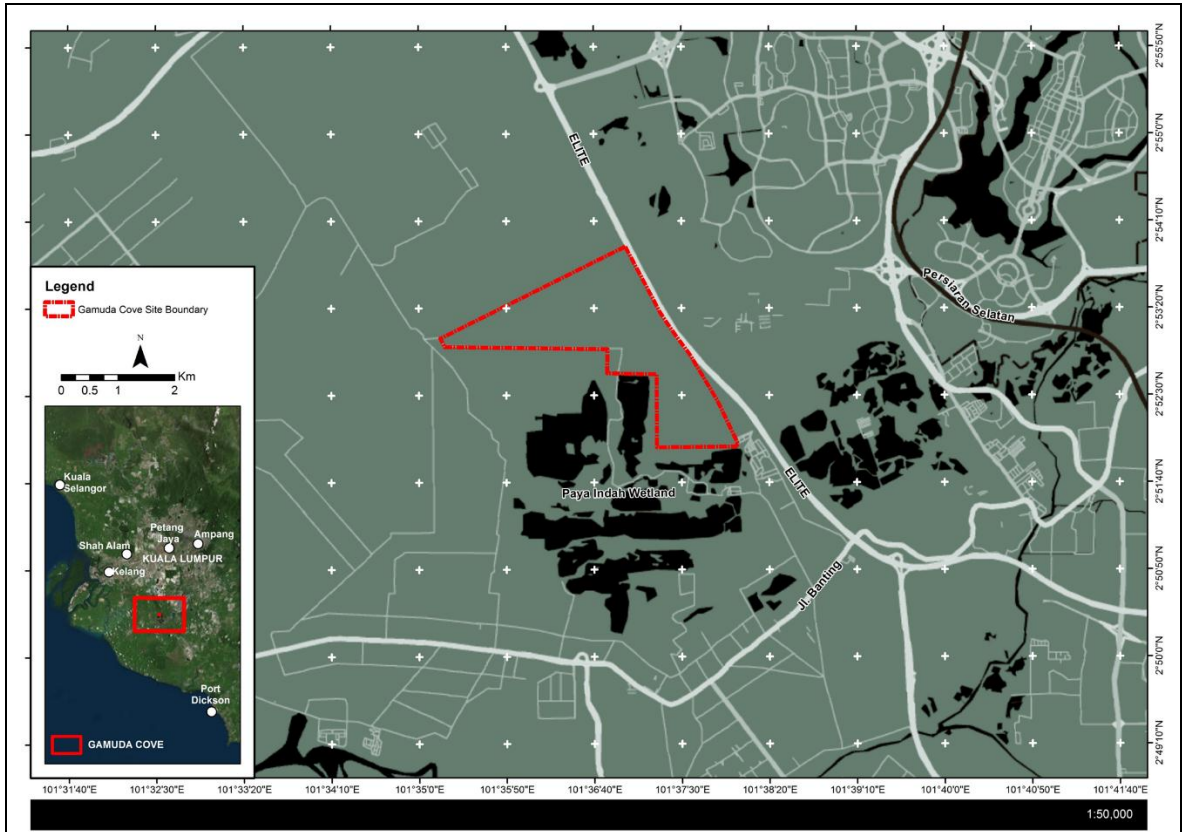
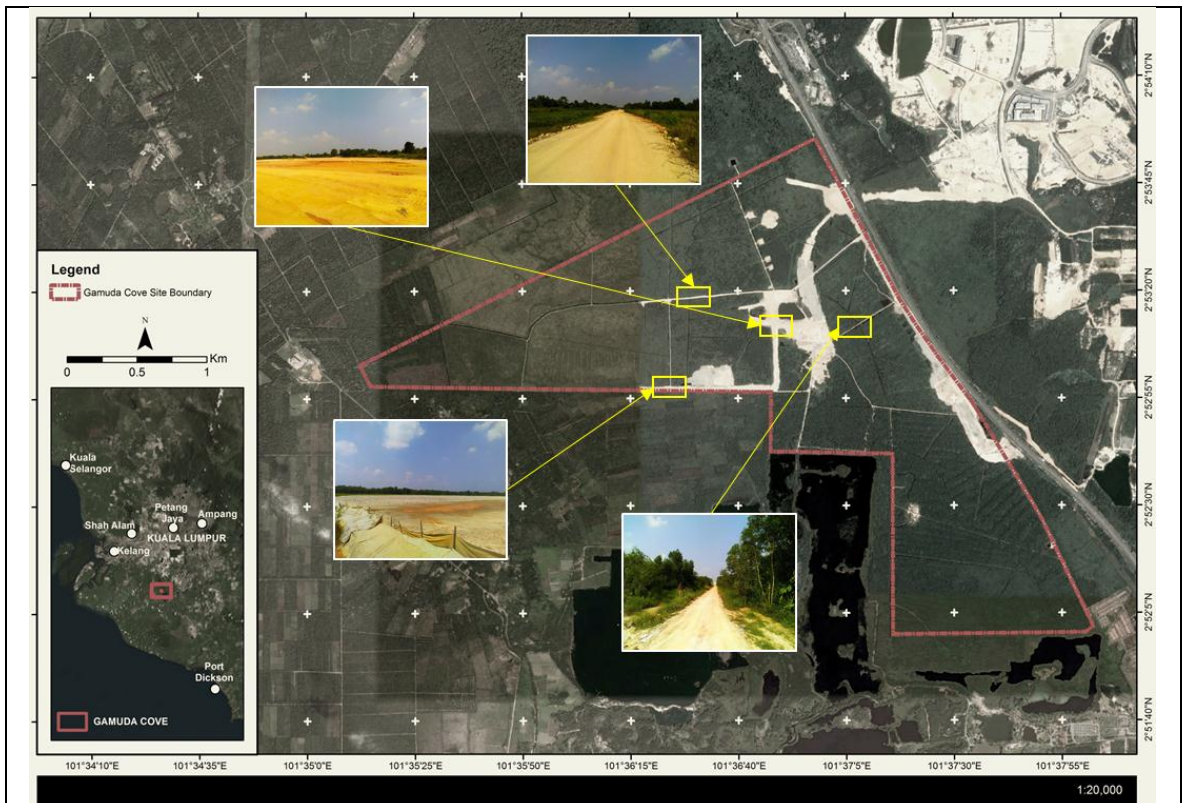


Figure 5 – Main Roads Connecting to Gamuda Cove



(Source: Google Maps)



Figure 6 – Unpaved Roads Surrounding the Site



**3.1.2 Current Site Conditions**

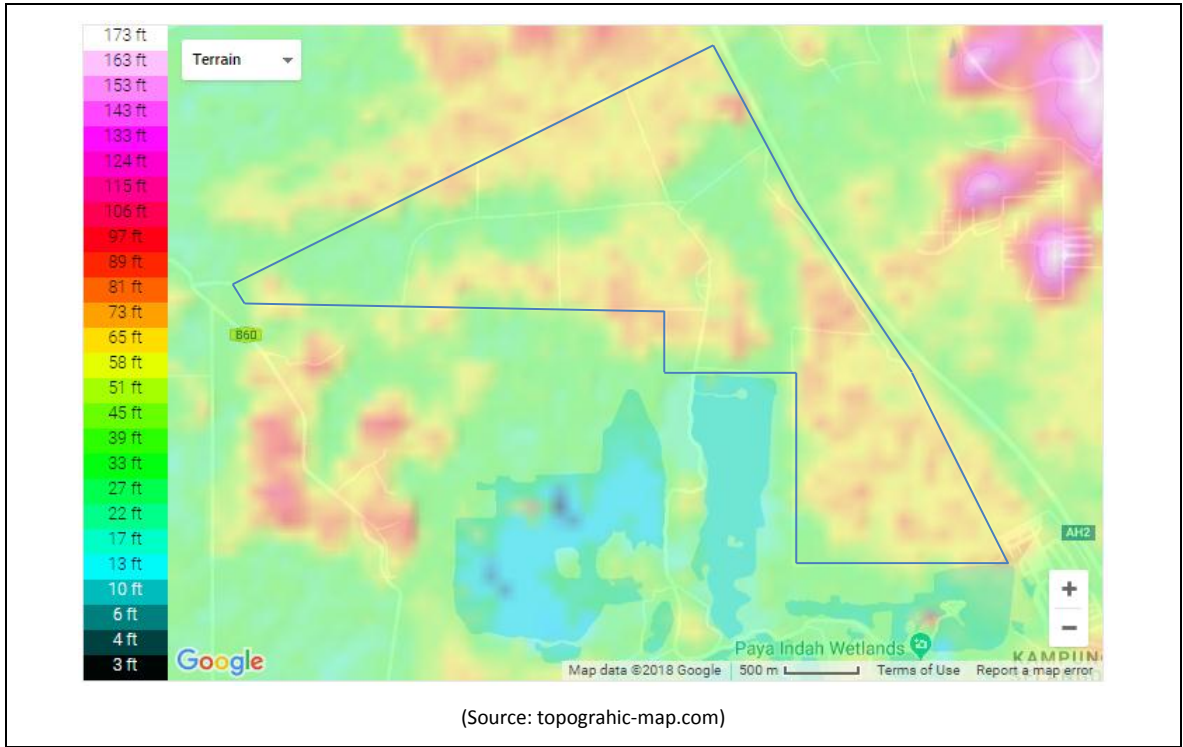
Project clearing works had already started onsite for access roads, platform levelling and manmade lake creation. However, the initial site reconnaissance survey conducted on 4<sup>th</sup> April 2018 shows large tracts of land still undeveloped with their original vegetation of secondary and degraded swamp forest. *Figure 7* shows pictures of the site conditions during the initial site visit.



**3.2 Geology and Soils**

**3.2.1 Site Topography**

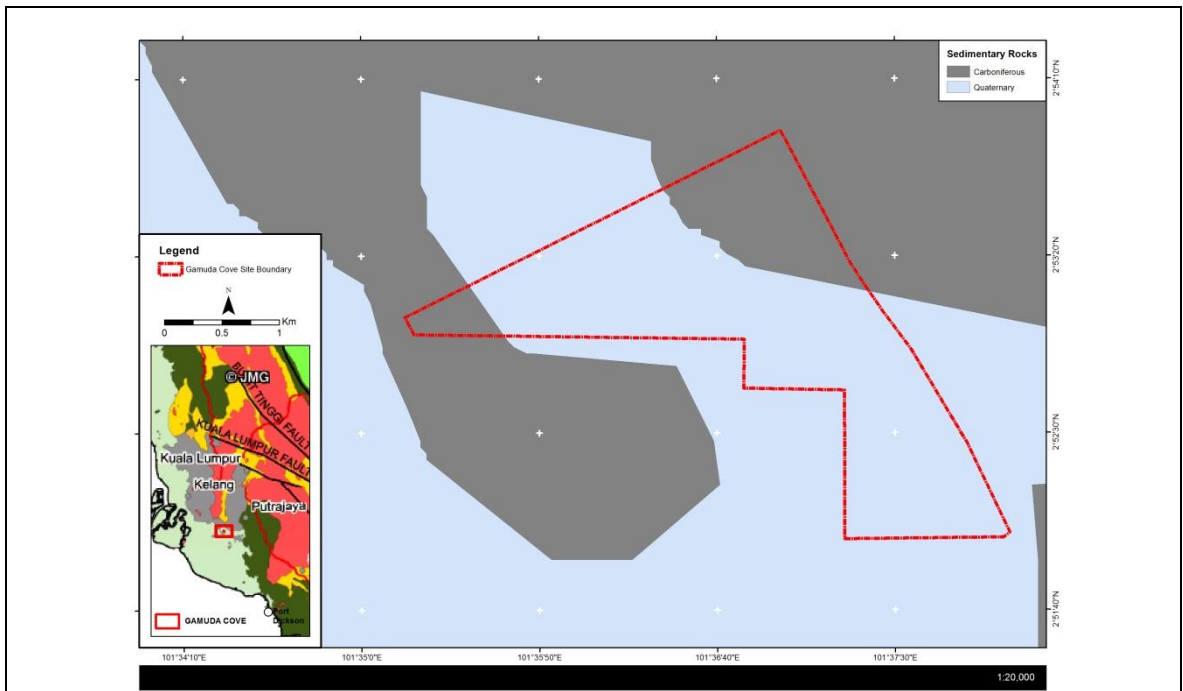
As seen in *Figure 8*, the Gamuda Cove site is situated on a low laying area at approximately 10 m to 24 m above mean sea level (amsl). Based on the topographic map the surface of the wetlands on the southern border of the site is approximately 7 m amsl.



**Figure 8 – Indicative Site Topography**

**3.2.2 Geology**

The geological map in *Figure 9* below shows that the area is comprised of quaternary with marine and continental deposits such as clay, silt, sand and peat with minor gravel. Moreover, soil materials from this site is categorised under unconsolidated deposits with peat, humic clay and silt.



**Figure 9 – Geological Map of Gamuda Cove**





### 3.3 Landuse

Gamuda Cove is under the Tanjung Dua Belas Planning Block (*Blok Perancangan*), within the district of Kuala Langat. A larger part of the 1,530 acres project site is covered with secondary vegetation of palm tree plantation with about 10% to 15% cleared for the construction of Phase 1. The surrounding landuse within 1 km radius of the site comprises residential areas, Paya Indah wetland park and camp, North Kuala Langat Forest Reserve, Dengkil inert waste landfill and a few other underdevelopment areas (see *Figure 9*).

#### 3.3.1 Sensitive Receptors

The sensitive receptors bordering the project site and that could be affected during the construction phase are identified as below:

**North Kuala Langat Forest Reserve:** The northern region of Gamuda Cove is bordered by the 1,000 acres North Kuala Langat Forest Reserve. Large areas of the forest are formed of peat swamp and is an important area for biodiversity. According to Global Environment Centre Malaysia<sup>8</sup>, rare species like the Malayan sun bear and the black clouded leopard can be found in that area.

Peat is highly flammable and therefore are vulnerable to fire accidents. In recent years, the Kuala Langat forest has been impacted by fire<sup>9</sup>. Historical data on peat fires were sourced from news reports. The earliest reported peat fire was in 2013. According to The Star newspaper, peat fire broke out at Compartment Eight of the Kuala Langat North Forest on 14th June 2013. It was estimated to have damaged at least 90 acres of the site<sup>10</sup>. Another 3 fires were reported in 2014 in February, June and August. Out of these 3 months, the biggest fire was recorded in February razing approximately 294 acres of the forest<sup>11</sup>. Rainfall data from that period (shown in Chapter 4) shows periods of low rainfall during that time. The most recent peat fire was recorded in August 2017, destroying approximately 25 acres of the forest<sup>12</sup>.

According to an article by Global Environment Center Malaysia, more than 800 acres of the forest suffered a forest fire during the dry season in 2014. It has also been reported that Gamuda Land had funded an initiative called the Kuala Langat North Forest Reserve Fire Prevention in June 2015<sup>13</sup>.

With reference to the Kuala Langat Local District Plan (*Rancangan Tempatan Daerah*), this forest is categorised as a Level 1 environmental sensitive area which means the forest is highly protected<sup>14</sup>.

#### Paya Indah Wetlands:

Gamuda Cove is nestled in between a forest reserve on the north and Paya Indah Wetlands at approximately less than 2 km on the south. The wetlands are one of Malaysia's eco-tourism parks covering 7,660 acres within Tanjung Dua Belas. The Selangor government had restored a former tin mining land into the wetlands park. The park has been planted with more than 70,000 trees and palm trees along with introduced 120 species birds, 20 fish species, 35 mammals, 4 hippopotamuses from Botswana, 15 crocodiles from Langkawi and 10 buffaloes<sup>15</sup>.

<sup>8</sup> Global Environment Center. (2015). Kuala Langat North Forest Reserve GEC Forest Conservation Project. Retrieved from [www.gec.org.my/view\\_file.cfm?fileid=3051](http://www.gec.org.my/view_file.cfm?fileid=3051)

<sup>9</sup> Global Environment Center. (2015). Kuala Langat North Forest Reserve GEC Forest Conservation Project. Retrieved from [www.gec.org.my/view\\_file.cfm?fileid=3051](http://www.gec.org.my/view_file.cfm?fileid=3051)

<sup>10</sup> The Star Online. (2013). Peat fire in Kuala Langat forest reserve under control. Retrieved from <https://www.thestar.com.my/news/community/2013/06/18/peat-fire-in-kuala-langat-forest-reserve-under-control/>

<sup>11</sup> Selangorkini, (2014). Kuala Langat Reserve Forest fire, fire fighters put off fire. Retrieved from <https://selangorkini.my/en/2014/10/kuala-langat-reserve-forest-fire-fire-fighters-put-off-fire/>

<sup>12</sup> New Straits Times. (2017). Selangor forest fires brought under control; over 100 hectares scorched. Retrieved from <https://www.nst.com.my/news/nation/2017/08/265998/selangor-forest-fires-brought-under-control-over-100-hectares-scorched>

<sup>13</sup> Global Environment Center. (2015). Kuala Langat North Forest Reserve Fire Prevention Initiative. Retrieved from <http://www.gec.org.my/index.cfm?&menuid=338>

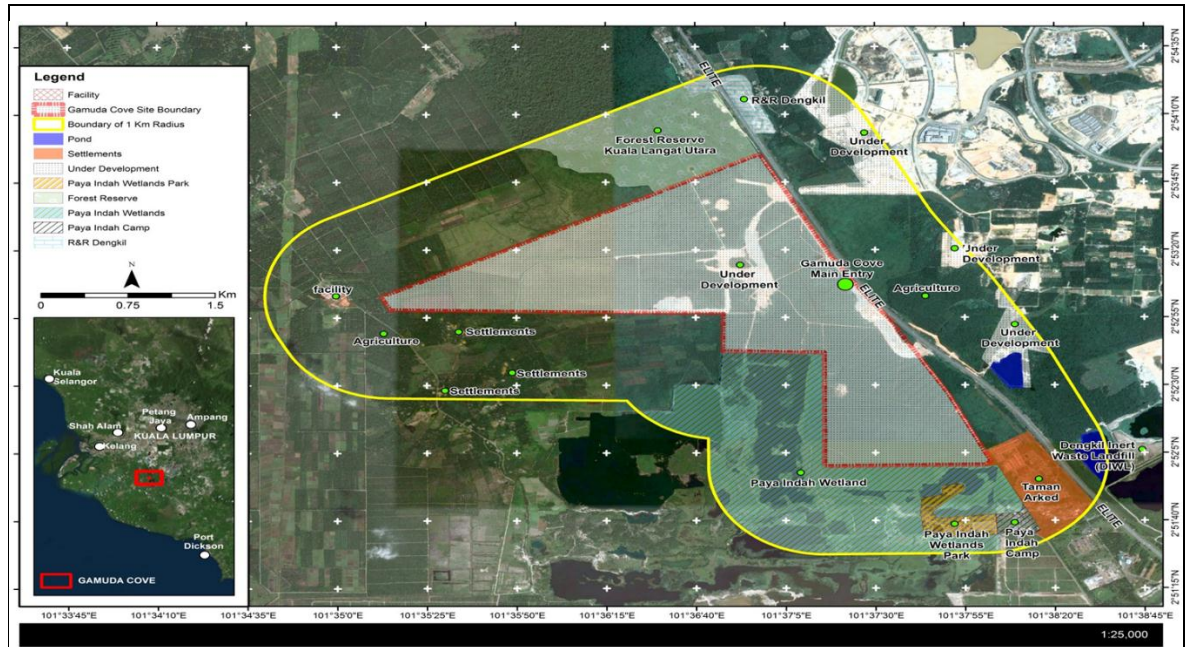
<sup>14</sup> Cadangan Pemuliharaan Kawasan Sensitif Alam Sekitar, Rancangan Tempatan Kuala Langat 2020.

<sup>15</sup> The Sun Daily. (2005). Retrieved from Paya Indah wetlands to reopen 2006: <http://www.thesundaily.my/node/178976>

The wetlands also offer a number of tourism activities such as bird watching, trekking, cycling within the parks, hippo feeding, crocodile feeding, fishing, kayaking and camps for school students. Chalets are also built for accommodation<sup>16</sup>. Desktop research showed that the Paya Indah Wetlands is not categorised as a “wetland of international importance” under the RAMSAR Convention of Wetlands.

**Residential Areas:**

As seen in *Figure 9* below, the project site is surrounded by a few residential areas. To the southeast of the project boundary, an area called Taman Arked consists of town houses and a mosque. The population of Taman Arked is estimated to be approximately 400 families. Additionally, a few village houses are scattered 1 – 2 km west of the site.



(Source: Gamuda and Google Earth Image 2016)

**Figure 10 – Gamuda Cove surroundings within 1 km radius**

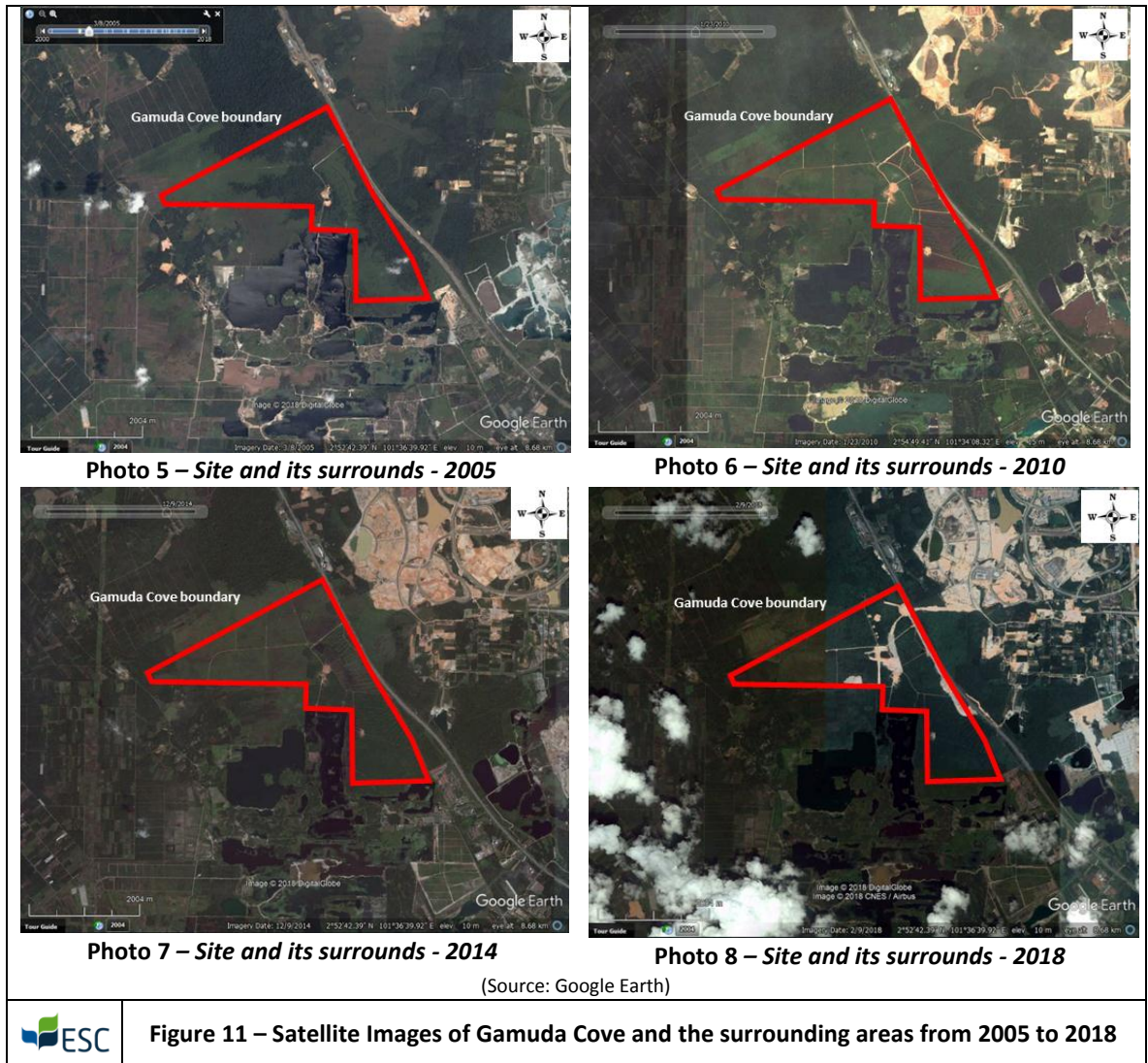
**3.3.2 Non-Sensitive Receptors**

Gamuda Cove is surrounded by other receptors including the Dengkil inert waste landfill, an abandoned warehouse facility, and areas under development near Cyberjaya.

**3.3.3 Historical Landuse**

Satellite images taken from Google Earth show no major changes on the site from 2005 to 2018. However, it can be observed from *Figure 11* that the boundary of the site had been plotted in 2010. Historical landuse of the site is mostly oil palm plantation. As for the areas surrounding the site, no changes were observed on the northern, western and southern regions. On the contrary, the eastern region has been observed to gradually develop from 2005 which looks like an extension of Cyberjaya.

<sup>16</sup> The Star Online. (2014). Cycling to see the hippos at Paya Indah Wetlands. Retrieved from <https://www.thestar.com.my/lifestyle/features/2014/05/10/cycling-to-see-the-hippos-at-paya-indah-wetlands/>



### 3.4 Hydrology & Hydrogeology

Based on satellite images from Google Earth, the closest river to Gamuda Cove is Sungai Langat, located about 9 km southeast of the site, which flows in a southwest direction and drains into the Straits of Malacca. Upstream of Sungai Langat are Langat Dam and Semenyih Dam (Figure 12).

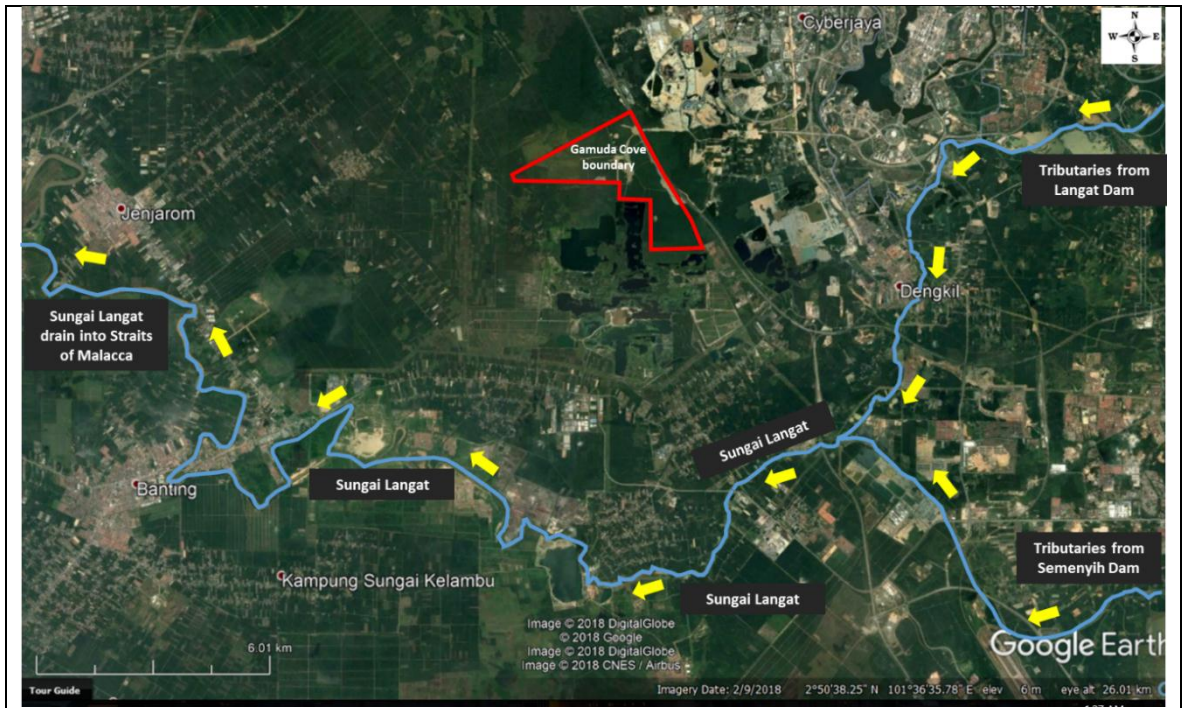
During the site visit on 4<sup>th</sup> April, other water bodies were identified on the site. There were man-made lakes built for the Central Park and a few irrigational canals which could have existed from the agricultural activities in the past (Figure 13). Apart from the lakes located at Paya Indah Wetlands and the Dengkil inert waste landfill, no other lakes were spotted surrounding the project site.

The water authorities of Selangor have gazetted alternate water sources around Selangor for use in the event of draughts. According to the Selangor’s Structural Plan 2035, waters from the Paya Indah Wetlands has been categorised as an alternate source under this division<sup>17</sup>.

A water intake point exists in upstream Sungai Langat (2° 50’ 48’’N, 101° 40’ 48’’E) about 7 km southeast of the site near Dengkil town. According to the Department of Environment’s (DoE) Environmental Quality Report 2016, waters flowing downstream of Sungai Langat were categorised under Class III (For use of water Supply where extensive treatment is required, or for fishery of common, economic value and tolerant species; livestock drinking) of the National Water Quality Standards for Malaysia. No groundwater wells were noted during the site visit and none are expected in the area.

<sup>17</sup> Jabatan Perancangan Bandar dan Desa. (2015). Draf Rancangan Struktur Negeri Selangor 2035. Shah Alam.





(Source: Google Earth)



**Figure 12 – Satellite Images of river surrounding Gamuda Cove**



**Photo 9 - Irrigation Canals in the site**

**Photo 10 - Man-made lake for Central Park**



**Figure 13 – Water Bodies within Gamuda Cove**

### 3.5 Climate & Meteorological Conditions

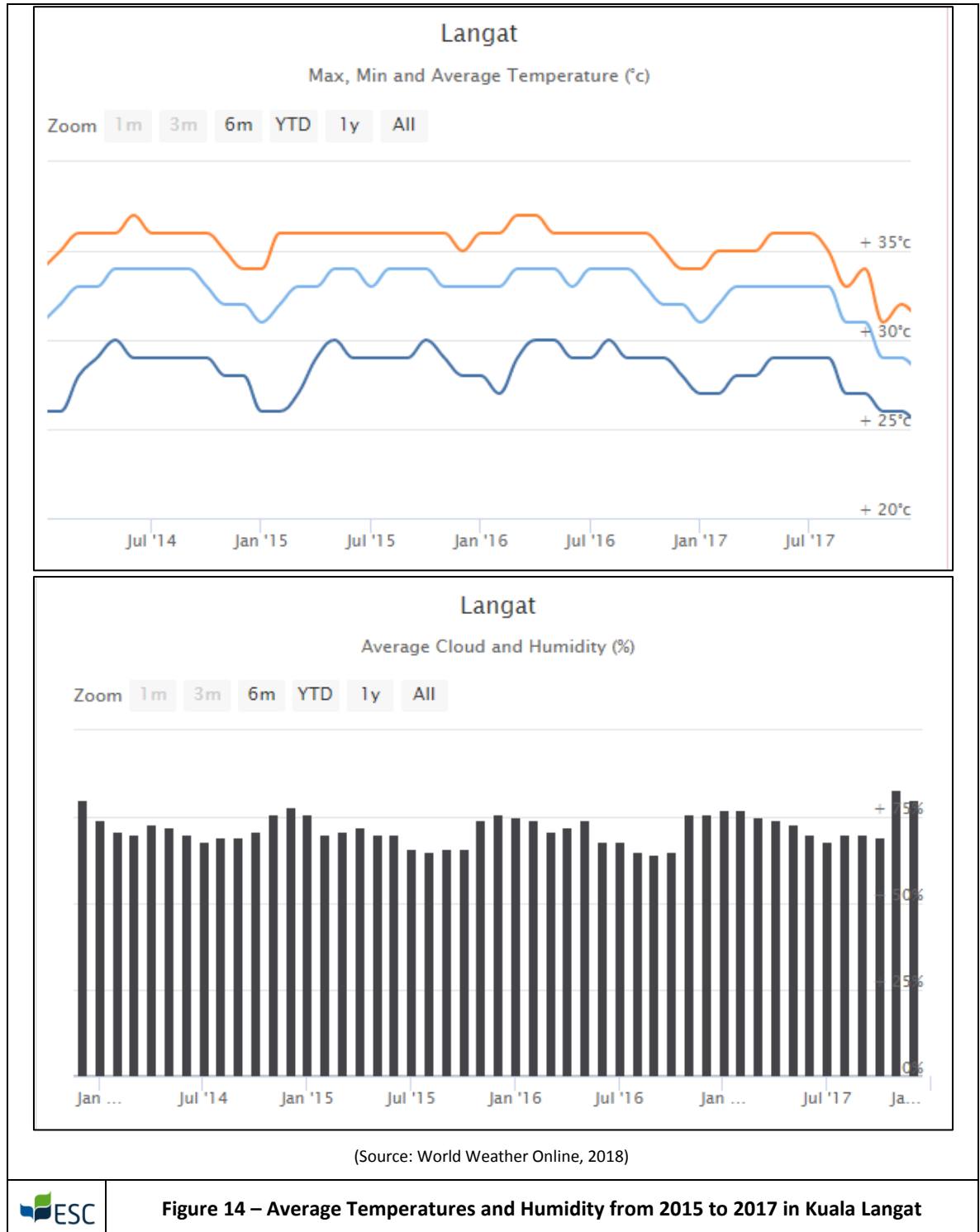
Data for the annual rainfall, temperatures and humidity were extracted from a secondary source, i.e. World Weather Online.



### 3.5.1 Temperature and Humidity

Temperature trends from 2014 - 2017 illustrated in *Figure 14* below shows average temperatures of the Kuala Langat district ranging from a minimum of 25°C (2018) to maximum of 37°C (2016). Further analysis of the graph shows a repeated trend of decrease in temperature from the months of October to January.

Change in temperature is relative to the change in humidity. As seen in *Figure 13*, the average humidity ranges from a minimum of 64% (2016) to a maximum of 83% (2017). The graph below shows similar trends to that of the temperature as mentioned above.





### 3.5.2 Rainfall

During the period of 2014 to 2017, the rainfall data shows annual rainfall at 536 mm. The rainfall activity is noted to be higher during the months of October to January each year and lower from May to July. Over the span of these four years, highest rainfall was recorded in November 2017 at a level of 635 mm.

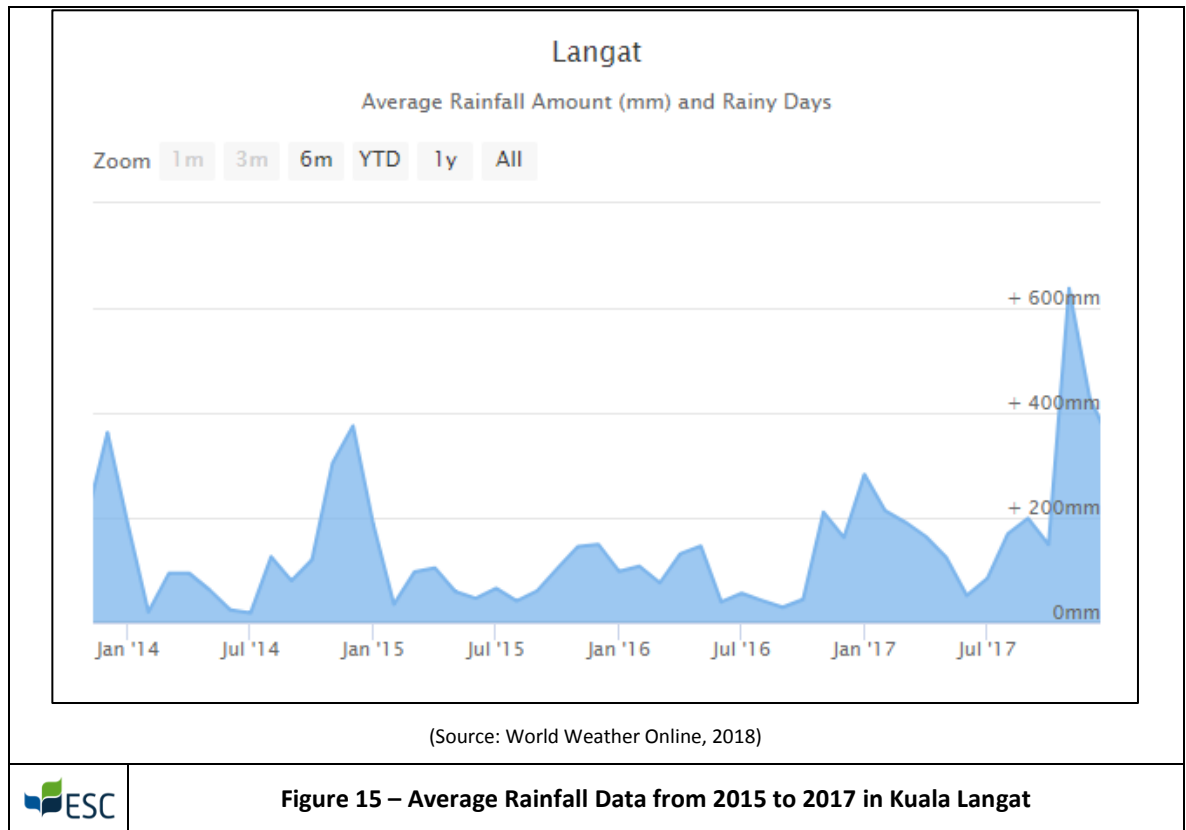


Figure 15 – Average Rainfall Data from 2015 to 2017 in Kuala Langat

### 3.6 Air Quality

The Department of Environment (DoE) monitors ambient air condition throughout Selangor to detect any significant change in the air quality which may be harmful to human health. The quality of air is reported in terms of the Air Pollution Index (API) which is calculated based on the concentrations of ozone, carbon monoxide, nitrogen dioxide, sulphur dioxide and particulate matter.

The closest air quality monitoring station is located at Kolej MARA Banting (2° 49' 0.84"N, 101° 37' 22.8"E) approximately 7.5 km south of the site and is classified as a suburban type of monitoring station. According to the Environmental Quality Report 2016 by the Department of Environment Malaysia, the Banting monitoring station commenced operation in 2010 and have reported recording 143 days of unhealthy air quality over the past 6 years. Among them, the majority of unhealthy days occurred in the year 2014 and 2015 for 41 and 45 days, respectively.

In 2014, a local newspaper had reported that the air pollution index (API) was recorded at an unhealthy rate of 189 at the Banting station<sup>18</sup>. This could have been caused by the peat fire accidents which continued over the last few years. This, in turn, had contributed to the haze problem faced by Selangor between 2014 to 2016.

<sup>18</sup> The Star Online. (2014). Haze in Malaysia: Schools in Kuala Langat district closed. Retrieved from: <https://www.thestar.com.my/news/nation/2014/03/14/haze-forces-closure-of-schools-in-kuala-langat-district/>

## 4 BASELINE FLORA AND FAUNA ASSESSMENT

As part of the Biodiversity Assessment, onsite flora and fauna field surveys were conducted to determine actual current site conditions and to record existing species. The information from these field surveys form the background baseline data for future reference.

### 4.1 Flora Assessment

The flora survey was conducted on 4<sup>th</sup>, 7<sup>th</sup> and 12<sup>th</sup> April 2018 to assess the existing conditions and to determine the flora composition of Project site. The flora survey includes a survey of undergrowth and non-woody species. Based on the satellite image and on-site survey, the Project site is dominated by shrubs, secondary forest, wild *Acacia* forest and oil palm plantation with some part of the area cleared for other development. Meanwhile, the surrounding areas are dominated by agricultural lands, forest reserve and wetland forest.

#### 4.1.1 Sampling Location

The flora survey had 37 sampling points within the Project site which consists of 16 sampling plots and 21 lines transects. All locations were chosen based on the condition of the site that allows effective sampling activities. The sampling location of the flora survey is shown in *Table 2* and *Appendix A*.

**Table 2 – Flora Survey Sampling Location within Gamuda Cove**

Sampling No.	Habitat	Sampling Type	Altitude	Coordinate	
				Latitude	Longitude
1	Swamp – dry	Sampling plot	1	02° 53' 06.3"	101° 36' 46.9"
2			13	02° 52' 58.7"	101° 36' 54.2"
3	Wetland		9	02° 53' 02.8"	101° 36' 51.5"
4			8	02° 52' 44.8"	101° 37' 03.1"
5			14	02° 52' 44.9"	101° 37' 07.9"
6			4	02° 52' 33.5"	101° 37' 18.5"
7			9	02° 52' 04.1"	101° 37' 20.2"
8			9	02° 52' 01.8"	101° 37' 27.8"
9			5	02° 52' 19.6"	101° 37' 46.9"
10			0	02° 52' 48.6"	101° 37' 12.2"
11	Swamp – dry	Line transect	12	02° 53' 02.4"	101° 35' 21.9"
12			11	02° 53' 04.8"	101° 35' 33.7"
13	Wetland		8	02° 53' 10.1"	101° 35' 47.1"
14			9	02° 53' 08.3"	101° 35' 53.1"
15			9	02° 53' 17.9"	101° 35' 58.8"
16			6	02° 53' 14.3"	101° 36' 01.4"
17			7	02° 53' 21.2"	101° 36' 16.5"
18			7	02° 53' 15.1"	101° 36' 19.4"
19			13	02° 53' 25.7"	101° 36' 48.5"
20			10	02° 53' 26.6"	101° 36' 42.8"
21	Wetland	Sampling plot	8	02° 53' 40.8"	101° 36' 38.7"
22			4	02° 53' 45.3"	101° 36' 39.6"
23	Wetland	Line transect	8	02° 53' 53.7"	101° 36' 57.8"
24			9	02° 53' 45.0"	101° 37' 00.2"
25			10	02° 53' 34.8"	101° 37' 04.2"
26			8	02° 53' 23.2"	101° 37' 07.7"
27			8	02° 53' 15.9"	101° 37' 11.8"
28			7	02° 53' 10.2"	101° 37' 10.4"
29			7	02° 53' 10.5"	101° 37' 06.4"
30			7	02° 53' 16.0"	101° 37' 01.6"

Sampling No.	Habitat	Sampling Type	Altitude	Coordinate	
				Latitude	Longitude
31		Sampling plot	8	02° 53' 19.2"	101° 37' 05.4"
32			7	02° 53' 04.0"	101° 36' 37.6"
33			9	02° 53' 01.8"	101° 36' 24.6"
34			8	02° 53' 07.4"	101° 36' 14.8"
35			9	02° 53' 00.9"	101° 36' 08.8"
36			10	02° 53' 01.6"	101° 35' 56.8"
37	Oil palm plantation		10	02° 52' 59.4"	101° 35' 43.4"

Although the sampling plots/transects were distributed as random as possible within the area, only a few plots were placed in the centre and northern part of the Gamuda Cove, because of the habitat conditions. There is a large watery area occupied by weed in the centre and northern part of Gamuda Cove as in transect line nos. 35 and 36. The sampling location of the flora survey is illustrated in *Figure 16*.

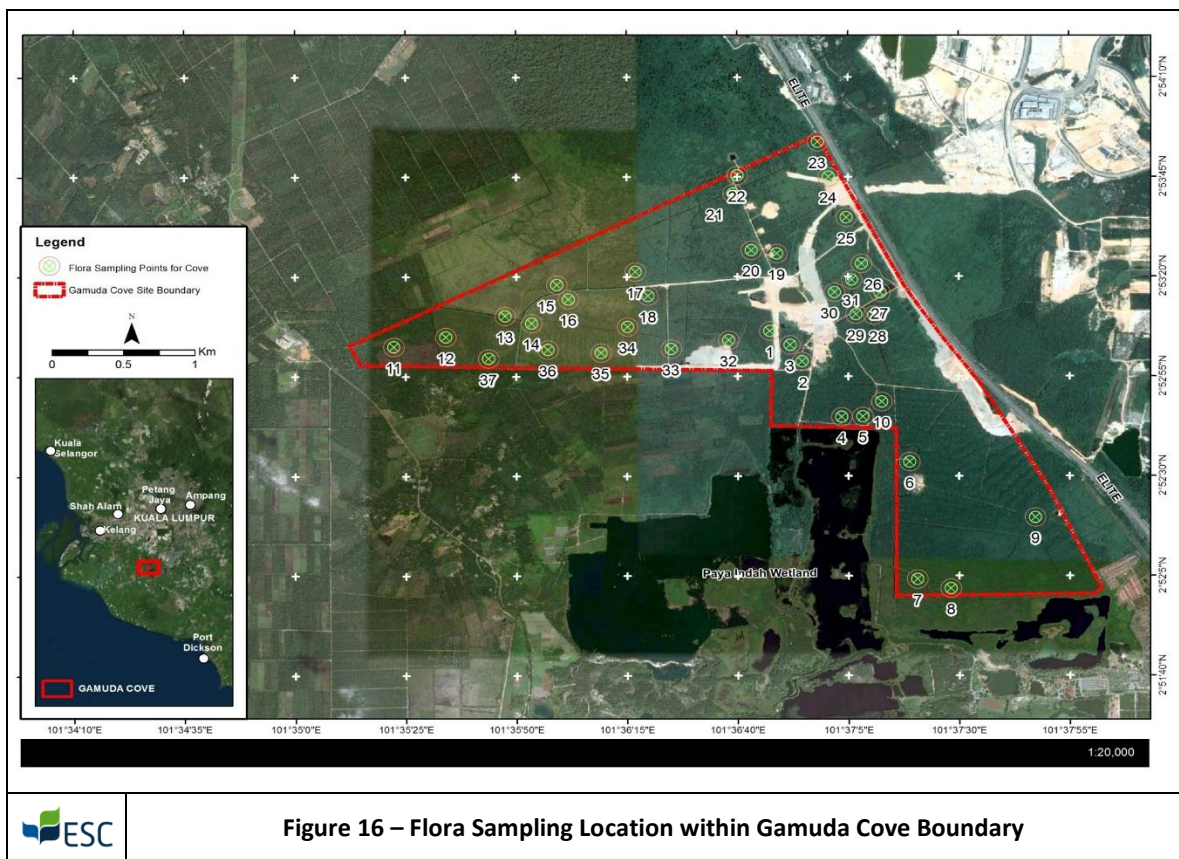


Figure 16 – Flora Sampling Location within Gamuda Cove Boundary

#### 4.1.2 Flora Species

Based on the site survey, the Project site is dominated by secondary forest and *Acacia* wildings as well as undergrowth vegetation such as ferns and coarse grasses (Figure 17). A total of 8 species were recorded within the sampling plots while 42 species were found along the line transect. Table 3 and 4 show the flora species recorded within the sampling plots and along the line transect within the Project site. The species lists were checked against the IUCN Red List to determine if there were any species of important conservation value.

**Table 3 – List of Flora within the Sampling Plots**

Plot No.	Family	Local Name	Scientific Name	No. of Individual Measured	IUCN List
1	Fabaceae	Akasia	<i>Acacia mangium</i>	24	NE
2	Euphorbiaceae	Hujan panas	<i>Croton argyratus</i>	1	
		Mahang paya	<i>Macaranga pruinosa</i>	2	
		Mahang gajah	<i>Macaranga gigantea</i>	3	
	Poaceae	Buluh	<i>Bamboo</i>	1	LC
3	Elaeocarpaceae	Mendong	<i>Elaeocarpus sp.</i>	1	-
	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	17	NE
		Mahang gajah	<i>Macaranga gigantea</i>	2	
4	Fabaceae	Akasia	<i>Acacia mangium</i>	2	
5	Fabaceae	Akasia	<i>Acacia mangium</i>	12	
6	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	6	
	Fabaceae	Akasia	<i>Acacia mangium</i>	2	
7	Fabaceae	Akasia	<i>Acacia mangium</i>	12	
	Rutaceae	Pepauh/ Tenggek burung	<i>Melicope lunu-akenda</i>	2	
8	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	12	
	Rutaceae	Pepauh or Tenggek burung	<i>Melicope lunu-akenda</i>	2	
9	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	20	NE
	Fabaceae	Akasia	<i>Acacia mangium</i>	9	
	Rutaceae	Pepauh/ Tenggek burung	<i>Melicope lunu-akenda</i>	4	
10	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	4	
		Mahang gajah	<i>Macaranga gigantea</i>	1	
	Fabaceae	Akasia	<i>Acacia mangium</i>	5	
	Rutaceae	Pepauh/ Tenggek burung	<i>Melicope lunu-akenda</i>	3	
19	Fabaceae	Akasia	<i>Acacia mangium</i>	14	
21	Fabaceae	Akasia	<i>Acacia mangium</i>	5	
22	Fabaceae	Akasia	<i>Acacia mangium</i>	5	
23	Euphorbiaceae	Balik angin	<i>Mallotus paniculatus</i>	1	
	Fabaceae	Akasia	<i>Acacia mangium</i>	6	
29	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	1	
	Fabaceae	Akasia	<i>Acacia mangium</i>	6	
32	Fabaceae	Akasia	<i>Acacia mangium</i>	5	

Notes : IUCN Classification – NE (Not Evaluated), LC (Least Concern)  
No. of individual measured is not representing majority species on site.

**Table 4 - List of Flora along the Line Transect\***

Family	Local Name	Scientific Name;	No. of Individual Measured	IUCN List
Apocynaceae	Pulai penipu bukit	<i>Alstonia macrophylla</i>	1	-
Arecaceae	Kelapa sawit	<i>Elaeis guineensis</i>	5	LC
Asteraceae	Rumput kapal terbang	<i>Chromolaena odorata</i>	1	NE
Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>	29	NE
Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>	25	
Dennstaedtiaceae	Bracken fern/ Resam besar	<i>Pteridium arachnoideum</i>	2	
Dilleniaceae	Simpoh air	<i>Dillenia suffruticosa</i>	5	
Euphorbiaceae	Balik angin	<i>Mallotus paniculatus</i>	10	
		<i>Mallotus sp.</i>	1	
	Hujan panas	<i>Croton argyratus</i>	3	NE
	Mahang paya	<i>Macaranga pruinosa</i>	23	
Mahang gajah	<i>Macaranga gigantea</i>	13		
Fabaceae	Akasia	<i>Acacia mangium</i>	18	NE
	Semalu besar	<i>Mimosa pigra</i>	3	
	Tulang daing	<i>Callerya atropurpurea</i>	1	
Gleicheniaceae	Resam	<i>Dicranopteris linearis</i>	6	NE
Poaceae	Lalang	<i>Imperata cylindrica</i>	20	
Gentianaceae	Tembusu padang	<i>Fagraea fragrans</i>	2	
Lycopodiaceae	Paku serani	<i>Lycopodiella cernua</i>	1	
Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>	21	
	Senduduk bulu	<i>Clidemia hirta</i>	6	
Moraceae	Ara	<i>Ficus sp.</i>	1	NE
Myrtaceae	Gelam	<i>Mallotus paniculatus</i>	3	
	Kelat	<i>Syzygium sp.</i>	1	
	Kelat paya	<i>Syzygium myrtifolium</i>	4	NE
Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>	19	NE
Nymphaeaceae	Telipok	<i>Nymphaea pubescens</i>	1	-
Passifloraceae	Letup-letup	<i>Passiflora foetida</i>	4	NE
Poaceae	Rumput	<i>Cymbopogon calcicola</i>	1	
		Rumput ekor kucing	<i>Pennisetum polystachion</i>	2
Phyllanthaceae	Kenidai	<i>Bridelia stipularis</i>	2	NE
Pteridaceae	Piai	<i>Acrostichum sp.</i>	16	-
Rhizophoraceae	Membuluh	<i>Pellacalyx saccardianus</i>	1	LC
Rubiaceae	Herb	<i>Oldenlandia auricularia</i>	2	NE
Rutaceae	Pepauh/ Tenggek burung	<i>Melicope lunu-akenda</i>	22	



Family	Local Name	Scientific Name;	No. of Individual Measured	IUCN List
Smilacaceae	Pepanjat	<i>Smilax sp.</i>	1	
Cannabaceae	Mengkirai	<i>Trema orientalis</i>	14	
Verbenaceae	Leban	<i>Vitex pinnata</i>	10	

Notes : IUCN Classification – NE (Not Evaluated), LC (Least Concern)

No. of individual measured is not representing majority species on site.

\* List of Flora along the Line Transect in sampling plots is presented in Appendix A.

The most dominant species found during the flora survey is *Acacia mangium* with an average of 25 trees/ha followed by *Macaranga pruinosa* (7 trees/ha) and *Melicope lumu-akenda* (2 trees/ha). The maximum diameter at breast height (dbh) measured was 39.4 cm and the average dbh is 16.1 cm. Meanwhile, the height ranged from 5.0 m and 25.4 m with an average of 12.3 m (Refer Appendix A).



Photo 11 – *Dillenia suffruticosa* (Simpoh air)



Photo 12 – *Mallotus paniculatus* (Gelam)



Photo 13 – *Melicope lunu-akenda* (Pepauh/  
Tengek burung)



Photo 14 – *Nymphaea pubescens* (Telipok)



Figure 17 – Common species found within the Project Site

Based on the site survey and IUCN Red List, there are no rare, threatened or endemic species found within the Project site. Most of the species were categorised as Not Evaluated (NE), which means the taxa have not yet been assessed for IUCN Red List and also Least Concern (LC) species. Some of the species were not recorded in the IUCN Red List. Currently, the Project Site is dominated by natural vegetation of secondary forest and *Acacia* wildings as well as undergrowth vegetation such as ferns and coarse grasses. The assessment revealed that the diversity of flora within the Project Site is low (38 trees/ha). Most of the flora

species found during the survey are common species which have neither conservation nor high economic value. However, some of the plant species encountered are important species for the birds as they are food sources e.g *Ficus* spp.

**4.1.3 Species to be removed/discouraged from planting**

*Acacia* species, a fast-growing evergreen tree with dense, spreading crown are dominated the Project Site. As invasive vegetation and not recommended for the biodiversity conservation purposes, it is suggested not to grow *Acacia* species even though the species is well known for rehabilitation purposes especially for the degraded area. The same goes to *Macaranga* species which is fast growing and an indicator for the degree of disturbances to a forested area, as this genus is among the first to colonize a newly opened area. Therefore, *Acacia* and *Macaranga* species is recommended to be discouraged from planting within the Project Site.

**4.1.4 Species to be protected/replanted**

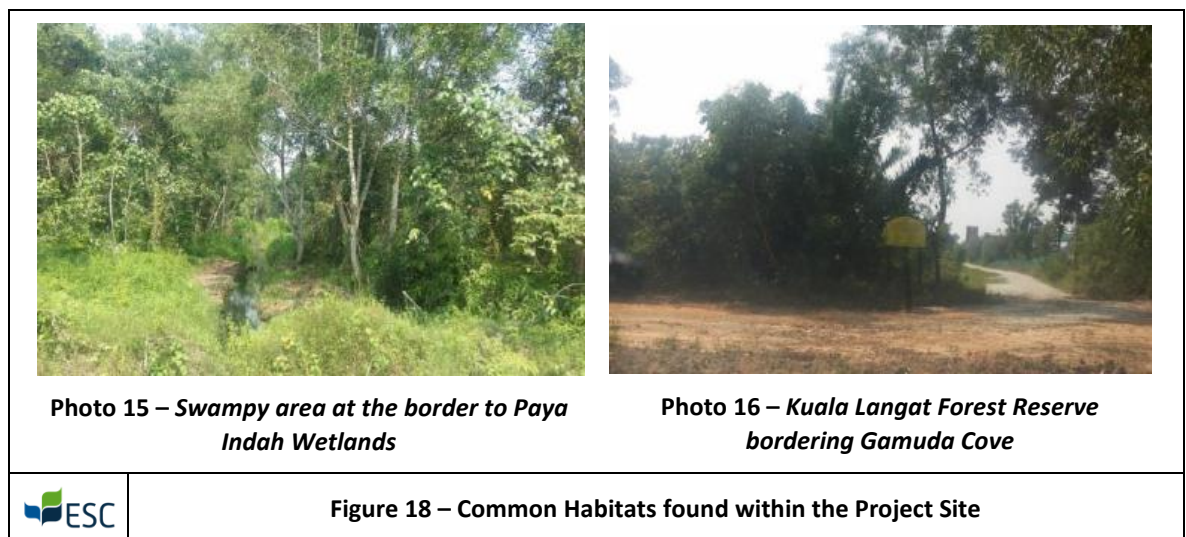
According to national landscape guidelines, there are seven categories of trees that need to preserve such as from rare, endemic and threatened species, has historical and aesthetical value, protocol trees and trees in preservation areas. Subsequently, Section 35H in Malaysia Tree Protection Order clearly state that trees with dbh exceeding 0.8 m (80 cm) at 0.5 m from ground level are required to be preserved unless there are three strong reasons such as tree which is dying or dead, prevention of an imminent danger and comply with any written law Town and Country Planning Act 1976 (Act 172) & Order (2011).

However, based on on-site survey data, there is no tree with dbh exceeding 80 cm (refer to *Appendix A*). Most of the trees measured are in the range of 10 to 20 cm dbh. The biggest tree is *Acacia mangium* with dbh of 39.4 cm and tree height of 21 m. There are also none mature, healthy, stable and native species to Malaysia from the species listing (refer to *Appendix A*).

Therefore, there are no species to be protected/replanted from the Project Site.

**4.2 Fauna Assessment**

Almost 70% of the total area in Gamuda Cove is swampy with old oil palm plantations, shrubs, open grasslands and secondary forests, therefore, fauna species associated with this type of forest are expected to exist (refer to *Figure 18*).



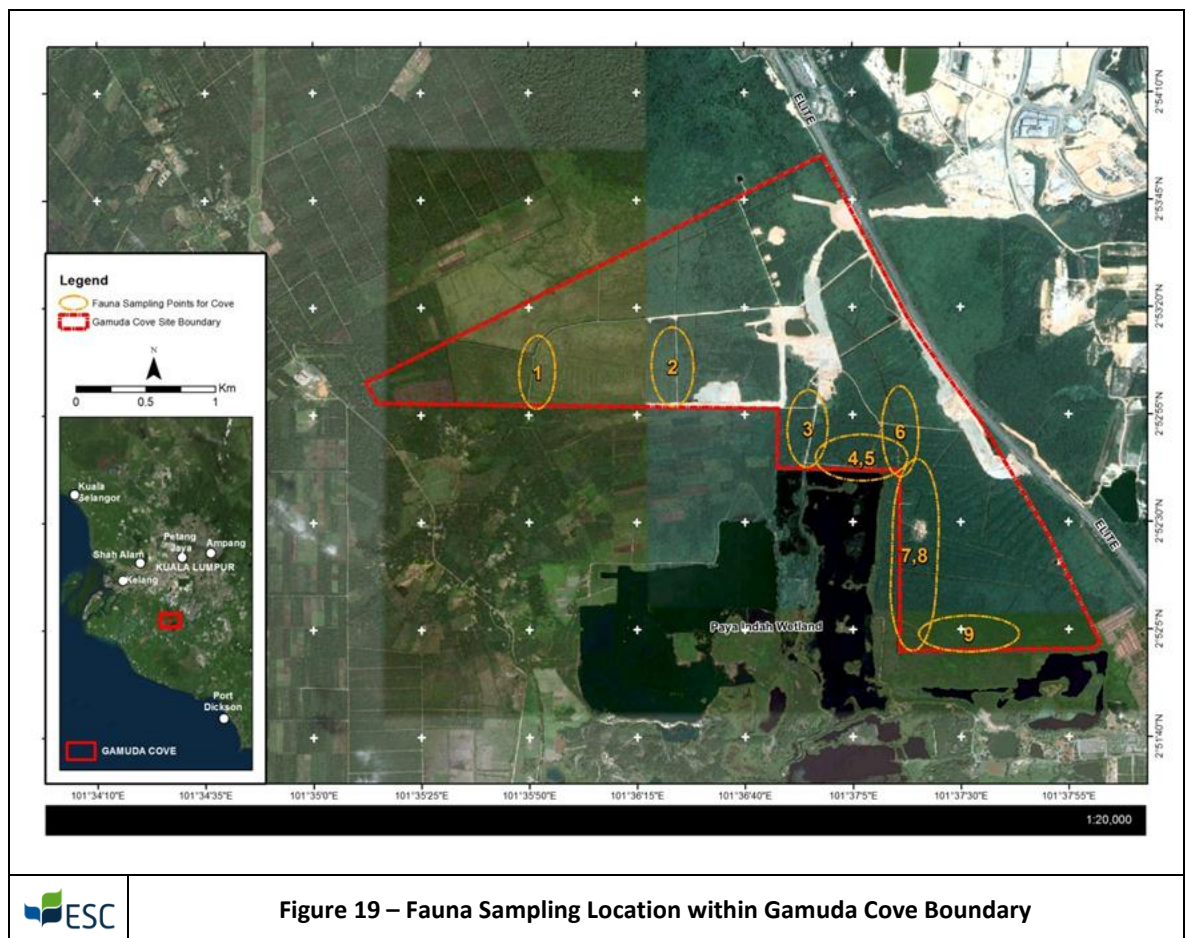
**4.2.1 Data Collection**

The fauna assessment for Gamuda Cove was performed on 12<sup>th</sup> and 14<sup>th</sup> April 2018 from day to night (0730 hours until 2230 hours). The assessment observed that there were no signs of animal in the northern and middle part of the site due to truck and heavy machinery activities that produce noise and dust in that particular area. Land clearing in the middle part of the eastside has also altered their habitat. This

disturbance also occurred along the northern part of the site that adjacent to access road and was observed to make all animals avoiding the area even at night time. Based on the condition, the fauna assessment was decided to be conducted in 9 different points within the project boundary as listed and illustrated in *Table 5* and *Figure 19* below.

**Table 5 – Fauna Survey Sampling Location within Gamuda Cove**

No.	Latitude	Longitude	Notes
P1	02° 52' 58.0" N	101° 35' 51.2" E	Bordering Oil Palm Plantations, Open grasslands and Swampy area
P2	02° 53' 00.5" N	101° 36' 24.0" E	Bordering swampy area and shrub
P3	02° 52' 53.1" N	101° 36' 55.6" E	Bordering both swampy areas
P4	02° 52' 43.1" N	101° 37' 03.0" E	Bordering swampy area, shrub and Paya Indah wetlands
P5	02° 52' 43.4" N	101° 37' 09.1" E	Bordering swampy area, Acacia trees, shrub and Paya Indah Wetlands
P6	02° 52' 42.5" N	101° 37' 15.1" E	Bordering shrubs and Acacia trees
P7	02° 52' 37.8" N	101° 37' 15.5" E	Bordering shrub, Acacia trees and Paya Indah Wetlands
P8	02° 52' 07.1" N	101° 37' 15.4" E	Bordering shrub and Acacia trees
P9	02° 52' 00.3" N	101° 37' 30.2" E	Bordering shrub, Acacia trees and Paya Indah Wetlands



**4.2.2 Results**

Fauna survey conducted at Gamuda Cove found various species ranging from mammals, birds to insects and herpetofauna. All presented data were coming from primary data. Secondary data was only available for avifauna from Paya Indah Wetlands as attached in *Appendix C*. The conservation status of species found is assessed in accordance to the International Union for Conservation of Nature (IUCN) Red List of Threatened



Species and the Malaysian Wildlife Conservation Act 2010 (Act 716). The levels of conservation are labelled from “Least Concern” up to “Extinct” for those under IUCN and “Protected Species” up to “Totally Protected Species” for those under the Wildlife Conservation Act 2010. Details on the identified species at Gamuda Cove are described below and the inventory provided in *Appendix B* which has included species status in IUCN Red List and the Malaysian Wildlife Conservation Act 2010 (Act 716).

### Mammals

*Table 6* below shows an inventory of 11 species from 9 different families that were spotted on site. Of these, 7 species were found listed under the Wildlife Conservation Act 2010 and 1 species were categorised as *Vulnerable* under the IUCN Red List.

As seen from *Table 6*, the Pig-tailed Macaque is classified under the IUCN Red List. The species is categorised under *Vulnerable* status which means that they are at higher risk of extinction in the wild. The Pig-tailed Macaque are found in lowland secondary forests and swamp area. It has been reported by IUCN that the population of the primate is believed to have been declined by at least 30% over the past 30-60 years due to the extensive loss of lowland forest in Malaysia for the expansion of oil palm plantations and other agricultural crops<sup>19</sup>.

The macaque’s taste for agricultural crops has also deemed them as pest and therefore are frequently being shot on sight. Furthermore, the primate is popularly used in laboratories as they are ideal for psychological studies and specimen for HIV research<sup>20</sup>.

As the Pig-tailed Macaques search for food in the dense forest, faeces are dropped and seeds from their diet of fruits and vegetables are dispersed throughout the forest. The Macaques needs dense forest to thrive so this adaptation aids their survival<sup>21</sup>. Footprints of porcupine were also spotted at the site (see *Figure 20*).

**Table 6 – Inventory of Mammals observed at Gamuda Cove**

No	Family	Species name	Common name	IUCN	Protection Status
1	Tupaiaidae	<i>Tupaia glis (Diard, 1820)</i>	Common Treeshrew	LC	P(II)*
2	Pteropodidae	<i>Cynopterus brachyotis open-country *Sunda* taxon</i>	Malaysian Fruit Bat	LC	Not Protected
3	Cercopithecidae	<i>Macaca fascicularis (Raffles, 1821)</i>	Long-tailed Macaque	LC	P(II)*
4	Cercopithecidae	<i>Macaca nemestrina (Linnaeus, 1766)</i>	Pig-tailed Macaque	VU	P(II)**
5	Viverridae	<i>Paradoxurus hermaphroditus (Pallas, 1777)</i>	Common Palm Civet	LC	P(I)*
6	Felidae	<i>Prionailurus bengalensis (Kerr, 1792)</i>	Leopard Cat	LC	TP*
7	Suidae	<i>Sus scrofa (Linnaeus, 1758)</i>	Wild Pig	LC	P(I)*
8	Sciuridae	<i>Callosciurus notatus (Boddaert, 1785)</i>	Plantain Squirrel	LC	Not Protected
9	Muridae	<i>Rattus rattus (Linnaeus, 1758)</i>	House Rat	LC	Not Protected
10	Muridae	<i>Rattus tiomanicus (Miller, 1900)</i>	Malaysian Wood Rat	LC	Not Protected

<sup>19</sup> International Union for Conservation of Nature (IUCN). (2008). *Macaca nemestrina*. Retrieved from The IUCN Red List of Threatened Species: <http://www.iucnredlist.org/details/12555/0>

<sup>20</sup> Wildscreen Arkive. (2018). Sunda pig-tailed macaque (*Macaca nemestrina*). Retrieved from <http://www.arkive.org/sunda-pig-tailed-macaque/macaca-nemestrina/>

<sup>21</sup> North, C. (2018). New England Primate Conservancy. Retrieved from Pigtailed Macaques: <http://www.neprimateconservancy.org/pigtail-macaque.html>

No	Family	Species name	Common name	IUCN	Protection Status
11	Hystricidae	<i>Hystrix brachyura</i> (Linnaeus, 1758)	Malayan Porcupine	LC	P(I)*

Notes:

\* Species identified under the Wildlife Conservation Act 2010

\*\* Species identified under the IUCN Red List, 2017

P(I) – *Protected Species* under Schedule 1 of Wildlife Conservation Act 2010; TP – *Totally Protected Species*; P(II) – *Protected Species* under Schedule 2 of Wildlife Conservation Act 2010.



Figure 20 – Footprint of Malayan Porcupine (*Hystrix brachyura*)

### Birds

59 species of 27 families were documented at the project site of which 50 birds are resident species, 7 are migratory and 2 are introduced. Of these, 39 are classified as *Totally Protected Species* while the remaining 12 are *Protected species* under the Wildlife Conservation Act 2010. Due to the neighbouring Paya Indah Wetlands, most wetland species like Red-wattled Lapwing and teal are also found roaming within the project site. Some other interesting species include water birds like Cinnamon bittern and Whistling teal as well as forest and migratory species like Malkoha and Honey buzzard respectively.

The species highlighted (in red) in *Table 7* are classified as *Near Threatened* under the IUCN Red List. The term *Near Threatened* explains that the species are likely to become endangered in the near future. Three species are classified under this which are the Grey-headed Fish-eagle, Buff-neck woodpecker and the Chestnut-bellied Malkoha.

#### Grey-headed Fish-eagles

Grey-headed Fish-eagle is a fish-eating bird found in South East Asia near slow flowing water bodies like lakes, reservoir and streams. This is a non-migratory eagle that spends much of their time perching upright

on bare branches over water bodies. The Grey-headed fish-eagle builds a huge stick nest up to 10-30 m above ground, on the tree, and is reused during their breeding season year after year<sup>22</sup>.

This species is undergoing a moderately rapid population reduction due to habitat degradation, pollution and over-fishing. Its global population has been estimated at 10,000 – 100,000 mature individuals which are gradually declining<sup>23</sup>.

#### Buff-neck woodpecker

The *Meiglyptes tukki* or also known as buff-necked woodpecker is a forest woodpecker species found in South East Asia. As the name implies, it has a buff-coloured neck patch which the buff-necked is 21 cm bigger than the buff-rumped woodpecker. The male has a red sub-mustachial stripe which the female lacks<sup>24</sup>. According to the IUCN, this species is found in primary evergreen and semi-evergreen lowland forests with dense undergrowth and rotting stumps. It can also be found in peat swamp forests and tall secondary formations.

The bird is categorised as a fairly common bird but not often encountered. Bird-watchers have found this species in a thick forest such as Belum-Temengor Forest Complex<sup>25</sup>, Tabin Wildlife Resort<sup>26</sup>, The National Park of Peninsular Malaysia (Taman Negara)<sup>27</sup>, Panti Forest and Ulu Muda Forest Reserve. The Buff-neck woodpecker, found mostly in lowland forests, is victims of habitat degradation and forest fires. Although data on the rates of decline are lacking, the degradation of forests and peat swamps suggest continually loss in their population and are most likely rapid<sup>28</sup>.

#### Chestnut-bellied Malkoha

Another near threatened bird species is the *Phaenicophaeus sumatranus* or commonly known as the chestnut-bellied malkoha. It is 40 cm long due to its long tail. It has a grey head with red skin around the eyes and strong light-coloured bill<sup>29</sup>. The chestnut-bellied malkoha inhabits primary and secondary forests including mangroves, durian plantation and peat swamp, to 1,000 m. It forages quietly and in an unobvious way in the dense crowns of trees to look for arthropods.

The species is described as generally fairly common which can be found in the Belum-Temengor Forest Complex, Bukit Kepala Gajah limestone area in Lenggong<sup>30</sup> and Ulu Segama-Malua Forest Reserve<sup>31</sup>. The chestnut-bellied malkoha is reported with a decreasing rate of population. Owing to the peat fires and degradation of forests, it is suspected to undergo rapid declination similar to the Buff-neck woodpecker. Exact population size of this species has not been quantified.

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<sup>22</sup> BirdLife International. (2018). Grey-headed Fish-eagle. Retrieved from Data Zone:  
<http://datazone.birdlife.org/species/factsheet/grey-headed-fish-eagle-ichthyophaga-ichthyaetus>

<sup>23</sup> International Union for Conservation of Nature (IUCN). (2008). *Ichthyophaga ichthyaetus*. Retrieved from The IUCN Red List of Threatened Species: <http://www.iucnredlist.org/details/22695163/0>

<sup>24</sup> Francis Yap Nature Photography, (2014). Ground Foraging Behaviour of the Buff-necked Woodpecker. Retrieved from <https://fryap.wordpress.com/2014/06/22/ground-foraging-behaviour-of-the-buff-necked-woodpecker/>

<sup>25</sup> Chye, L.K. (2010). Belum-Temengor Forest Complex, north peninsular Malaysia. *BirdingASIA* 14. Retrieved from <http://birdingasia.org/wp-content/uploads/2012/11/LimKimChye-Belum.pdf>

<sup>26</sup> Leong, C.K. (2013). Bird List For Tabin Wildlife Resort. Retrieved from <http://www.tabinwildlife.com.my/pdf/bird-list-20130501.pdf>

<sup>27</sup> UNESCO, (2014). National Park (Taman Negara) of Peninsular Malaysia. Retrieved from <https://whc.unesco.org/en/tentativelists/5927/>

<sup>28</sup> International Union for Conservation of Nature (IUCN). (2008). *Meiglyptes tukki*. Retrieved from The IUCN Red List of Threatened Species: <http://www.iucnredlist.org/details/22681562/0>

<sup>29</sup> Worldbirds.com. Chestnut-bellied Malkoha. Retrieved from <http://www.world-birds.com/birds/v/chestnut-bellied-malkoha>

<sup>30</sup> Mansor, M.S., & Shah, S.A.M., (2012). The Influence of Habitat Structure on Bird Species Composition in Lowland Malaysia Rain Forests. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3799396/>

<sup>31</sup> HCV 1 (Species Diversity). Retrieved from <http://www.forest.sabah.gov.my/usm/pdf/HCV%201.2.pdf>

**Table 7 – Inventory of Birds Identified at Gamuda Cove**

No	Family	Common Name	Scientific name	Status	Protection Status	IUCN
1	Accipitridae	Grey-headed Fish-eagle	<i>Icthyophaga ichthyaetus</i>	Resident	TP	NT*
2	Oriolidae	Black-naped Oriole	<i>Oriolus chinensis</i>	Resident	TP	LC
3	Cuculidae	Greater Coucal	<i>Centropus sinensis</i>	Resident	TP	LC
4	Alcedinidae	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	Resident	TP	LC
5	Estrildidae	Tricoloured munia	<i>Lonchura malacca</i>	Resident	UP	LC
6	Ploceidae	Baya Weaver	<i>Ploceus philippinus</i>	Resident	P	LC
7	Cisticolidae	Yellow-bellied Prinia	<i>Prinia flaviventris</i>	Resident	TP	LC
8	Columbidae	Spotted Dove	<i>Spilopelia chinensis</i>	Resident	UP	LC
9	Sturnidae	Jungle Myna	<i>Acridotheres fuscus</i>	Resident	UP	LC
10	Pycnonotidae	Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	Resident	UP	LC
11	Muscicapidae	Magpie Robin	<i>Copsychus saularis</i>	Resident	P	LC
12	Phasianidae	Red Junglefowl	<i>Gallus gallus</i>	Resident	P	LC
13	Ardeidae	Yellow Bittern	<i>Ixobrychus sinensis</i>	Resident	TP	LC
14	Columbidae	Peaceful Dove	<i>Geopelia striata</i>	Resident	IP	LC
15	Rallidae	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	Resident	P	LC
16	Columbidae	Green-winged Pigeon	<i>Chalcophaps indica</i>	Resident	P(I)	LC
17	Sturnidae	Common Myna	<i>Acridotheres tristis</i>	Resident	UP	LC
18	Cuculidae	Lesser Coucal	<i>Centropus bengalensis</i>	Resident	TP	LC
19	Cisticolidae	Common Tailorbird	<i>Orthotomus sutorius</i>	Resident	TP	LC
20	Ardeidae	Purple Heron	<i>Ardea purpurea</i>	Resident	TP	LC
21	Apodidae	Asian Palm-swift	<i>Cypsiurus balasiensis</i>	Resident	TP	LC
22	Meropidae	Blue-tailed Bee-eater	<i>Merops philippinus</i>	Resident	TP	LC
23	Aegithinidae	Common lora	<i>Aegithina tiphia</i>	Resident	TP	LC
24	Phasianidae	Blue-breasted Quail	<i>Syonicus chinensis</i>	Resident	P(I)	LC
25	Accipitridae	Crested Serpent-eagle	<i>Spilornis cheela</i>	Resident	TP	LC
26	Estrildidae	White-headed Munia	<i>Lonchura maja</i>	Resident	P	LC
27	Picidae	Rufous Woodpecker	<i>Micropternus brachyurus</i>	Resident	TP	LC
28	Cisticolidae	Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>	Resident	TP	LC
29	Rhipiduridae	Pied Fantail Flycatcher	<i>Rhipidura javanica</i>	Resident	TP	LC
30	Picidae	Buff-necked Woodpecker	<i>Meiglyptes tukki</i>	Resident	TP	NT*
31	Caprimulgidae	Large-tailed Nightjar	<i>Caprimulgus macrurus</i>	Resident	TP	LC
32	Corvidae	Large-billed Crow	<i>Corvus macrorhynchos</i>	Resident	UP	LC
33	Accipitridae	Japanese Sparrowhawk	<i>Accipiter gularis</i>	Migratory	TP	LC
34	Columbidae	Pink-necked Green-pigeon	<i>Treron vernans</i>	Resident	P	LC
35	Columbidae	Little Green Pigeon	<i>Treron olax</i>	Resident	P	LC
36	Rallidae	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	Resident	P	LC

No	Family	Common Name	Scientific name	Status	Protection Status	IUCN
37	Ardeidae	Cinnamon Bittern	<i>Ixobrychus cinnamomeus</i>	Resident	TP	LC
38	Caprimulgidae	Savanna Nightjar	<i>Caprimulgus affinis</i>	Resident	TP	LC
39	Cisticolidae	Rufous-tailed Tailorbird	<i>Orthotomus sericeus</i>	Resident	TP	LC
40	Dicaeidae	Yellow-breasted Flowerpecker	<i>Prionochilus maculatus</i>	Resident	TP	LC
41	Cuculidae	Plaintive Cuckoo	<i>Cacomantis merulinus</i>	Resident	TP	LC
42	Cisticolidae	Ashy Tailorbird	<i>Orthotomus ruficeps</i>	Resident	TP	LC
43	Cuculidae	Drongo Cuckoo	<i>Surniculus lugubris</i>	Resident	TP	LC
44	Cuculidae	Chestnut-bellied Malkoha	<i>Phaenicophaeus sumatranus</i>	Resident	TP	NT*
45	Estrildidae	Scaly-breasted Munia	<i>Lonchura punctulata</i>	Resident	P	LC
46	Cisticolidae	Rufescent Prinia	<i>Prinia rufescens</i>	Resident	TP	LC
47	Columbidae	Thick-billed Pigeon	<i>Treron curvirostra</i>	Resident		LC
48	Cisticolidae	Rufous-tailed Tailorbird	<i>Orthotomus sericeus</i>	Resident	P(I)	LC
49	Hirundinidae	Asian House-martin	<i>Delichon dasypus</i>	Migratory	TP	LC
50	Cuculidae	Plaintive Cuckoo	<i>Cacomantis merulinus</i>	Resident	TP	LC
51	Accipitridae	Eurasian Honey-buzzard	<i>Pernis ptilorhynchus</i>	Migratory	TP	LC
52	Charadriidae	Red-wattled Lapwing	<i>Vanellus indicus</i>	Resident	TP	LC
53	Podicipedidae	Little Grebe	<i>Tachybaptus ruficollis</i>	Migratory	TP	LC
54	Locustellidae	Lanceolated Warbler	<i>Locustella lanceolata</i>	Migratory	TP	LC
55	Cisticolidae	Zitting Cisticola	<i>Cisticola juncidis</i>	Introduced	TP	LC
56	Anatidae	Lesser Whistling-duck	<i>Dendrocygna javanica</i>	Resident	TP	LC
57	Corvidae	House Crow	<i>Corvus splendens</i>	Introduced	TP	LC
58	Hirundinidae	Pacific Swallow	<i>Hirundo tahitica</i>	Resident	TP	LC
59	Hirundinidae	Barn Swallow	<i>Hirundo rustica</i>	Migratory	TP	LC

Notes:

\* Species identified under the IUCN Red List, 2017

TP- *Totally Protected Species*; P(I) – *Protected Species* under Schedule 1 of Wildlife Conservation Act 2010; P – *Protected Species*; LC – *Least Concern*; NT- *Near Threatened*; UP – *Under Protected*

*Resident* means the species that lives permanently at a certain area.

*Migratory* means the species that travels from one country to another whether during the day or night or a bird that travels from one place to another at regular times often over long distances.

*Introduced* means the species is not a resident to a country but was introduced for certain purposes like hunting.





**Photo 17 – Purple Heron in swampy area**



**Photo 18 – Grey-headed Fish- eagle**



**Photo 19 – Eggs of a Large-tailed Nightjar**



**Photo 20 – Peaceful Dove**



**Photo 21 – Ashy tailorbird**



**Photo 22 – Pink-necked green pigeon**



**Figure 21 – Pictures of the Bird Species Found at Gamuda Cove**

### Herpetofauna and Insects

There were at least 6 species of amphibians and reptiles documented during the site visit. Common species like monitor lizard, skink and garden lizard were recorded including venomous species like spitting cobra. Insects that were observed during the survey consisted of 26 known species and 4 unidentified species. Most of the known species were butterflies then followed by dragonflies and only 1 species of ant (nest on acacia trees abundant), termite and grasshopper were observed during the survey. Unidentified species that were observed during the survey were 3 species of millipedes and 1 species of damselfly.

Table 8 below shows the list of species recorded during sampling and the location where it was spotted. No species in the table below are listed under IUCN Red List.

**Table 8 – Inventory of Insects and Herpetofauna**

Order	Family	Species	Common Names
<b>Insects</b>			
Odonata	Libellulidae	<i>Crocthemis servilia</i>	Dragonfly
		<i>NetroThemis fluctuans</i>	
		<i>Rhothemis Phyllis</i>	
	Gomphidae	<i>Ictinogamphus decoratus</i>	
Odonata	Coenagrionidae	Unidentified	Damselfly indicator water quality
Coleoptera	Cicindelinae	<i>Cicindela aurulenta</i>	Tiger Beetle
	Melolonthinae	<i>Lepidiota stigma</i>	Pest of palms beetle
	Formicidae	<i>Oceophylla smaragdina</i>	Green tree ant
	Pieridae	<i>Leptosia nina nina</i>	Butterfly
		<i>Catopsilia pomona</i>	
		<i>Mycalesis sp.</i>	
		<i>Eurema sp.</i>	
	Nymphalidae	<i>Cethosia hypsea</i>	
		<i>Junonia almana</i>	
		<i>Moduza procris ilonia</i>	
	Papilionidae	<i>Grapium sp.</i>	
Lycaenidae	<i>Chilades sp.</i>		
Danainae	<i>Ideopsis sp.</i>		
Lepidoptera	Danainae	<i>Euploea mulciber</i>	
Isoptera	Rhinotermitinae	<i>Coptotermes sp.</i>	Termite mound
Hemiptera	Reduviidae	<i>Nsycanus dichotomus</i>	Stink bug
	Redviidae	<i>Sycanus sp.</i>	Stink bug
Hymenoptera	Vespidae	<i>Vespa affinis</i>	Wasp
	Eumenidae	<i>Eumenes sp</i>	Potter wasp
	Xylocopidae	<i>Xylocopidae latipes</i>	Carpenter bee
<i>Xylocopa confusa</i>			
Orthoptera	Acrididae	<i>Valanga nigricornis</i>	Grasshopper
Diplopoda	Julidae	Unidentified	Round millipede
	Polydesmidae	Unidentified	Flat millipede
Sphaerotherida	Sphaerotheriidae	Unidentified	Pill millipede
<b>Reptiles</b>			
Squamata	Agamidae	<i>Calotes versicolor</i>	Oriental garden lizard
	Scincidae	<i>Eutropis multifasciata</i>	Skink
	Colubridae	<i>Ahaetulla prasina</i>	Green whip snake
	Elapidae	<i>Naja sumatrana</i>	Spitting cobra



Order	Family	Species	Common Names
	Acrochordidae	<i>Acrochordus javanicus</i>	Elephant trunk snake
<b>Night Spotting (Amphibians &amp; Reptile)</b>			
Anura	Bufonidae	<i>Bufo apera</i>	Toad
	Ranidae	<i>Rana erythraea</i>	Frog
		<i>Rana blythii</i>	Frog
Squamata	Elapidae	<i>Naja sumatrana</i>	Spitting cobra

## 5 BIODIVERSITY MANAGEMENT PLAN

The baseline study shows that there are no flora species that are considered endangered or threatened in the project area. The flora species identified are consistent with secondary and peat swamp forests species as well as oil palm plantation remnants. However, due to its location, the field assessments revealed a number of important fauna species classified as Totally Protected and Protected under the Wildlife Conservation Act 2010 and Near Threatened under the IUCN Red List. As such the mitigation measures described here concentrates on the protection of the fauna species in the area as well as measures to encourage the return of the important species identified following completion of the project.

### 5.1 Potential Threats

#### 5.1.1 Habitat Degradation

The environment can be negatively affected by deforestation in many ways. The worst is the loss of habitat for indigenous species. The Earth's forests are home to 70% of the world's land animals and the survival of many is completely dependent on a healthy biome. The removal of these eco-systems also changes the water cycle; the amount of moisture put back into the atmosphere. The land can become so dry that little can survive. Another critical role trees play is in protecting the atmosphere from greenhouse gases. Trees absorb the harmful gases that are thought to be the cause of global warming. As Gamuda Cove construction activities will result in loss of vegetation, it is important to ensure that the land is rehabilitated by re-planting and landscaping programmes.

#### 5.1.2 Human wildlife conflicts especially on wild boars, macaques, rats and snakes

Fauna associated with forest will be chased out when the trees are chopped except for certain species that can tolerate human existence such house rats, wild boars, long-tailed macaques, house crows, river toads and pythons. The occurrence of these species will definitely create a conflict among human for shelter and food resources. Wild boars, macaques and rats are scavengers that definitely consume almost everything and attracted to garbage and wastes. These species will tear up all the plastic that were used to keep all the waste outside our house before being collected. Macaques and rats are food sources for snake especially pythons. Whenever there is a macaque and rat, python will exist.

#### 5.1.3 Forest fires – South Selangor Peat Swamp Forest

Kuala Langat river basin catchment extended 2,350 km<sup>2</sup> covering a large area of South Selangor. Likewise, in the north the Selangor River's extensive floodplains extended 1,960 km<sup>2</sup> (110 km long), comprising numerous tributaries of Kerling, Kubu, Buloh, Rening, Batang Kali, and Sembah Rivers<sup>32</sup>. With the conversion of extensive peatland areas in the last few decades, large areas have been left abandoned and degraded. Forest fires pose a major threat to these areas. Between 1995 and 2001, 750 ha of peatlands were destroyed by fire, including 500 ha in 1998. Some areas have suffered frequent fires and are dominated by herbaceous vegetation with little tree regeneration.

#### 5.1.4 Pollution

Water, air and noise pollutions are a threat to the surrounding area. Source of pollutions may come from heavy machinery, means of transportation and burning lands. Oil spills from the machines/ trucks that rundown to the nearby streams and riparian areas will definitely affect the fauna associated with water. The temperature will rise in areas with fewer trees which cannot provide cool air, shade and shelter to nest and rest for the animals. Smoke from the machines and dust from the barren soils will also pollute the air in the areas.

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<sup>32</sup> Davies, J. (2010). A Quick Scan of Peatlands in Malaysia. Wetlands International - Malaysia Project funded by the Kleine Natuur Initiatief Projecten, Royal Netherlands Embassy, p.38

### 5.1.5 Zoonotic disease

Leptospirosis is a common public health problem worldwide with an estimated annual incidence ranging from 0.1 to 1 per 100,000 per year in temperate climates to 10 or more per 10,000 per year in the humid tropics. Based on Department of Public Health data in 2011, the estimated case-fatality rates in different parts of the world have been reported to range from <5% to 30%. These figures, however, are probably grossly underestimated because in many countries especially those where the disease is highly endemic, diagnostic capabilities are not readily available resulting in significantly poor surveillance and reporting of leptospirosis.

Leptospirosis is an infectious disease with a broad range of clinical manifestations, ranging from mild flu-like illness to very severe disease with haemorrhagic manifestations and multiorgan failures. Severe leptospirosis commonly resulted in case fatalities if aggressive management is not instituted at an early stage.

In Malaysia, an increasing number of reported cases and outbreaks which had resulted in a significant number of deaths have been observed over the past decade. There is a great need for improvement in case surveillance, in order to define strategies in control and prevention of case morbidity and mortality related to this disease. Thus, under the Prevention and Control of Infectious Diseases Act 1988 leptospirosis has been gazetted as a notifiable disease on 9 December 2010.

Leptospirosis is an infectious disease caused by pathogenic spirochete bacteria of the genus *Leptospira* that are transmitted directly or indirectly from animals to human (i.e., a zoonotic disease). Pathogenic leptospires belong to the species *Leptospira interrogans*, which is subdivided into more than 200 serovars with 25 serogroups. The leptospiral serovars are naturally carried in the renal tubules of rodents, wild and domestic animals.

Leptospirosis is usually a seasonal disease that starts at the onset of the rainy season and declines as the rainfall recedes. Sporadic cases may occur throughout the year with outbreaks associated with extreme changing weather events such as heavy rainfall and flooding.

There are several factors that responsible for the emergence of Leptospirosis namely:

a) Reservoir and carrier hosts

Leptospirosis has a very wide range of natural rodent, and non-rodent reservoir hosts especially rats, cattle, dogs, foxes, rabbits, etc. The animals act as carriers of the leptospires and excrete large number of leptospires in their urine, thus responsible for the contamination of large and small water bodies as well as soil.

b) Flooding, drainage congestion

Flooding and drainage congestion may be risk factors for contamination of water bodies with infected animal urine. Waterlogged areas may force rodent population to abandon their burrows and contaminate the stagnant water by their urine.

c) Animal-Human Interface

The potential for infection increases through exposure from occupational or recreational activities without proper protection. Poor cleanliness/sanitation in recreational areas may attract animal host such as rodent thus increases the risk of contamination. These may be due to poor maintenance of facilities, improper disposal of waste and public attitude/ apathy.

d) Human host risk factors

Several sections of the population are more susceptible to infection such as those not previously exposed to the bacteria in their environment (naïve immunities), and those with chronic disease and open skin wounds.

These bacteria can be transmitted via:

Infection is acquired from contact through the skin, mucosa/ conjunctiva with water or soil contaminated with the urine of rodents, carrier or diseased animals in the environment. Ingestion of contaminated water may also cause infection. There is no documentation of human to human transmission.

Exposure depends on chance contacts between human and infected animals or a contaminated environment through occupational and/or recreational activities. Some groups are at higher risk to contract the disease such as:

- i. Workers in the agricultural sectors;
- ii. Sewerage workers;
- iii. Livestock handlers;
- iv. Pet shops workers;
- v. Military personnel;
- vi. Search and rescue workers in high risk environment;
- vii. Disaster relief workers (e.g. during floods);
- viii. People involved in outdoor/recreational activities such as water recreational activities, jungle trekking, etc.;
- ix. Travellers who are not previously exposed to the bacteria in their environment especially those travellers and/or participants in jungle adventure trips or outdoor sports activities; and
- x. People with chronic disease and open skin wounds.

## 5.2 Mitigation Measures

### 5.2.1 Habitat Degradation and Pollution

When certain development is being carried out, the greatest care must be exercised to ensure the natural topography be maintained as far as possible. Development schedule must be clearly defined and timing of construction spread evenly and according to phases. Trees should be marked and not cut indiscriminately. Riparian reserve in accordance with Drainage and Irrigation Department Guidelines shall also be incorporated.

The innovative concept of design with Mother Nature, will not only minimize the impact of the development project on the environment thus making it environmentally acceptable but will also enhance the project visually. Some of the concepts being promoted are:

- Making use of natural topography where possible;
- Exploiting natural features as tourist attractions; and
- Balancing cut and fill.

Proposed projects need to be consistent with existing development plan, master plan or land use plan to avoid incompatibility of land-use. Encroachment from forest and plantations into residential areas or vice versa and without sufficient buffers is the typical cause of complaints of nuisance such as air pollution, noise and odour. Half the battle would have been won with proper planning and appropriate siting. Of utmost importance for consideration during layout planning is the concept of buffer zone. Adequate buffer zone within the development, between forest, plantations and residential areas are critical so as to avoid nuisance. Design of silt ponds and retention ponds for example should be able to cope with the surface run-off during construction and the most adverse weather conditions.

During construction, earthwork is the most critical stage and the problems of soil erosion need to be urgently addressed. Soil erosion created a host of other associated problems including siltation, deterioration of water quality and flooding of areas downstream of Project Site.

#### Control of Earthworks

Every site differs in topography, geology and soil types. The type of activity undertaken also varies. Earthworks contribute the highest impact if not carried out with proper environmental control. There is a tendency for developers to clear large tracts of land to save cost and time

without giving due consideration to the environmental impact. If the project is sited on hill slopes, landslide and mudslide could also be a problem. The usual excuse is that there is a need to reach the platform level before any control measures can be taken. Developers are not amiable to phased development where mitigation measures can be instituted as the project progresses.

There is a need to plan the earthworks and implement control measures at the earliest stage. Appropriate sediment control measures must be incorporated as part of the development and developers, consultants and contractors must be in place before other earthworks commence. Earthworks shall be scheduled to avoid rainy season and detailed earthworks plan shall be prepared and endorsed by professional engineer.

In addition, during the earthworks, if practicable, it is advised to keep the top soils for the species planting in the 60 hectares of Central Park and landscape in the project site.

#### Control of Erosion and Siltation

Erosion is a natural process by which earth is loosened and removed usually by wind and rain. Natural erosion occurs slowly, but when man's activities alter the landscape, the erosion process can be greatly accelerated. Sedimentation is a process of deposition of any size of soil or earth materials on lands, in rivers or sea. It is essentially the settling out of the earth particles that have been transported by wind and water. The rate of deposition depends primarily on particles size and velocity of runoff. Heavier particles such as gravel and sand are deposited first and the finer particles such as clay remain in suspension.

Clay particles can become electrostatically charged due to the turbulence and can stay suspended in water for long periods, contributing significantly to water turbidity or discolouration. Control is based firstly on the protection of surface soil from rain and runoff, and secondly on capturing eroded soil particles onsite. As the finer particles can be very difficult to capture once they have been mobilized, the best way to control the generation of sediment is to prevent erosion. The Department of Environment has published the Guidelines for Prevention and Control of Soil Erosion and Siltation in Malaysia that provide a useful reference for housing developers and contractors. Techniques for the prevention and control of soil erosion are highlighted.

The design of these control measures must ensure that the discharge standards for suspended solids can be met. Silt traps alone might not be enough. A combination of measures such as turfing, retention pond and phased development might be needed. In some cases, silt traps are undersized or insufficient numbers provided resulting in sediments being carried over and polluting the receiving river. In other cases, sediment traps/ponds are not maintained causing a build-up of silt that virtually renders them useless.

#### Control of Water Quality

Other than sediment that can cause deterioration of water quality, the discharge of untreated sewage and sullage especially from workers' quarters can be another source of pollutants.

Temporary sanitary facilities complying with the requirements of the Department Sewerage Services should be provided in the workers quarters.

#### Disposal of Solid Waste

Overburden or earth spoil shall be disposed of within the project area or in designated spoil tips. Open burning of waste construction materials such as formworks and biomass removed is strictly prohibited. These materials should be chipped and carted away or used as fuel.

#### Control of Air Pollution

Water spraying facilities shall be provided at construction sites and wheels of vehicles or machinery used for transportation of construction materials shall be cleaned before leaving the construction site so as not to litter the roads with mud and soil. Wash trough and water jets can be used. Access roads shall be paved before any construction starts or water trucks provided to wet roads especially during dry periods.

#### Control of Noise

Noise is unwanted sound and has various effects on human beings ranging from annoyance and discomfort to hearing loss. Noise from construction site is generated by different activities. Vibration from piling operation not only can cause annoyance but can also cause structural failure to nearby buildings. The main



activities emitting noise during construction are; piling operation, blasting, boring and drilling, rock crushing, power generators, compressor, pneumatic tools, earth moving vehicles and vehicle movements.

Noise control can be done by either engineering means, separation of source and receptors or through limiting the hours of operation of the noise source. Engineering methods could be the installation of quiet machines, insulating the machines or providing screens and noise barriers. Generally, noise the boundary of the construction site shall be controlled so as not to exceed 55 dB(A) at night and 65 dB(A) during the day.

However, in noise sensitive areas such as hospital, schools, residential and places of worship, a lower noise level must be observed. In this instance, the noise level at the receiving landuse must be observed and should not exceed 50 dB(A) during the daytime and 40 dB(A) at night.

#### Monitoring

The need for environmental monitoring and audit, especially in EIA cases, is never overemphasized. It is useful in enhancing the effectiveness of the EIA system by reviewing how the predictions and the recommended mitigation measures actually work in reality, and what needs to be done to rectify the deficiencies. Monitoring involves measuring and recording the physical, biological, social and economic variables associated with the development such as air quality, water quality, noise traffic flows, employment etc. Monitoring shall be done by a competent person and reports submitted to the Department of Environment on a regular basis.

### **5.2.2 Habitat Enrichment**

A healthy forest creates a closed canopy that supports animals such as macaques and other tree dwelling creatures. It also maintains steady temperatures, not too hot during the day and not too cool at night. The land below is often cool and damp, which many animals and plants need to survive. Birds rely on every part of the forest for important resources. And because different birds rely on different parts of the woods, ensuring the health of all layers of the forest will help draw a diverse community of birds.

- Maintain a consistent, unbroken, multi-layered forest that birds can rely on

This is already being implemented in Gamuda Cove by the establishment of the Central Park. However, during maintenance activities, when cutting trees, practice single-tree removal or limit sections of tree removal. Retaining clusters of overstorey trees will help provide continuous habitat for birds. Increase the area of unbroken canopy cover and plant trees with big crowns in the park and buffer zones to attract forest-dwelling birds. Also plant groundcover, bushes and understorey trees to birds that frequent the lower understorey layer will also have plenty of covers.

- Providing the nursery

A nursery is a place where plants are propagated and grown to usable size. Establishment of nursery will supply the needs of gardens in Central Park, and for conservation biology. Nurseries can grow plants in open fields, on container fields, in tunnels or greenhouses. In open fields, nurseries grow ornamental trees, shrubs and herbaceous perennials, especially the plants meant for amenity plantings. On a container field nurseries grow small trees, shrubs and herbaceous plants, usually destined for sales in garden centres. Nurseries also grow plants in greenhouses, a building of glass or in plastic tunnels, designed to protect young plants from harsh weather.

- Plan management activities by season

Forest management activities will impact birds, but you can minimize that impact by trimming and cutting trees outside of the breeding season, which differs across species. Therefore, it is suggested that these activities are carried out before rainy season which typically starts in October until February. Then, by giving breeding birds a chance to hatch rear and fledge their young, you will give them a better chance for breeding success and encourage them to consider your park and community a safe place to live.

- Leave deadwood and brush piles

In a natural forest, nobody is out clearing the old trees and shrubs. Because of this, many birds have grown to rely on deadwood. An average of 40 species in a given forest use dead trees and logs for

perches and cover, as well as an important source of bugs and other critters that birds like to eat. So if you can, let it lie.

- Plant trees for biodiversity conservation purposes

Rehabilitation re-establishes the original productivity of the area and some, but not necessarily all, of the plant and animal species thought to be originally present at the area. The on-site survey clearly indicated that there are currently 47 species present within the Project Site. Nevertheless, all species found had their own uses for biodiversity conservation.

However, for enhancing biodiversity and scenic quality, species as listed in *Table 9* are recommended to be introduced and planted within the Project Site. These tree species are categorized in the following land type; wetland/swamp and inland area and are widely planted within the country.

The species recommended include Malaysia rainforest tree species and fruit trees which one way or another will act amongst other as shade provider, contribute in purifying the emissions gaseous, enhance scenic quality and attract fruit eating mammals and avifauna thus increase the biodiversity. Once the bigger tree species mature, it is recommended that some species of epiphytes (e.g. *Platyserium coronarium* and *Asplenium nidus*) and orchids (e.g. *Coelogyne asperata*) be introduced to further enrich the biodiversity of the area.

**Table 9 – Recommended Species to be Introduced and Planted within the Project Site**

Land type/ Habitat	Species/ Genus to be planted	Common name	Purpose (in term of biodiversity conservation)
Wetland	<i>Shorea platycarpa</i>	Meranti paya	Important timber species
	<i>Aglaiia</i> spp.	Bekak	Important timber species. Fruits are food source for bird and mammals
	<i>Gonystylus bancanus</i>	Ramin	Important timber species
	<i>Melaleuca cajuputi</i>	Gelam	For bees
	<i>Durio carinatus</i>	Durian hutan	Food source for hornbills, other birds & mammals
	<i>Alstonia angustiloba</i>	Pulai	Large emergent tree- nesting bird
	<i>Tetramerista glabra</i>	Punah	Important timber species. Fruits are food source for bird and mammals
	<i>Koompassia malaccensis</i>	Kempas	Important timber species
	<i>Tristanopsis whiteana</i>	Pelawan	Landscape- colouring stem
	<i>Calophyllum</i> spp.	Bintangor	Important timber species
Inland	<i>Shorea leprosula</i>	Meranti tembaga	Important timber species
	<i>Shorea parvifolia</i>	Meranti sarang punai	Important timber species
	<i>Koompassia excelsa</i>	Tualang	For bees
	<i>Dryobalanops aromatica</i>	Kapur	Important timber species
	<i>Dipterocarpus oblongfolia</i>	Keruing neram	Landscape & fruit
	<i>Pometia pinnata</i>	Kasai	Landscape & fruit
	<i>Elateriospermum tapos</i>	Perah	Landscape & fruit
	<i>Actinodaphne sesquipedalis</i>	Medang payung	Landscape & fruit
	<i>Lepisanthes rubiginosa</i>	Mertajam	Food source for birds & mammals
	<i>Baccaurea pyriformis</i>	Tampoi	Food source for birds & mammals
<i>Baccaurea kunstleri</i>	Jentik bukit/ Rambai hutan	Food source for birds & mammals	

	<i>Parkia speciosa</i>	Petai	Food source for birds & mammals
	<i>Melicope lunu-akenda</i>	Pepauh/ Tenggek burung/ Tenggek burung	Food source for birds & nesting for small birds
	<i>Platynerium coronarium</i>	Staghorn fern	Introduce as to enrich the biodiversity
	<i>Asplenium nidus</i>	Bird's-nest fern	Introduce as to enrich the biodiversity
	<i>Coelogyne asperata</i>	The rough lipped Coelogyne	Introduce as to enrich the biodiversity

- Minimise the negative impacts of edge habitat and accentuate the positive

Edge habitat is where a forest transition into a field and it can be a very productive area with many diverse species of birds. But it can be dangerous for some birds, particularly if the change is abrupt. Predators like domesticated cats, non-native birds and racoons have an advantage when the forest opens abruptly. You can minimize the negative impacts of abrupt edge habitat by maintaining a circular or square-shaped forest. Where edges exist, make a transition zone by planting trees sparsely on the edge and encouraging the growth of thickets of fruit-bearing native shrubs. You can also cut trees selectively to soften the edge and encourage the growth of thickets. Consider adding nest boxes at your softened development edge to encourage birds like magpie robins, bulbuls and leafbird to inhabit the enhanced edge. This will also encourage the return of the Chestnut-bellied Malkoha, one of IUCN NT birds sighted onsite during the field survey.

- Promote the health of waterways and wetlands

Gamuda Cove is already fulfilling this by constructing man-made lakes in the Central Park. It is, however essential to keep the lake healthy by planting the correct plant species as well as putting fish and other aquatic species in the lake. One of the IUCN NT species sighted onsite, the Grey-headed fish eagle is a piscivore and as such having some small species of fish may encourage them to return post development activities.

Water is essential for all birds, for bathing, drinking and foraging. Having healthy water sources will help you attract all types of birds.

- Reduce non-native, invasive plant species like *Acacia* or Kiambang and invasive fauna that present in Malaysia<sup>33</sup> like *Lithobates catesbeianus* (American bullfrog)

These invasive plants/ fauna often out-compete or kill native plant species that provide important resources for native birds. Keeping them in check is an important element of maintaining a healthy forest.

- Avoid the use of pesticides and herbicides

Chemical weed and insect controls can poison waterways and food sources for birds, as well as posing hazards to people and pets. An estimated 7 million birds die annually due to the use of pesticides on lawns. If pesticide usage is necessary, try utilising bio-safe pesticides. Alternatively, encouraging natural insect predators such as frogs, toads, fish, common lizards and birds will help ensure a healthy and bio-diverse environment.

- Keep cats indoors

Domesticated cats may kill birds as occurred in the U.S where cats kill hundreds of millions of birds annually. Therefore, one important way to ensure birds can live safely in the woods is to keep cats inside or to construct a brush pile for birds to hide in.

<sup>33</sup> Global Invasive Species Database. (2018). Retrieved from

<http://issg.org/database/species/search.asp?st=sss&sn=&rn=Malaysia&ri=19467&hci=-1&ei=-1&fr=1&sts=&lang=EN>

- Help birds see windows  
Help birds to avoid collisions by installing screens, closing curtains (especially light coloured curtains), and using other methods that may help birds to identify glass surfaces. It is estimated that 1 billion birds die annually in the United States alone from running into windows.
- Support celestial navigation  
Many migrating birds use the stars as waypoints. But when there are distracting electronic sources of light, birds can be thrown dangerously off course. Residents may help to reduce the distraction by turning off interior and exterior lights when they are not in use. Gamuda may support by avoiding the use of bright street lights in the areas that are close to Paya Indah and the forest reserve.  
As for aquatic fish and fauna associated with water, provide adequate control over factors that influence the quality of fish habitats, including aquatic plants, habitat structures and water quality.
- Water quality: Reducing the amount of pollution, in the form of sewage, fertilizer, pesticides and herbicides and garbage, entering the water is the most direct way to improve water quality. This can be done by reducing soil erosion and runoff from the roads and cultivating a buffer zone around the water, and through clean-up efforts.
- Aquatic plants: They produce oxygen, improve water quality, attract food, provide cover and serve as feeding and nesting habitats for wildlife. But when aquatic plants begin to dominate, they can cause die-offs. There are various mechanical, biological and chemical methods to control aquatic plants, such as cutting, uprooting, poisoning and introducing fish that eat vegetation. But the best way to control their growth is by limiting the amount of plant food that enters an ecosystem in the form of sewage, fertilizer and tillage.
- Habitat structures: Underwater structures within an aquatic habitat provide cover where fish can rest, hide from predators, feed or spawn. They are also where the bottom of the food chain -- algae and phytoplankton -- develops. Natural or man-made objects such as logs, rocks and boulders, brush bundles, artificial reefs and even discarded Christmas trees can be sunk and used to add form to the bottom of a water body.
- Provide training and information to residents: Some species of fauna may not be welcomed in the homes of residents such snakes, macaques and large monitor lizard. Provide information package and training to residents on who to call in case of such encounters. The fire department and the PERHILITAN can safely remove the animals and relocate it to a more suitable environment without harming the animal.

### 5.2.3 Zoonotic disease (Leptospirosis)

Because of a large number of serovars, variety of infection sources and the wide differences in transmission conditions, the prevention and control of leptospirosis is complex. Effective prevention and control can be achieved by controlling the reservoir or reducing infection in animal reservoir populations such as dogs or livestock via treatment or vaccination of the animals. Control of wild animals may be difficult. Preventive measures must be based on knowledge of the groups at particular risk of infection and the local epidemiological factors.

Prevention and control should be targeted at:

- a) The infection source;
- b) The route of transmission between the infection source and the human host; or
- c) Prompt and proper treatment of infection.

Preventive and control measures are as below:

- Health Education: Health education activities are to be carried out to create awareness among the public about the disease and motivate them to take preventive actions. This needs to be done through multiple strategies in order to reach the specific target groups. This could be done by using the electronic, printed and interpersonal means. It is important to ensure that messages delivered are

relevant, timely and culturally acceptable to the target groups. A proper needs assessment has to be done to ascertain the target groups' needs in order to alleviate their fear and concerns.

- Risk assessment of possible contaminated water sources/bodies.
- Alert public or users regarding the hazards of possible contaminated areas. Health hazard warning signage should be posted in areas found to be contaminated through environment risk assessment (co-operation with local authorities).
- Persons with occupational or recreational exposure to potentially contaminated water or soil should:
  - Wear waterproof protective clothing such as rubber boots and gloves.
  - Cover skin lesions with waterproof dressings.
  - Wash with clean water immediately after exposure.
  - Seek immediate medical treatment if develop symptoms within the incubation period.
- Advise the public to keep their homes and premises free from rodents.
- Advise people to vaccinate their pets against leptospirosis.
- Promote cleanliness at the recreational areas, food premises as well as housing area.
- Promote interagency collaboration such as with local authorities, Wildlife Department (PERHILITAN), Department of Veterinary Services (JPV), National Training Service Department (JLKN), etc. to maintain cleanliness in the respective environmental settings, especially rodent control.

#### 5.2.4 Termites control

Termites feed on dead plants and trees and get nutrients from cellulose which can be found in wood and plant matter. Termites, however also eat other materials such as paper, plastic, and drywall. Commonly, termites live in wooden structures, decayed trees, fallen timber, and soil. Termites are found in greater numbers in tropical regions where living conditions is optimal for them because they require several amounts of moisture to live.

To eliminate the termite, an Integrated Pest Management (IPM) is to be used as a proactive approach to controlling pests, including termites. IPM for termites focuses on structural changes to reduce the risk of a termite infestation. IPM uses the least amount of targeted treatment materials required to prevent and control termite infestations. A few IPM practices to prevent and reduce termite activity when constructing a residential area include designing residential area that does not attract termites by building homes with non-cellulose building materials and using termite barriers. Another way to eliminate termite is by destroying termite food source and to use the *Metarhizium anisopliae*, formerly known as *Entomophthora anisopliae* (basionym), which is a fungus that grows naturally in soils throughout the world and causes disease in various insects by acting as a parasitoid. Based on the laboratory test, the *Metarhizium anisopliae* can effectively eliminate termite.

However, termite management and control are on-going processes. Even with modern termiticide formulations and technologies, it is still necessary to analyse and carefully identify the signs of termite activity; location of potential trouble spots in and around The Project Site; and carefully select proper IPM before and after the construction of landscape and building itself.

As parts of Project Site located in the watery area covered with shrubs and oil palm, the IPM of termite based on Malaysian Palm Oil Board (MPOB) is also advised to be used<sup>34</sup>. The IPM is divided into 3 stages i.e. (1) Located its population by baiting with rubberwood stake or corrugated cardboard in termite detector station; (2) Mark infested & six adjacent palms based on the detected area to avoid new infestation at nearest palms; and (3) Treat with chemicals (spraying mature palm with fipronil) by also scraping the mud-work to improve penetration. Chemical application is best to be conducted in the wet season.

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<sup>34</sup> Masijan, Z., Hj Kamarudin. N., Moslim. R., & Wahid. MB. (2014). Integrated Pest Management of Termite and Bunch Moth in Oil Palm Planted on Peat In Malaysia. Malaysian Palm Oil Board (MPOB).



### 5.3 Monitoring Programme

It is recommended that a flora and fauna survey be conducted a year after the first phase of project completion to check and review species onsite. The survey should also focus on whether the identified species of importance are still found onsite. The survey should include plants/trees health and suitability check especially with regards to fauna enhancement. In addition to improve the monitoring programme the following monitoring is also needed to be conducted:

- Monitoring of invasive species of flora and fauna

The best way to fight invasive species is to prevent them from occurring in the first place, therefore, protecting native animals and only planting native plants is important. The philosophy behind invasive flora/fauna management programs often is to reduce the potential for spread within and among selected locations by reducing the species to the greatest extent practicable. Several ways to ensure effective monitoring of invasive species are: (1) verify that all planted plants and fauna in the project site are not invasive; (2) replace invasive plants with non-invasive alternatives and replace the habitat of invasive fauna including fish as some of the predator for invasive fauna is a dangerous species to human; (3) encourage residents not to have fruits and vegetables, plants, insects and animals that can carry pests or become invasive themselves; and (4) educate the residence about the invasive flora and fauna

- Fencing of the project site and movement of fauna especially small mammal from the Kuala Langat Forest Reserve and Wetland.

A recent study by Huijser et al.<sup>35</sup> about fencing stated that fencing with at least 5 km long, can reduce 80% of vehicle-wildlife collisions. Shorter fences were less effective overall and more variable in their effectiveness. In short fencing, the location especially that covers collisions hotspots and adjacent buffer zones supported by the use of fence-end treatment will make an impact on effectiveness.

As to ensure the wildlife corridor, efforts to build underpasses and overpasses in proper places and with proper structure will help to conserve animal populations and connect them to their habitat and will reduce wildlife-vehicle/ wildlife-human collisions.

- Maintenance of the lake at the Central Park and its aquatic plants as well as all riverine plant species

Maintenance of a lake includes annual management services such as: control of aquatic plant that include riverine plant, algae, and aquatic weed control; fountain and aerator service; mosquito control; biological augmentation; sedimentation/dredging analysis; lake dye; pond and BMP (best management practice) inspections and repairs; shoreline vegetation management; water quality monitoring and testing; wetlands management; and lake clean up and debris removal. However, identification of needs and formulation of comprehensive plans to achieve practical solutions to ensure good water quality should be done to determine required annual management services as to ensure sustainable value and aesthetic beauty of water features.

The Aquatic Plant Management Society (APMS) defines aquatic plant control as techniques used alone or in combination that results in a timely, consistent, and substantial reduction of a target plant population to levels that alleviate an existing or potential impairment to the uses or functions of the water body. However addressing issue based on the definition of aquatic plant control cannot cover each specific contingency, therefore, resource manager and stakeholders must first establish expectations for the amount and duration of plant control prior to the initiation of a control activity, and then implement a management strategy to meet these expectations.

In relation to native or exotic plants, there are several problems associated with nuisance native vegetation which are typically site specific while invasive plants can impair uses and functions of

<sup>35</sup> Huijser, M. P., Fairbank, E. R., Camel-Means, W., Graham, J., Watson, V., Basting, P., & Becker, D. (2016). Effectiveness of short sections of wildlife fencing and crossing structures along highways in reducing wildlife-vehicle collisions and providing safe crossing opportunities for large mammals. *Biological Conservation*, 197, p. 61-68.

waters across a broad spectrum of conditions and on a regional scale. These plants have the potential to spread and dominate new ecosystems and they also have demonstrated the ability to become established in relatively stable aquatic systems. However, early detection and rapid response programs can resolve the problem that typically unique to invasive exotic species.

**APPENDIX A**  
**FLORA INVENTORY**

## GAMUDA COVE FLORA ASSESSMENT SITES

ASSESSMENT DATE	PLOT NO	LAND CLASS	SAMPLING TYPE	ALTITUDE (M)	COORDINATE X	COORDINATE Y	REMARKS
7/4/2018	1	Paya kering	PLOT	1	02 53' 06.3"	101 36' 46.9"	Paya kering, dipenuhi dengan pokok Akasia
7/4/2018	2	Paya kering	PLOT	13	02 52' 58.7"	101 36' 54.2"	kawasan buluh, tanah berbukit kecil
7/4/2018	3	Paya basah	PLOT	9	02 53' 02.8"	101 36' 51.5"	Kawasan paya berair. Dipenuhi dengan paku pakis
7/4/2018	4	Paya basah	PLOT	8	02 52' 44.8"	101 37' 03.1"	Kawasan paya berair, dipenuhi dengan Akasia
7/4/2018	5	Paya basah	PLOT	14	02 52' 44.9"	101 37' 07.9"	Kawasan paya berair, dipenuhi dengan Akasia
7/4/2018	6	Paya basah	PLOT	4	02 52' 33.5	101 37' 18.5"	Kawasan paya berair, dipenuhi dengan Akasia. Purata ketinggian 6m
7/4/2018	7	Paya basah	PLOT	9	02 52' 04.1"	101 37' 20.2"	Kawasan paya berair, dipenuhi dengan Akasia. Purata ketinggian 10m
7/4/2018	8	Paya basah	PLOT	9	02 52' 01.8"	101 37' 27.8"	Kawasan paya berair, dipenuhi dengan Mahang. Tiada Akasia
7/4/2018	9	Paya basah	PLOT	5	02 52' 19.6"	101 37' 46.9"	Terdapat campuran Akasia & Mahang
7/4/2018	10	Paya basah	PLOT	0	02 52' 48.6"	101 37' 12.2"	Terdapat campuran Akasia & Mahang
12/4/2018	11	Paya kering	TRANSECT	12	02° 53' 02.4"	101° 35' 21.9"	Ladang kelapa sawit tinggal
12/4/2018	12	Paya kering	TRANSECT	11	02° 53' 04.8"	101° 35' 33.7"	Ladang kelapa sawit tinggal
12/4/2018	13	Paya berair	TRANSECT	8	02° 53' 10.1"	101° 35' 47.1"	Paya. Gelam ditemui di kawasan ini
12/4/2018	14	Paya berair	TRANSECT	9	02° 53' 08.3"	101° 35' 53.1"	Paya. Padang rumput Lalang.
12/4/2018	15	Paya berair	TRANSECT	9	02° 53' 17.9"	101° 35' 58.8"	dipenuhi Lalang dan sendayan dan terdapat pokok gelam
12/4/2018	16	Paya berair	TRANSECT	6	02° 53' 14.3"	101° 36' 01.4"	dipenuhi lalang & sendayan
12/4/2018	17	Paya basah	TRANSECT	7	02° 53' 21.2"	101° 36' 16.5"	dipenuhi lalang & sendayan. Pokok-pokok rendah di bawah bawah 8m tinggi.
12/4/2018	18	Paya berair	TRANSECT	7	02° 53' 15.1"	101° 36' 19.4"	Paya. Padang rumput dipenuhi lalang-
12/4/2018	19	Paya basah	PLOT	13	02° 53' 25.7"	101° 36' 48.5"	Kawasan paya basah, dipenuhi dengan Akasia purata tinggi 10 m. Terdapat kesan balak lama terbakar.

ASSESSMENT DATE	PLOT NO	LAND CLASS	SAMPLING TYPE	ALTITUDE (M)	COORDINATE X	COORDINATE Y	REMARKS
12/4/2018	20	Paya berair	TRANSECT	10	02° 53' 26.6"	101° 36' 42.8"	Kawasan paya berair. Dipenuhi dengan paku pakis. Purata ketinggian 8m
12/4/2018	21	Paya basah	PLOT	8	02° 53' 40.8"	101° 36' 38.7"	Kawasan paya berair, dipenuhi dengan Akasia
12/4/2018	22	Paya basah	PLOT	4	02° 53' 45.3"	101° 36' 39.6"	Kawasan paya, dipenuhi dengan Akasia & rumput sendayan
12/4/2018	23	Pamah kering	PLOT	8	02° 53' 53.7"	101° 36' 57.8"	Terletak bersebelahan dengan hutan simpan.
12/4/2018	24	Pamah kering	TRANSECT	9	02° 53' 45.0"	101° 37' 00.2"	dipenuhi pokok Akasia dengan purata ketinggian 5-6 m.
12/4/2018	25	Pamah kering	TRANSECT	10	02° 53' 34.8"	101° 37' 04.2"	dipenuhi pokok Akasia dengan purata ketinggian 5-6 m.
12/4/2018	26	Pamah kering	TRANSECT	8	02° 53' 23.2"	101° 37' 07.7"	dipenuhi pokok Mahang dengan purata ketinggian 5-6 m.
12/4/2018	27	Paya berair	TRANSECT	8	02° 53' 15.9"	101° 37' 11.8"	Kawasan terbuka, pokok-pokok telah di tebang/ditolak.
12/4/2018	28	Paya basah	TRANSECT	7	02° 53' 10.2"	101° 37' 10.4"	Terdapat campuran Akasia & Mahang.
12/4/2018	29	Kawasan berair	PLOT	7	02° 53' 10.5"	101° 37' 06.4"	Kawasan paya berair, dipenuhi dengan Akasia.
12/4/2018	30	Kawasan berair	TRANSECT	7	02° 53' 16.0"	101° 37' 01.6"	60% ditumbuhi pokok Acacia bersaiz kurang daripada 10 cm dbh.
12/4/2018	31	Kawasan berair	TRANSECT	8	02° 53' 19.2"	101° 37' 05.4"	60% diliputi rumput sendayan.
12/4/2018	32	Kawasan berair	PLOT	7	02° 53' 04.0"	101° 36' 37.6"	50% lalang & rumput sendayan.
12/4/2018	33	Kawasan berair	TRANSECT	9	02° 53' 01.8"	101° 36' 24.6"	90% lalang, purata ketinggian pokok 6m.
12/4/2018	34	Kawasan berair	TRANSECT	8	02° 53' 07.4"	101° 36' 14.8"	90% lalang, pokok kecil & tidak padat dengan purata tinggi pokok lebih kurang 12m
12/4/2018	35	Kawasan berair	TRANSECT	9	02° 53' 00.9"	101° 36' 08.8"	80% lalang, pokok kecil & tidak padat dan purata tinggi pokok 6 m
12/4/2018	36	Kawasan berair	TRANSECT	10	02° 53' 01.6"	101° 35' 56.8"	90% lalang, tiada pokok besar
12/4/2018	37	Kebun Sawit	TRANSECT	10	02° 52' 59.4"	101° 35' 43.4"	kawasan ladang sawit tinggal



**LIST OF FLORA RECORDED WITHIN THE SAMPLING PLOTS AT GAMUDA COVE**

INDEX	PLOT NO	TREE NO	FAMILY	LOCAL NAME	SCIENTIFIC NAME	DBH (CM)	HEIGHT (M)	NO OF CLUMPS	REMARKS
1	1	1	Fabaceae	Akasia	<i>Acacia mangium</i>	14.0	12.0		
2	1	2	Fabaceae	Akasia	<i>Acacia mangium</i>	10.8	11.1		
3	1	3	Fabaceae	Akasia	<i>Acacia mangium</i>	10.2	8.0		condong
4	1	4	Fabaceae	Akasia	<i>Acacia mangium</i>	10.4	7.0		
5	1	5	Fabaceae	Akasia	<i>Acacia mangium</i>	13.4	13.1		
6	1	6	Fabaceae	Akasia	<i>Acacia mangium</i>	14.1	11.8		
7	1	7	Fabaceae	Akasia	<i>Acacia mangium</i>	11.3	12.0		
8	1	8	Fabaceae	Akasia	<i>Acacia mangium</i>	12.5	12.1		
9	1	9	Fabaceae	Akasia	<i>Acacia mangium</i>	15.0	12.4		
10	1	10	Fabaceae	Akasia	<i>Acacia mangium</i>	13.3	12.6		cabang
11	1	11	Fabaceae	Akasia	<i>Acacia mangium</i>	11.6	11.0		
12	1	12	Fabaceae	Akasia	<i>Acacia mangium</i>	15.4	12.0		
13	1	13	Fabaceae	Akasia	<i>Acacia mangium</i>	12.7	13.2		cabang
14	1	14	Fabaceae	Akasia	<i>Acacia mangium</i>	17.7	12.4		
15	1	15	Fabaceae	Akasia	<i>Acacia mangium</i>	15.8	11.5		
16	1	16	Fabaceae	Akasia	<i>Acacia mangium</i>	16.1	8.2		
17	1	17	Fabaceae	Akasia	<i>Acacia mangium</i>	18.6	14.1		
18	1	18	Fabaceae	Akasia	<i>Acacia mangium</i>	14.1	12.0		
19	1	19	Fabaceae	Akasia	<i>Acacia mangium</i>	13.6	12.8		
20	1	20	Fabaceae	Akasia	<i>Acacia mangium</i>	16.8	11.1		
21	1	21	Fabaceae	Akasia	<i>Acacia mangium</i>	15.3	11.0		
22	1	22	Fabaceae	Akasia	<i>Acacia mangium</i>	14.7	9.8		
23	1	23	Fabaceae	Akasia	<i>Acacia mangium</i>	13.2	7.5		
24	1	24	Fabaceae	Akasia	<i>Acacia mangium</i>	18.2	13.9		
25	2	1	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	11.9	7.5		
26	2	2	Euphorbiaceae	Hujan panas	<i>Croton argyratus</i>	15.1	8.4		

INDEX	PLOT NO	TREE NO	FAMILY	LOCAL NAME	SCIENTIFIC NAME	DBH (CM)	HEIGHT (M)	NO OF CLUMPS	REMARKS
27	2		Poaceae	Buluh	Unidentified			10	
28	2	3	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	15.3	6.8		
29	2	4	Euphorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>	32.2	10.8		
30	2	5	Euphorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>	18.2	11.7		
31	2	6	Euphorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>	15.4	6.5		
32	3	1	Elaeocarpaceae	Mendong	<i>Elaeocarpus sp.</i>	18.2	15.4		
33	3	2	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	14.2	9.8		
34	3	3	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	15.2	12.1		
35	3	4	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	22.2	12.4		
36	3	5	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	13.3	10.4		
37	3	6	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	16.0	12.1		
38	3	7	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	10.8	11.8		
39	3	8	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	13.2	12.1		
40	3	9	Euphorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>	19.4	11.2		patah
41	3	10	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	18.3	10.6		
42	3	11	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	20.4	12.6		
43	3	12	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	19.3	15.1		
44	3	13	Euphorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>	20.2	11.4		
45	3	14	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	20.0	13.3		
46	3	15	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	17.7	14.1		
47	3	16	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	16.7	14.0		
48	3	17	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	17.3	15.0		
49	3	18	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	18.0	14.5		
50	3	19	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	16.7	12.3		condong
51	3	20	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	19.6	14.1		
52	4	1	Fabaceae	Akasia	<i>Acacia mangium</i>	17.0	13.8		
53	4	2	Fabaceae	Akasia	<i>Acacia mangium</i>	24.0	18.2		
54	4	3	Fabaceae	Akasia	<i>Acacia mangium</i>	25.8	18.9		

INDEX	PLOT NO	TREE NO	FAMILY	LOCAL NAME	SCIENTIFIC NAME	DBH (CM)	HEIGHT (M)	NO OF CLUMPS	REMARKS
55	4	4	Fabaceae	Akasia	<i>Acacia mangium</i>	15.2	13.6		
56	4	5	Fabaceae	Akasia	<i>Acacia mangium</i>	26.8	19.2		
57	4	6	Fabaceae	Akasia	<i>Acacia mangium</i>	17.3	21.4		
58	4	7	Fabaceae	Akasia	<i>Acacia mangium</i>	28.2	22.1		
59	4	8	Fabaceae	Akasia	<i>Acacia mangium</i>	24.2	20.6		
60	4	9	Fabaceae	Akasia	<i>Acacia mangium</i>	14.1	16.9		
61	4	10	Fabaceae	Akasia	<i>Acacia mangium</i>	10.1	7.2		
62	4	11	Fabaceae	Akasia	<i>Acacia mangium</i>	13.8	22.1		
63	4	12	Fabaceae	Akasia	<i>Acacia mangium</i>	10.0	7.0		
64	4	13	Fabaceae	Akasia	<i>Acacia mangium</i>	23.6	21.0		
65	4	14	Fabaceae	Akasia	<i>Acacia mangium</i>	27.9	22.0		
66	4	15	Fabaceae	Akasia	<i>Acacia mangium</i>	25.8	15.5		
67	4	16	Fabaceae	Akasia	<i>Acacia mangium</i>	14.1	16.2		
68	4	17	Fabaceae	Akasia	<i>Acacia mangium</i>	14.2	21.0		
69	4	18	Fabaceae	Akasia	<i>Acacia mangium</i>	17.9	21.2		
70	4	19	Fabaceae	Akasia	<i>Acacia mangium</i>	10.1	16.2		
71	4	20	Fabaceae	Akasia	<i>Acacia mangium</i>	19.2	20.3		
72	4	21	Fabaceae	Akasia	<i>Acacia mangium</i>	24.2	21.6		
73	4	22	Fabaceae	Akasia	<i>Acacia mangium</i>	32.2	20.0		
74	4	23	Fabaceae	Akasia	<i>Acacia mangium</i>	26.8	22.6		
75	4	24	Fabaceae	Akasia	<i>Acacia mangium</i>	21.2	22.1		
76	4	25	Fabaceae	Akasia	<i>Acacia mangium</i>	12.3	10.2		
77	5	1	Fabaceae	Akasia	<i>Acacia mangium</i>	11.0	14.2		
78	5	2	Fabaceae	Akasia	<i>Acacia mangium</i>	13.8	13.7		
79	5	3	Fabaceae	Akasia	<i>Acacia mangium</i>	26.8	22.4		
80	5	4	Fabaceae	Akasia	<i>Acacia mangium</i>	25.2	16.9		
81	5	5	Fabaceae	Akasia	<i>Acacia mangium</i>	22.2	23.4		
82	5	6	Fabaceae	Akasia	<i>Acacia mangium</i>	24.2	20.0		

INDEX	PLOT NO	TREE NO	FAMILY	LOCAL NAME	SCIENTIFIC NAME	DBH (CM)	HEIGHT (M)	NO OF CLUMPS	REMARKS
83	5	7	Fabaceae	Akasia	<i>Acacia mangium</i>	16.3	9.6		
84	5	8	Fabaceae	Akasia	<i>Acacia mangium</i>	11.1	12.8		
85	5	9	Fabaceae	Akasia	<i>Acacia mangium</i>	13.2	7.4		
86	5	10	Fabaceae	Akasia	<i>Acacia mangium</i>	27.9	16.8		
87	5	11	Fabaceae	Akasia	<i>Acacia mangium</i>	22.4	25.4		
88	5	12	Fabaceae	Akasia	<i>Acacia mangium</i>	17.3	12.0		condong
89	5	13	Fabaceae	Akasia	<i>Acacia mangium</i>	19.2	16.8		
90	5	14	Fabaceae	Akasia	<i>Acacia mangium</i>	10.2	12.1		
91	5	15	Fabaceae	Akasia	<i>Acacia mangium</i>	19.6	20.0		
92	5	16	Fabaceae	Akasia	<i>Acacia mangium</i>	25.0	20.5		
93	5	17	Fabaceae	Akasia	<i>Acacia mangium</i>	12.3	7.0		
94	5	18	Fabaceae	Akasia	<i>Acacia mangium</i>	12.0	8.6		
95	5	19	Fabaceae	Akasia	<i>Acacia mangium</i>	23.1	22.0		
96	5	20	Fabaceae	Akasia	<i>Acacia mangium</i>	10.0	7.0		
97	5	21	Fabaceae	Akasia	<i>Acacia mangium</i>	16.2	18.3		
98	5	22	Fabaceae	Akasia	<i>Acacia mangium</i>	24.6	22.1		
99	5	23	Fabaceae	Akasia	<i>Acacia mangium</i>	13.4	16.1		
100	5	24	Fabaceae	Akasia	<i>Acacia mangium</i>	12.4	10.8		
101	5	25	Fabaceae	Akasia	<i>Acacia mangium</i>	10.0	9.0		
102	5	26	Fabaceae	Akasia	<i>Acacia mangium</i>	18.6	19.7		
103	5	27	Fabaceae	Akasia	<i>Acacia mangium</i>	16.5	18.2		
104	5	28	Fabaceae	Akasia	<i>Acacia mangium</i>	25.8	23.6		
105	5	29	Fabaceae	Akasia	<i>Acacia mangium</i>	15.1	18.2		
106	5	30	Fabaceae	Akasia	<i>Acacia mangium</i>	21.0	22.0		
107	5	31	Fabaceae	Akasia	<i>Acacia mangium</i>	17.4	20.0		
108	5	32	Fabaceae	Akasia	<i>Acacia mangium</i>	11.6	9.0		
109	5	33	Fabaceae	Akasia	<i>Acacia mangium</i>	21.2	18.0		
110	5	34	Fabaceae	Akasia	<i>Acacia mangium</i>	17.8	22.0		

INDEX	PLOT NO	TREE NO	FAMILY	LOCAL NAME	SCIENTIFIC NAME	DBH (CM)	HEIGHT (M)	NO OF CLUMPS	REMARKS
111	5	35	Fabaceae	Akasia	<i>Acacia mangium</i>	16.9	20.0		
112	5	36	Fabaceae	Akasia	<i>Acacia mangium</i>	17.6	20.0		
113	5	37	Fabaceae	Akasia	<i>Acacia mangium</i>	14.8	18.6		
114	5	38	Fabaceae	Akasia	<i>Acacia mangium</i>	12.3	19.0		
115	5	39	Fabaceae	Akasia	<i>Acacia mangium</i>	19.2	20.0		
116	5	40	Fabaceae	Akasia	<i>Acacia mangium</i>	17.6	19.0		
117	5	41	Fabaceae	Akasia	<i>Acacia mangium</i>	15.0	20.0		
118	5	42	Fabaceae	Akasia	<i>Acacia mangium</i>	10.7	11.0		
119	6	1	Fabaceae	Akasia	<i>Acacia mangium</i>	27.3	16.3		
120	6	2	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	11.2	10.1		
121	6	3	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	11.2	7.6		
122	6	4	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	12.4	8.6		
123	6	5	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	10.0	7.3		
124	6	6	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	11.4	6.8		
125	6	7	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	12.4	7.3		
126	6	8	Fabaceae	Akasia	<i>Acacia mangium</i>	12.6	12.3		
127	7	1	Fabaceae	Akasia	<i>Acacia mangium</i>	17.6	13.1		
128	7	2	Rutaceae	Tengek burung *	<i>Melicope lunu-akenda</i>	11.1	10.1		
129	7	3	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>	11.6	9.2		
130	7	4	Fabaceae	Akasia	<i>Acacia mangium</i>	15.1	12.0		
131	7	5	Fabaceae	Akasia	<i>Acacia mangium</i>	26.5	18.1		
132	7	6	Fabaceae	Akasia	<i>Acacia mangium</i>	18.9	14.7		
133	7	7	Rutaceae	Tengek burung *	<i>Melicope lunu-akenda</i>	12.4	9.7		
134	7	8	Rutaceae	Tengek burung *	<i>Melicope lunu-akenda</i>	12.2	8.6		
135	7	9	Rutaceae	Tengek burung *	<i>Melicope lunu-akenda</i>	15.0	8.0		
136	7	10	Fabaceae	Akasia	<i>Acacia mangium</i>	25.2	9.5		
137	7	11	Fabaceae	Akasia	<i>Acacia mangium</i>	15.8	10.0		
138	7	12	Fabaceae	Akasia	<i>Acacia mangium</i>	17.3	11.2		

INDEX	PLOT NO	TREE NO	FAMILY	LOCAL NAME	SCIENTIFIC NAME	DBH (CM)	HEIGHT (M)	NO OF CLUMPS	REMARKS
139	7	13	Fabaceae	Akasia	<i>Acacia mangium</i>	14.7	12.0		
140	7	14	Fabaceae	Akasia	<i>Acacia mangium</i>	11.2	12.0		
141	7	15	Fabaceae	Akasia	<i>Acacia mangium</i>	16.8	10.2		
142	7	16	Fabaceae	Akasia	<i>Acacia mangium</i>	15.6	14.2		
143	7	17	Fabaceae	Akasia	<i>Acacia mangium</i>	18.7	13.0		
144	8	1	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	22.5	11.0		
145	8	2	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	20.9	10.1		
146	8	3	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	23.6	11.0		
147	8	4	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	25.6	13.0		
148	8	5	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	28.2	13.7		
149	8	6	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	22.0	8.0		
150	8	7	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	24.2	12.0		
151	8	8	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	17.3	11.4		
152	8	9	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	24.7	13.0		
153	8	10	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	18.2	12.0		
154	8	11	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	20.0	12.4		
155	8	12	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	13.7	8.6		
156	8	13	Rutaceae	Tengek burung *	<i>Melicope lunu-akenda</i>	10.2	8.2		
157	8	14	Rutaceae	Tengek burung *	<i>Melicope lunu-akenda</i>	13.5	8.0		
158	9	1	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	10.1	8.0		
159	9	2	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	14.9	10.2		
160	9	3	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	15.3	11.0		
161	9	4	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	14.6	11.0		
162	9	5	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	17.2	13.0		
163	9	6	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	16.7	12.4		
164	9	7	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	18.1	13.0		
165	9	8	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	14.2	12.8		
166	9	9	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	13.7	12.0		



INDEX	PLOT NO	TREE NO	FAMILY	LOCAL NAME	SCIENTIFIC NAME	DBH (CM)	HEIGHT (M)	NO OF CLUMPS	REMARKS
167	9	10	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	17.2	8.0		
168	9	11	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	12.1	11.0		
169	9	12	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	11.2	11.8		
170	9	13	Fabaceae	Akasia	<i>Acacia mangium</i>	13.3	12.0		
171	9	14	Fabaceae	Akasia	<i>Acacia mangium</i>	10.8	9.0		
172	9	15	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	10.2	8.0		
173	9	16	Fabaceae	Akasia	<i>Acacia mangium</i>	17.3	12.4		
174	9	17	Fabaceae	Akasia	<i>Acacia mangium</i>	15.6	13.0		
175	9	18	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	13.0	9.0		
176	9	19	Rutaceae	Tengek burung *	<i>Melicope lunu-akenda</i>	13.7	12.0		
177	9	20	Fabaceae	Akasia	<i>Acacia mangium</i>	10.0	12.0		
178	9	21	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	15.2	11.0		
179	9	22	Fabaceae	Akasia	<i>Acacia mangium</i>	12.1	13.4		
180	9	23	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	17.5	12.0		
181	9	24	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	11.2	7.0		
182	9	25	Rutaceae	Tengek burung *	<i>Melicope lunu-akenda</i>	10.0	11.0		
183	9	26	Rutaceae	Tengek burung *	<i>Melicope lunu-akenda</i>	11.4	9.6		
184	9	27	Fabaceae	Akasia	<i>Acacia mangium</i>	17.4	11.2		
185	9	28	Fabaceae	Akasia	<i>Acacia mangium</i>	13.0	13.6		
186	9	29	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	24.0	12.6		
187	9	30	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	13.4	13.0		
188	9	31	Fabaceae	Akasia	<i>Acacia mangium</i>	16.2	14.0		
189	9	32	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	22.3	12.2		
190	9	33	Rutaceae	Tengek burung *	<i>Melicope lunu-akenda</i>	12.0	8.0		
191	10	1	Fabaceae	Akasia	<i>Acacia mangium</i>	24.3	18.0		
192	10	2	Fabaceae	Akasia	<i>Acacia mangium</i>	35.6	22.0		
193	10	3	Fabaceae	Akasia	<i>Acacia mangium</i>	18.3	22.0		
194	10	4	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	12.3	6.5		

INDEX	PLOT NO	TREE NO	FAMILY	LOCAL NAME	SCIENTIFIC NAME	DBH (CM)	HEIGHT (M)	NO OF CLUMPS	REMARKS
195	10	5	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	13.1	8.0		
196	10	6	Rutaceae	Tengek burung *	<i>Melicope lunu-akenda</i>	13.4	7.0		
197	10	7	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	12.2	8.6		
198	10	8	Rutaceae	Tengek burung *	<i>Melicope lunu-akenda</i>	11.1	8.0		
199	10	9	Fabaceae	Akasia	<i>Acacia mangium</i>	18.6	12.0		
200	10	10	Rutaceae	Tengek burung *	<i>Melicope lunu-akenda</i>	12.8	7.0		
201	10	11	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	12.2	10.3		
202	10	12	Fabaceae	Akasia	<i>Acacia mangium</i>	39.4	21.0		
203	10	13	Euphorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>	12.2	7.5		
204	19	1	Fabaceae	Akasia	<i>Acacia mangium</i>	10.8	10.8		
205	19	2	Fabaceae	Akasia	<i>Acacia mangium</i>	11.3	8.0		
206	19	3	Fabaceae	Akasia	<i>Acacia mangium</i>	12.6	10.8		
207	19	4	Fabaceae	Akasia	<i>Acacia mangium</i>	13.7	8.5		
208	19	5	Fabaceae	Akasia	<i>Acacia mangium</i>	10.4	6.0		
209	19	6	Fabaceae	Akasia	<i>Acacia mangium</i>	10.4	7.5		
210	19	7	Fabaceae	Akasia	<i>Acacia mangium</i>	11.3	8.2		
211	19	8	Fabaceae	Akasia	<i>Acacia mangium</i>	10.6	10.0		
212	19	9	Fabaceae	Akasia	<i>Acacia mangium</i>	12.5	7.2		
213	19	10	Fabaceae	Akasia	<i>Acacia mangium</i>	10.8	8.0		
214	19	11	Fabaceae	Akasia	<i>Acacia mangium</i>	17.0	12.0		
215	19	12	Fabaceae	Akasia	<i>Acacia mangium</i>	11.6	6.5		
216	19	13	Fabaceae	Akasia	<i>Acacia mangium</i>	11.2	7.5		
217	19	14	Fabaceae	Akasia	<i>Acacia mangium</i>	13.7	8.2		
218	21	1	Fabaceae	Akasia	<i>Acacia mangium</i>	19.1	7.0		
219	21	2	Fabaceae	Akasia	<i>Acacia mangium</i>	10.8	7.0		
220	21	3	Fabaceae	Akasia	<i>Acacia mangium</i>	10.3	7.0		
221	21	4	Fabaceae	Akasia	<i>Acacia mangium</i>	11.0	10.1		
222	21	5	Fabaceae	Akasia	<i>Acacia mangium</i>	11.0	7.0		

INDEX	PLOT NO	TREE NO	FAMILY	LOCAL NAME	SCIENTIFIC NAME	DBH (CM)	HEIGHT (M)	NO OF CLUMPS	REMARKS
223	22	1	Fabaceae	Akasia	<i>Acacia mangium</i>	11.5	6.8		
224	22	2	Fabaceae	Akasia	<i>Acacia mangium</i>	10.5	9.0		
225	22	3	Fabaceae	Akasia	<i>Acacia mangium</i>	10.7	7.2		
226	22	4	Fabaceae	Akasia	<i>Acacia mangium</i>	10.2	6.0		
227	22	5	Fabaceae	Akasia	<i>Acacia mangium</i>	12.8	7.3		
228	23	1	Fabaceae	Akasia	<i>Acacia mangium</i>	20.3	8.0		
229	23	2	Fabaceae	Akasia	<i>Acacia mangium</i>	13.5	5.0		
230	23	3	Fabaceae	Akasia	<i>Acacia mangium</i>	18.2	8.0		
231	23	4	Fabaceae	Akasia	<i>Acacia mangium</i>	13.7	7.0		
232	23	5	Fabaceae	Akasia	<i>Acacia mangium</i>	16.2	6.0		
233	23	6	Euphorbiaceae	Balik angin	<i>Mallotus paniculatus</i>	10.7	5.9		
234	23	7	Fabaceae	Akasia	<i>Acacia mangium</i>	20.3	10.0		
235	29	1	Fabaceae	Akasia	<i>Acacia mangium</i>	16.8	7.0		
236	29	2	Fabaceae	Akasia	<i>Acacia mangium</i>	12.3	6.0		
237	29	3	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	11.2	6.0		
238	29	4	Fabaceae	Akasia	<i>Acacia mangium</i>	18.5	10.0		
239	29	5	Fabaceae	Akasia	<i>Acacia mangium</i>	17.5	7.9		
240	29	6	Fabaceae	Akasia	<i>Acacia mangium</i>	15.0	8.0		
241	29	7	Fabaceae	Akasia	<i>Acacia mangium</i>	10.5	6.0		
242	32	1	Fabaceae	Akasia	<i>Acacia mangium</i>	16.5	11.0		
243	32	2	Fabaceae	Akasia	<i>Acacia mangium</i>	15.2	9.0		
244	32	3	Fabaceae	Akasia	<i>Acacia mangium</i>	10.8	8.0		
245	32	4	Fabaceae	Akasia	<i>Acacia mangium</i>	13.2	7.0		
246	32	5	Fabaceae	Akasia	<i>Acacia mangium</i>	15.4	7.5		

\*Tengek burung also known asTenggek burung or Pepauh

## LIST OF FLORA ALONG THE LINE TRANSECT IN SAMPLING PLOTS

Plot	Tree No.	Family	Local name	Scientific name
1	1	Euphorbiaceae	Balik angin	<i>Mallotus paniculatus</i>
	2	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
	3	Apocynaceae	Pulai penipu bukit	<i>Alstonia macrophylla</i>
	4	Euphorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>
	5	Euphorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
	6	Euphorbiaceae	Kenidai	<i>Bridelia stipularis</i>
	7	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	8	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>
	9	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
2	1	Melastomataceae	Senduduk bulu	<i>Clidemia hirta</i>
	2	Dilleniaceae	Simpoh air	<i>Dillenia suffruticosa</i>
	3	Fabaceae	Tulang daing	<i>Callerya atropurpurea</i>
	4	Arecaceae	Kelapa sawit	<i>Elaeis guineensis</i>
	5	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	6	Cannabaceae	Mengkirai	<i>Trema orientalis</i>
	7	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
	8	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	9	Poaceae	Lalang	<i>Imperata cylindrica</i>
	10	Rubiaceae	Herb	<i>Oldenlandia auricularia</i>
	11	Poaceae	Rumput	<i>Cymbopogon calcicola</i>
3	1	Euohorbiaceae	Balik angin	<i>Mallotus paniculatus</i>
	2	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
	3	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	4	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	5	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>
	6	Verbenaceae	Leban	<i>Vitex pinnata</i>
	7	Rhizophoraceae	Membuluh	<i>Pellacalyx saccardianus</i>
	8	Fabaceae	Akasia	<i>Acacia mangium</i>
	9	Gleicheniaceae	Resam	<i>Dicranopteris linearis</i>
4	1	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	2	Euohorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
	3	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	4	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
5	1	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	2	Euohorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
	3	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
6	1	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
	2	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	3	Euohorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>
	4	Euohorbiaceae	Hujan panas	<i>Croton argyratus</i>
	5	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	6	Gleicheniaceae	Resam	<i>Dicranopteris linearis</i>

Plot	Tree No.	Family	Local name	Scientific name
7	1	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	2	Euohorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
8	1	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
	2	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	3	Fabaceae	Akasia	<i>Acacia mangium</i>
	4	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
9	1	Gleicheniaceae	Resam	<i>Dicranopteris linearis</i>
	2	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	3	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
10	1	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	2	Euohorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
	3	Fabaceae	Akasia	<i>Acacia mangium</i>
	4	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
11	1	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	2	Arecaceae	Kelapa sawit	<i>Elaeis guineensis</i>
	3	Cannabaceae	Mengkirai	<i>Trema orientalis</i>
	4	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>
	5	Verbenaceae	Leban	<i>Vitex pinnata</i>
	6	Fabaceae	Akasia	<i>Acacia mangium</i>
	7	Verbenaceae	Leban	<i>Vitex pinnata</i>
	8	Passifloraceae	Letup-letup	<i>Passiflora foetida</i>
	9	Poaceae	Rumput ekor kucing	<i>Pennisetum polystachion</i>
	10	Rubiaceae	Herb	<i>Oldenlandia auricularia</i>
12	1	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	2	Arecaceae	Kelapa sawit	<i>Elaeis guineensis</i>
	3	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
	4	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	5	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	6	Melastomataceae	Senduduk bulu	<i>Clidemia hirta</i>
	7	Gleicheniaceae	Resam	<i>Dicranopteris linearis</i>
	8	Euohorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
	9	Verbenaceae	Leban	<i>Vitex pinnata</i>
	10	Euohorbiaceae	Hujan panas	<i>Croton argyratus</i>
	11	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>
	12	Myrtaceae	Kelat	<i>Syzygium</i> sp.
	13	Asteraceae	Rumput kapalterbang	<i>Chromolaena odorata</i>
13	1	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>
	2	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	3	Myrtaceae	Gelam	<i>Melaleuca cajuputi</i>
	4	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	5	Dilleniaceae	Simpoh air	<i>Dillenia suffruticosa</i>
	6	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	7	Euohorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>

Plot	Tree No.	Family	Local name	Scientific name
	8	Euhorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>
	9	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
	10	Arecaceae	Kelapa sawit	<i>Elaeis guineensis</i>
	11	Pteridaceae	Piai	<i>Acrostichum sp.</i>
	12	Fabaceae	Semalu besar	<i>Mimosa pigra</i>
14	1	Poaceae	Lalang	<i>Imperata cylindrica</i>
	2	Fabaceae	Akasia	<i>Acacia mangium</i>
	3	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	4	Pteridaceae	Piai	<i>Acrostichum sp.</i>
	5	Fabaceae	Semalu besar	<i>Mimosa pigra</i>
15	1	Poaceae	Lalang	<i>Imperata cylindrica</i>
	2	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	3	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	4	Euhorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
	5	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
	6	Pteridaceae	Piai	<i>Acrostichum sp.</i>
	7	Fabaceae	Akasia	<i>Acacia mangium</i>
	8	Euhorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>
	9	Euhorbiaceae	Hujan panas	<i>Croton argyratus</i>
16	1	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	2	Poaceae	Lalang	<i>Imperata cylindrica</i>
	3	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	4	Pteridaceae	Piai	<i>Acrostichum sp.</i>
17	1	Dilleniaceae	Simpoh air	<i>Dillenia suffruticosa</i>
	2	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	3	Euhorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
	4	Pteridaceae	Piai	<i>Acrostichum sp.</i>
	5	Poaceae	Lalang	<i>Imperata cylindrica</i>
	6	Fabaceae	Akasia	<i>Acacia mangium</i>
	7	Verbenaceae	Leban	<i>Vitex pinnata</i>
	8	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>
	9	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	10	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	11	Poaceae	Rumput ekor kucing	<i>Pennisetum polystachion</i>
18	1	Pteridaceae	Piai	<i>Acrostichum sp.</i>
	2	Poaceae	Lalang	<i>Imperata cylindrica</i>
	3	Fabaceae	Akasia	<i>Acacia mangium</i>
	4	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	5	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	6	Myrtaceae	Gelam	<i>Melaleuca cajuputi</i>
	7	Nymphaeaceae	Telipok	<i>Nymphaea sp.</i>
19	1	Fabaceae	Akasia	<i>Acacia mangium</i>
	2	Verbenaceae	Leban	<i>Vitex pinnata</i>



Plot	Tree No.	Family	Local name	Scientific name	
	3	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>	
	4	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>	
	5	Euohorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	
	6	Myrtaceae	Kelat paya	<i>Syzygium myrtifolium</i>	
	7	Loganiaceae	Tembusu padang	<i>Fagraea fragrans</i>	
	8	Dilleniaceae	Simpoh air	<i>Dillenia suffruticosa</i>	
	20	1	Pteridaceae	Piai	<i>Acrostichum sp.</i>
		2	Fabaceae	Akasia	<i>Acacia mangium</i>
3		Melastomataceae	Senduduk bulu	<i>Clidemia hirta</i>	
4		Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>	
5		Fabaceae	Semalu besar	<i>Mimosa pigra</i>	
6		Euohorbiaceae	Balik angin	<i>Mallotus paniculatus</i>	
7		Euohorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	
8		Cannabaceae	Mengkirai	<i>Trema orientalis</i>	
9		Poaceae	Lalang	<i>Imperata cylindrica</i>	
21	1	Gleicheniaceae	Resam	<i>Dicranopteris linearis</i>	
	2	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>	
	3	Poaceae	Lalang	<i>Imperata cylindrica</i>	
	4	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>	
	5	Loganiaceae	Tembusu padang	<i>Fagraea fragrans</i>	
	6	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>	
	7	Euohorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	
	8	Euohorbiaceae	Balik angin	<i>Mallotus paniculatus</i>	
	9	Euohorbiaceae	Kenidai	<i>Bridelia stipularis</i>	
	10	Dennstaedtiaceae	Resam besar	<i>Pteridium arachnoideum</i>	
22	1	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>	
	2	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>	
	3	Euohorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>	
	4	Myrtaceae	Gelam	<i>Melaleuca cajuputi</i>	
	5	Moraceae	Ara	<i>Ficus sp.</i>	
	6	Pteridaceae	Piai	<i>Acrostichum sp.</i>	
	7	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>	
23	1	Cannabaceae	Mengkirai	<i>Trema orientalis</i>	
	2	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>	
	3	Euohorbiaceae	Balik angin	<i>Mallotus paniculatus</i>	
	4	Euohorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>	
	5	Verbenaceae	Leban	<i>Vitex pinnata</i>	
	6	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>	
	7	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>	
	8	Myrtaceae	Kelat paya	<i>Syzygium myrtifolium</i>	
	9	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>	
24	1	Euohorbiaceae	Balik angin	<i>Mallotus paniculatus</i>	
	2	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>	

Plot	Tree No.	Family	Local name	Scientific name
	3	Cannabaceae	Mengkirai	<i>Trema orientalis</i>
	4	Euohorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>
	5	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
	6	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	7	Poaceae	Lalang	<i>Imperata cylindrica</i>
	8	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
25	1	Euohorbiaceae	Balik angin	<i>Mallotus paniculatus</i>
	2	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>
	3	Cannabaceae	Mengkirai	<i>Trema orientalis</i>
	4	Euohorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
	5	Euohorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>
	6	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	7	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
	8	Poaceae	Lalang	<i>Imperata cylindrica</i>
	9	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	10	Cannabaceae	Mengkirai	<i>Trema orientalis</i>
	11	Verbenaceae	Leban	<i>Vitex pinnata</i>
	12	Passifloraceae	Letup-letup	<i>Passiflora foetida</i>
	13	Melastomataceae	Senduduk bulu	<i>Clidemia hirta</i>
26	1	Cannabaceae	Mengkirai	<i>Trema orientalis</i>
	2	Euohorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
	3	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>
	4	Melastomataceae	Senduduk bulu	<i>Clidemia hirta</i>
	5	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	6	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	7	Euohorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>
	8	Verbenaceae	Leban	<i>Vitex pinnata</i>
	9	Fabaceae	Akasia	<i>Acacia mangium</i>
	10	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	11	Poaceae	Lalang	<i>Imperata cylindrica</i>
	12	Gleicheniaceae	Resam	<i>Dicranopteris linearis</i>
	13	Lycopodiaceae	Paku serani	<i>Lycopodiella cernua</i>
	14	Passifloraceae	Letup-letup	<i>Passiflora foetida</i>
	15	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>
27	1	Euohorbiaceae	Balik angin	<i>Mallotus paniculatus</i>
	2	Cannabaceae	Mengkirai	<i>Trema orientalis</i>
	3	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	4	Pteridaceae	Piai	<i>Acrostichum sp.</i>
	5	Euohorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
28	1	Euohorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
	2	Euohorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>
	3	Fabaceae	Akasia	<i>Acacia mangium</i>
	4	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>








Plot	Tree No.	Family	Local name	Scientific name
	5	Cannabaceae	Mengkirai	<i>Trema orientalis</i>
	6	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	7	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	8	Poaceae	Lalang	<i>Imperata cylindrica</i>
	9	Passifloraceae	Letup-letup	<i>Passiflora foetida</i>
29	1	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	2	Euhorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
	3	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	4	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	5	Smilacaceae	Pepanjat	<i>Smilax sp.</i>
30	1	Euhorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
	2	Fabaceae	Akasia	<i>Acacia mangium</i>
	3	Euhorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>
	4	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	5	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>
	6	Cannabaceae	Mengkirai	<i>Trema orientalis</i>
	7	Pteridaceae	Piai	<i>Acrostichum sp.</i>
	8	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	9	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	10	Poaceae	Lalang	<i>Imperata cylindrica</i>
	11	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
31	1	Euhorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
	2	Fabaceae	Akasia	<i>Acacia mangium</i>
	3	Euhorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>
	4	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	5	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>
	6	Cannabaceae	Mengkirai	<i>Trema orientalis</i>
	7	Pteridaceae	Piai	<i>Acrostichum sp.</i>
	8	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	9	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	10	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
32	1	Euhorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
	2	Fabaceae	Akasia	<i>Acacia mangium</i>
	3	Euhorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>
	4	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	5	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>
	6	Verbenaceae	Leban	<i>Vitex pinnata</i>
	7	Myrtaceae	Kelat paya	<i>Syzygium myrtifolium</i>
	8	Poaceae	Lalang	<i>Imperata cylindrica</i>
	9	Pteridaceae	Piai	<i>Acrostichum sp.</i>
	10	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	11	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
	12	Dennstaedtiaceae	Bracken fern	<i>Pteridium arachnoideum</i>

Plot	Tree No.	Family	Local name	Scientific name
33	1	Dilleniaceae	Simpoh air	<i>Dillenia suffruticosa</i>
	2	Euohorbiaceae	Balik angin	<i>Mallotus paniculatus</i>
	3	Myrtaceae	Kelat paya	<i>Syzygium myrtifolium</i>
	4	Euohorbiaceae	Mahang gajah	<i>Macaranga gigantea</i>
	5	Pteridaceae	Piai	<i>Acrostichum sp.</i>
	6	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	7	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
	8	Poaceae	Lalang	<i>Imperata cylindrica</i>
34	1	Fabaceae	Akasia	<i>Acacia mangium</i>
	2	Poaceae	Lalang	<i>Imperata cylindrica</i>
	3	Pteridaceae	Piai	<i>Acrostichum sp.</i>
	4	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	5	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
35	1	Poaceae	Lalang	<i>Imperata cylindrica</i>
	2	Euohorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
	3	Fabaceae	Akasia	<i>Acacia mangium</i>
	4	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	5	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>
	6	Cannabaceae	Mengkirai	<i>Trema orientalis</i>
	7	Euohorbiaceae	Balik angin	<i>Mallotus paniculatus</i>
	8	Poaceae	Lalang	<i>Imperata cylindrica</i>
	9	Pteridaceae	Piai	<i>Acrostichum sp.</i>
	10	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	11	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
	12	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
36	1	Fabaceae	Akasia	<i>Acacia mangium</i>
	2	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	3	Poaceae	Lalang	<i>Imperata cylindrica</i>
	4	Pteridaceae	Piai	<i>Acrostichum sp.</i>
	5	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	6	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
	7	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
37	1	Arecaceae	Kelapa sawit	<i>Elaeis guineensis</i>
	2	Rutaceae	Tengek burung*	<i>Melicope lunu-akenda</i>
	3	Melastomataceae	Senduduk	<i>Melastoma malabathricum</i>
	4	Cannabaceae	Mengkirai	<i>Trema orientalis</i>
	5	Euohorbiaceae	Balik angin	<i>Mallotus paniculatus</i>
	6	Euohorbiaceae	Mahang paya	<i>Macaranga pruinosa</i>
	7	Blechnaceae	Paku midin	<i>Stenochlaena palustris</i>
	8	Davalliaceae	Paku pakis	<i>Nephrolepis auriculata</i>
	9	Cyperaceae	Sendayan	<i>Scleria sumatrensis</i>
	10	Poaceae	Lalang	<i>Imperata cylindrica</i>
	11	Melastomataceae	Senduduk bulu	<i>Clidemia hirta</i>









\*Tengek burung also known as Tenggek burung or Pepauh








**STAND PROFILE FOR EACH SAMPLING PLOT**







Plot No.	Stand Profile	
1		
Swamp Dry		
2		
Swamp Dry		
3		
Wetland		
4		<p>Wetland</p>











Plot No.	Stand Profile	
5		
Wetland		
6		
Wetland		
7		
Wetland		
8		
Wetland		



Plot No.	Stand Profile	
9		
10	Wetland	
		
11	Wetland	
		<p data-bbox="847 1346 1062 1375">Oil Palm Plantation</p>
12	Wetland	
		<p data-bbox="847 1740 1062 1769">Oil Palm Plantation</p>

Plot No.	Stand Profile	
13		
Grassland		
14		
Grassland		
15		<p data-bbox="847 1328 1310 1357">Grassland. Presence of <i>Melaleuca cajuputi</i></p>
16		<p data-bbox="847 1738 975 1767">Grassland</p>











Plot No.	Stand Profile	
17		
Grassland		
18		
Grassland		
19		
Wetland		
20		
<i>Mixed Acacia and Macaranga spp.</i>		














Plot No.	Stand Profile	
21		
<i>Acacia</i> area		
		
Grassland. Presence of <i>Acacia</i> sp. with mean height of 8 m.		
23		
Wetland dominated by <i>Acacia</i> sp. (80%)		
24		
Mixed species. Trees height range between 5 and 6 m. Thick understorey plant.		







Plot No.	Stand Profile	
25		
<p>Mixed species, mostly <i>Acacia</i> and <i>Mallotus</i> spp. The tallest tree is 7 m high.</p>		
26		
<p>Area dominated by Mahang species and weed. Most of the trees are small in size.</p>		
27		
<p>Cleared land</p>		
28		
<p>Grassland, seedlings and saplings of <i>Acacia</i> and <i>Macaranga</i> spp. were found.</p>		



Plot No.	Stand Profile	
29		
Wetland dominated by <i>Acacia</i> sp. (80%). Thick undergrowth		
30		
Grassland with the presence of <i>Acacia</i> sp. The highest trees is 7 m tall		
31		Grassland
32		
Dominated with <i>Acacia</i>		<i>Syzygium myrtifolium</i> and weed also present at the site

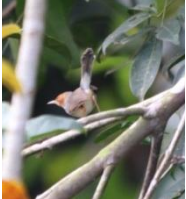
Plot No.	Stand Profile	
33		Grassland
34		Grassland
35		 <p data-bbox="331 1563 1326 1597">Watery area and dominated by weed. About 10% of the area filled by <i>Acacia</i> sp.</p>


Plot No.	Stand Profile	
		
37	<p data-bbox="651 674 1018 712">Watery area filled with weed</p>   <p data-bbox="309 1151 1316 1189">Planted with oil palm, but now been dominated by <i>Macaranga</i> and <i>Mallotus</i> spp.</p>	


**APPENDIX B**  
**FAUNA INVENTORY**




**Birds**


<b>Scientific Name:</b>	<i>Orthotomus ruficeps</i>
<b>Common Name:</b>	Ashy Tailorbird ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>NT</b>
	Found at P6 & P9 (On-site photo)


<b>Scientific Name:</b>	<i>Delichon dasypus</i>
<b>Common Name:</b>	Asian House-martin ( <i>migratory</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P8


<b>Scientific Name:</b>	<i>Cypsiurus balasiensis</i>
<b>Common Name:</b>	Asian Palm-swift ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P4


<b>Scientific Name:</b>	<i>Hirundo rustica</i>
<b>Common Name:</b>	Barn Swallow ( <i>migratory</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P9


<b>Scientific Name:</b>	<i>Ploceus philippinus</i>
<b>Common Name:</b>	Baya Weaver ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>P-II</b>
	IUCN status: <b>LC</b>
	Found at P1, P2, & P5


<b>Scientific Name:</b>	<i>Oriolus chinensis</i>
<b>Common Name:</b>	Black-naped Oriole ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P1, P4, & P6


<b>Scientific Name:</b>	<i>Synoicus chinensis</i>
<b>Common Name:</b>	Blue-breasted Quail ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>P</b>
	IUCN status: <b>LC</b>
	Found at P2 & P3


<b>Scientific Name:</b>	<i>Merops philippinus</i>
<b>Common Name:</b>	Blue-tailed Bee-eater ( <i>migratory</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P1, P5 & P8


<b>Scientific Name:</b>	<i>Meiglyptes tukki</i>
<b>Common Name:</b>	Buff-necked Woodpecker ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>NC</b>
	Found at P4

<b>Scientific Name:</b>	<i>Phaenicophaeus sumatranus</i>
<b>Common Name:</b>	Chestnut-bellied Malkoha ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>NC</b>
	Found at P7


<b>Scientific Name:</b>	<i>Ixobrychus cinnamomeus</i>
<b>Common Name:</b>	Cinnamon Bittern ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P5 & P9

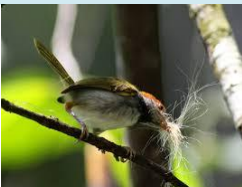
<b>Scientific Name:</b>	<i>Aegithina tiphia</i>
<b>Common Name:</b>	Common Iora ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P2, P3, P4, P6, & P9


<b>Scientific Name:</b>	<i>Acridotheres tristis</i>
<b>Common Name:</b>	Common Myna ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>UP</b>
	IUCN status: <b>LC</b>
	Found at P1


<b>Scientific Name:</b>	<i>Orthotomus sutorius</i>
<b>Common Name:</b>	Common Tailorbird ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P1 & P5





<b>Scientific Name:</b>	<i>Spilornis cheela</i>
<b>Common Name:</b>	Crested Serpent-eagle ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P3


<b>Scientific Name:</b>	<i>Orthotomus atrogularis</i>
<b>Common Name:</b>	Dark-necked Tailorbird ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P4 & P7


<b>Scientific Name:</b>	<i>Surniculus lugubris</i>
<b>Common Name:</b>	Drongo Cuckoo ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P6, & P7

<b>Scientific Name:</b>	<i>Pernis apivorus</i>
<b>Common Name:</b>	Eurasian Honey-buzzard ( <i>migratory</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P9


<b>Scientific Name:</b>	<i>Centropus sinensis</i>
<b>Common Name:</b>	Greater Coucal ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P1


<b>Scientific Name:</b>	<i>Chalcophaps indica</i>
<b>Common Name:</b>	Green-winged Pigeon ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: <b>LC</b>
	Found at P1 & P7


<b>Scientific Name:</b>	<i>Ichthyophaga ichthyaetus</i>
<b>Common Name:</b>	Grey-headed Fish-eagle ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>NT</b>
	Found at P1 (On-site photo)

<b>Scientific Name:</b>	<i>Corvus splendens</i>
<b>Common Name:</b>	House Crow ( <i>introduced</i> )
	Wildlife Conservation Act 2010 status: <b>UP</b>
	IUCN status: <b>LC</b>
	Found at P9


<b>Scientific Name:</b>	<i>Accipiter gularis</i>
<b>Common Name:</b>	Japanese Sparrowhawk ( <i>migratory</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P5


<b>Scientific Name:</b>	<i>Acridotheres fuscus</i>
<b>Common Name:</b>	Jungle Myna ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>UP</b>
	IUCN status: <b>LC</b>
	Found at P1 & P2


<b>Scientific Name:</b>	<i>Locustella lanceolata</i>
<b>Common Name:</b>	Lanceolated Warbler ( <i>migratory</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P9


<b>Scientific Name:</b>	<i>Corvus macrorhynchos</i>
<b>Common Name:</b>	Large-billed Crow ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>UP</b>
	IUCN status: <b>LC</b>
	Found at P5


<b>Scientific Name:</b>	<i>Caprimulgus macrurus</i>
<b>Common Name:</b>	Large-tailed Nightjar ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P5


<b>Eggs</b>	
	Eggs were found during assessment (On-site photo)


<b>Scientific Name:</b>	<i>Centropus bengalensis</i>
<b>Common Name:</b>	Lesser Coucal ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P1 & P4


<b>Scientific Name:</b>	<i>Dendrocygna javanica</i>
<b>Common Name:</b>	Lesser Whistling-duck ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P9


<b>Scientific Name:</b>	<i>Tachybaptus ruficollis</i>
<b>Common Name:</b>	Little Grebe ( <i>migratory</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P9

<b>Scientific Name:</b>	<i>Treron olax</i>
<b>Common Name:</b>	Little Green Pigeon ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: <b>LC</b>
	Found at P5, P6 & P8

<b>Scientific Name:</b>	<i>Copsychus saularis</i>
<b>Common Name:</b>	Magpie Robin ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: <b>LC</b>
	Found at P1


<b>Scientific Name:</b>	<i>Hirundo tahitica</i>
<b>Common Name:</b>	Pacific Swallow ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P9


<b>Scientific Name:</b>	<i>Geopelia striata</i>
<b>Common Name:</b>	Peaceful Dove ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>UP</b>
	IUCN status: <b>LC</b>
	Found at P1, P2, P4 & P5 (On-site photo)

<b>Scientific Name:</b>	<i>Rhipidura javanica</i>
<b>Common Name:</b>	Pied Fantail Flycatcher ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P4 & P6


<b>Scientific Name:</b>	<i>Treron vernans</i>
<b>Common Name:</b>	Pink-necked Green-pigeon ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: <b>LC</b>
	Found at P5 & P6


	(On-site photo)
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<b>Scientific Name:</b>	<i>Cacomantis merulinus</i>
<b>Common Name:</b>	Plaintive Cuckoo ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P6 & P9

<b>Scientific Name:</b>	<i>Ardea purpurea</i>
<b>Common Name:</b>	Purple Heron ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P1


	(On-site photo)
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<b>Scientific Name:</b>	<i>Gallus gallus</i>
<b>Common Name:</b>	Red Junglefowl ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: <b>LC</b>
	Found at P1 & P9 (On-site photo)


<b>Scientific Name:</b>	<i>Vanellus indicus</i>
<b>Common Name:</b>	Red-wattled Lapwing ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P9


<b>Scientific Name:</b>	<i>Prinia rufescens</i>
<b>Common Name:</b>	Rufescent Prinia ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P7





<b>Scientific Name:</b>	<i>Micropternus brachyurus</i>
<b>Common Name:</b>	Rufous Woodpecker ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P4


<b>Scientific Name:</b>	<i>Orthotomus sericeus</i>
<b>Common Name:</b>	Rufous-tailed Tailorbird ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P6 & P8


<b>Scientific Name:</b>	<i>Caprimulgus affinis</i>
<b>Common Name:</b>	Savanna Nightjar ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P5


<b>Scientific Name:</b>	<i>Lonchura punctulata</i>
<b>Common Name:</b>	Scaly-breasted Munia ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: <b>LC</b>
	Found at P7


<b>Scientific Name:</b>	<i>Spilopelia chinensis</i>
<b>Common Name:</b>	Spotted Dove ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: <b>LC</b>
	Found at P1, P2, P4, P5 & P6


<b>Scientific Name:</b>	<i>Treron curvirostra</i>
<b>Common Name:</b>	Thick-billed Pigeon ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: <b>LC</b>
	Found at P7


<b>Scientific Name:</b>	<i>Lonchura Malacca</i>
<b>Common Name:</b>	Tricoloured munia ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>UP</b>
	IUCN status: <b>LC</b>
	Found at P1


<b>Scientific Name:</b>	<i>Amaurornis phoenicurus</i>
<b>Common Name:</b>	White-breasted Waterhen ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: <b>LC</b>
	Found at P1 & P5


<b>Scientific Name:</b>	<i>Lonchura maja</i>
<b>Common Name:</b>	White-headed Munia ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: <b>LC</b>
	Found at P3

<b>Scientific Name:</b>	<i>Halcyon smyrnensis</i>
<b>Common Name:</b>	White-throated Kingfisher ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P1, P4 & P6

<b>Scientific Name:</b>	<i>Ixobrychus sinensis</i>
<b>Common Name:</b>	Yellow Bittern ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P1 & P4

<b>Scientific Name:</b>	<i>Prinia flaviventris</i>
<b>Common Name:</b>	Yellow-bellied Prinia ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P1, P2, P3, P4, P6 & P8

<b>Scientific Name:</b>	<i>Prionochilus maculatus</i>
<b>Common Name:</b>	Yellow-breasted Flowerpecker ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P6

<b>Scientific Name:</b>	<i>Pycnonotus goiavier</i>
<b>Common Name:</b>	Yellow-vented Bulbul ( <i>resident</i> )
	Wildlife Conservation Act 2010 status: <b>UP</b>
	IUCN status: <b>LC</b>
	Found at P1, P2, P3, P4, P5, P6, P8 & P9

<b>Scientific Name:</b>	<i>Cisticola juncidis</i>
<b>Common Name:</b>	Zitting Cisticola ( <i>introduced</i> )
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P9



**Sources:**

On-site photo during fauna assessment; ecologyasia.com; en.wikipedia.org; hbw.com; malayanparadise.blogspot.com; malaysianbirds.com; malaysia-wildlife-and-nature.com; orientalbirdimages.org; pinterest.com; singaporebirds.blogspot.com; singaporebirds.com; and zulkarnain.blogspot.com.

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**Glossary**

**Wildlife Conservation Act 2010 status:**


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**IUCN status:**


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**Mammals**


<b>Scientific Name:</b>	<i>Tupaia glis</i>
<b>Common Name:</b>	Common Treeshrew
	Wildlife Conservation Act 2010 status: <b>P-II</b>
	IUCN status: <b>LC</b>
	Found at P9


<b>Scientific Name:</b>	<i>Cynopterus brachyotis</i>
<b>Common Name:</b>	Malaysian FrUpt Bat
	Wildlife Conservation Act 2010 status: Not protected
	IUCN status: <b>LC</b>
	Found at P9


<b>Scientific Name:</b>	<i>Macaca fascicularis</i>
<b>Common Name:</b>	Long-tailed Macaque
	Wildlife Conservation Act 2010 status: <b>P-II</b>
	IUCN status: <b>LC</b>
	Found at P9


<b>Scientific Name:</b>	<i>Macaca nemestrina</i>
<b>Common Name:</b>	Pig-tailed Macaque
	Wildlife Conservation Act 2010 status: <b>P-II</b>
	IUCN status: <b>VU</b>
	Found at P9


<b>Scientific Name:</b>	<i>Paradoxurus hermaphrodites</i>
<b>Common Name:</b>	Common Palm Civet
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: <b>LC</b>
	Found at P9


<b>Scientific Name:</b>	<i>Prionailurus bengalensis</i>
<b>Common Name:</b>	Leopard Cat
	Wildlife Conservation Act 2010 status: <b>TP</b>
	IUCN status: <b>LC</b>
	Found at P9


<b>Scientific Name:</b>	<i>Sus scrofa</i>
<b>Common Name:</b>	Wild Pig
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: <b>LC</b>
	Found at P9

<b>Scientific Name:</b>	<i>Rattus tiomanicus</i>
<b>Common Name:</b>	Malaysian Wood Rat
	Wildlife Conservation Act 2010 status: Not protected
	IUCN status: <b>LC</b>
	Found at P9

<b>Scientific Name:</b>	<i>Callosciurus notatus</i>
<b>Common Name:</b>	Plantain SqUPrrel
	Wildlife Conservation Act 2010 status: Not protected
	IUCN status: <b>LC</b>
	Found at P9

<b>Scientific Name:</b>	<i>Hystrix brachyura</i>
<b>Common Name:</b>	Malayan Porcupine
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: <b>LC</b>
	Found at P1

<b>Scientific Name:</b>	<i>Rattus rattus</i>
<b>Common Name:</b>	House Rat
	Wildlife Conservation Act 2010 status: Not protected
	IUCN status: <b>LC</b>
	Found at P9

	(On-site photo)
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**Sources:**

On-site photo during fauna assessment; cleanmalaysia.com; ecologyasia.com; en.wikipedia.org; gwildanimals.blogspot.com; malaysia.com;

**Glossary**


**Wildlife Conservation Act 2010 status:**


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**IUCN status:**


**VU = Vulnerable; NT = Near Threatened; LC = Least Concern**

**Insects**


<b>Scientific Name:</b>	<i>Crocthemis servilia</i>
<b>Common Name:</b>	Dragonfly
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P1 & P2


<b>Scientific Name:</b>	<i>Netrothemis fluctuans</i>
<b>Common Name:</b>	Dragonfly
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P1, P4 & P7


<b>Scientific Name:</b>	<i>Rhothemis Phyllis</i>
<b>Common Name:</b>	Dragonfly
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P1, P2, P7, P9

<b>Scientific Name:</b>	<i>Ictinogamphus decorates</i>
<b>Common Name:</b>	Dragonfly
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P1 & P2


<b>Scientific Name:</b>	Unidentified
<b>Common Name:</b>	Damselfly
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P1 & P2


<b>Scientific Name:</b>	<i>Cicindela aurulenta</i>
<b>Common Name:</b>	Tiger Beetle
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P1 & P9


<b>Scientific Name:</b>	<i>Lepidiota stigma</i>
<b>Common Name:</b>	Beetle
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P1


<b>Scientific Name:</b>	<i>Oceophylla smaragdina</i>
<b>Common Name:</b>	Red ants
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P1, P2, P3, P4, P5, P6, P7, P8, & P9

<b>Scientific Name:</b>	<i>Leptosia nina nina</i>
<b>Common Name:</b>	Butterfly
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P1, P2, P4 & P8


<b>Scientific Name:</b>	<i>Catopsilia Pomona</i>
<b>Common Name:</b>	Butterfly
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P1 & P3


<b>Scientific Name:</b>	<i>Mycalesis sp.</i>
<b>Common Name:</b>	Butterfly
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P1, P3 & P8


<b>Scientific Name:</b>	<i>Eurema sp.</i>
<b>Common Name:</b>	Butterfly
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P8


<b>Scientific Name:</b>	<i>Cethosia hypsea</i>
<b>Common Name:</b>	Butterfly
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P5


<b>Scientific Name:</b>	<i>Junonia almana</i>
<b>Common Name:</b>	Butterfly
	Wildlife Conservation Act 2010 status: -
	IUCN status: <b>LC</b>
	Found at P4


<b>Scientific Name:</b>	<i>Moduza procris milonia</i>
<b>Common Name:</b>	Butterfly
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P4

<b>Scientific Name:</b>	<i>Grapium</i> sp.
<b>Common Name:</b>	Butterfly
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P8

<b>Scientific Name:</b>	<i>Chilades</i> sp.
<b>Common Name:</b>	Butterfly
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P6

<b>Scientific Name:</b>	<i>Ideopsis</i> sp.
<b>Common Name:</b>	Butterfly
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P8

<b>Scientific Name:</b>	<i>Euploea mulciber</i>
<b>Common Name:</b>	Butterfly
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P8

<b>Scientific Name:</b>	<i>Coptotermes</i> sp.
<b>Common Name:</b>	Termite
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P5



<b>Scientific Name:</b>	<i>Nsycanus dichotomus</i>
<b>Common Name:</b>	Stink bug
Wildlife Conservation Act 2010 status:	-
IUCN status:	-
Found at	P7 & P9



<b>Scientific Name:</b>	<i>Sycanus sp.</i>
<b>Common Name:</b>	Stink Bug
Wildlife Conservation Act 2010 status:	-
IUCN status:	-
Found at	P9



<b>Scientific Name:</b>	<i>Vespa affinis</i>
<b>Common Name:</b>	Wasp
Wildlife Conservation Act 2010 status:	-
IUCN status:	-
Found at	P6



<b>Scientific Name:</b>	<i>Eumenes sp.</i>
<b>Common Name:</b>	Potter wasp
Wildlife Conservation Act 2010 status:	-
IUCN status:	-
Found at	P7 & P9




<b>Scientific Name:</b>	<i>Xylocopidae latipes</i>
<b>Common Name:</b>	Carpenter bee
Wildlife Conservation Act 2010 status:	-
IUCN status:	-
Found at	P9




<b>Scientific Name:</b>	<i>Xylocopa confuse</i>
<b>Common Name:</b>	Carpenter bee
Wildlife Conservation Act 2010 status:	-
IUCN status:	-
Found at	P8 & P9




<b>Scientific Name:</b>	<i>Valanga nigricornis</i>
<b>Common Name:</b>	Grasshopper
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P2 & P7


<b>Scientific Name:</b>	Unidentified
<b>Common Name:</b>	Round millipede
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P7 & P9


<b>Scientific Name:</b>	Unidentified
<b>Common Name:</b>	Flat millipede
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P7 & P9


<b>Scientific Name:</b>	Unidentified
<b>Common Name:</b>	Pill millipede
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P7


**Reptiles**


<b>Scientific Name:</b>	<i>Calotes versicolor</i>
<b>Common Name:</b>	Oriental garden lizard
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: -
	Found at P1, P5, P8, & P9 (On-site photo)


<b>Scientific Name:</b>	<i>E. multifasciata</i>
<b>Common Name:</b>	Skink
	Wildlife Conservation Act 2010 status: <b>UP</b>
	IUCN status: -
	Found at P5


<b>Scientific Name:</b>	<i>Ahaetulla prasina</i>
<b>Common Name:</b>	Green whip snake
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: <b>LC</b>
	Found at P5

<b>Scientific Name:</b>	<i>Naja sumatrana</i>
<b>Common Name:</b>	Spitting cobra
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: <b>LC</b>
	Found at P1 (day and night spotting) & P6 (night spotting)

<b>Scientific Name:</b>	<i>Acrochordus javanicus</i>
<b>Common Name:</b>	Elephant trunk snake
	Wildlife Conservation Act 2010 status: <b>P-I</b>
	IUCN status: <b>LC</b>
	Found at P1

<b>Scientific Name:</b>	<i>Bufo apera</i>
<b>Common Name:</b>	Common Toad
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P1 (night spotting)

<b>Scientific Name:</b>	<i>Rana erythraea</i>
<b>Common Name:</b>	Common green frog
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P1, P2, P3 & P9 (night spotting)

<b>Scientific Name:</b>	<i>Rana blythii</i>
<b>Common Name:</b>	Frog
	Wildlife Conservation Act 2010 status: -
	IUCN status: -
	Found at P1, P2, P8 (night spotting)

**Sources:**

On-site photo during fauna assessment; alamy.com; ecologyasia.com; en.wikipedia.org; malysiabutterflies.myspsecies.info.com; malaysia-wildlife-and-nature.com; mantegroup.com; odobod.org; odunata-malaysia.blogspot.com; pinterest.com; wildherps.com; and wildlifemalaysia.com.

**Glossary**

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**APPENDIX C**  
**BIRDS INVENTORY - PAYA INDAH WETLAND**



**BIRDS INVENTORY IN PAYA INDAH WETLANDS**

(Based on Rajpar, M.N., &amp; Zakaria, M. (2010). Density and diversity of water birds and terrestrial birds at Paya Indah Wetland Reserve, Selangor Peninsular Malaysia. Journal of Biological Sciences 10 (7): 658 – 666)

Table 1: The density of water birds and terrestrial birds of paya indah wetland reserve, peninsular Malaysia

Status of bird species	Density estimate (birds ha <sup>-1</sup> )	Density estimate at 95% confidence interval (birds ha <sup>-1</sup> )
Over all density	83.92±4.53	75.40-93.41
Water birds	13.09±1.78	10.01-17.12
Terrestrial birds	70.26±4.48	61.94-79.69

Table 2: Ranking of water bird density at paya indah wetland reserve, peninsular Malaysia

Common name	Scientific name	Density (birds ha <sup>-1</sup> )	Density at 95% confidence interval (birds ha <sup>-1</sup> )
Purple swamphen	<i>P. porphyrio</i>	5.05±0.89	3.54-7.21
Lesser whistling duck	<i>D. javania</i>	4.66±1.12	1.42-11.62
White-breasted waterhen	<i>A. phoeniurus</i>	3.02±0.35	2.35-3.88
Yellow bittern	<i>I. sinensis</i>	2.84±0.62	1.85-4.36
Cotton pygmy goose	<i>N. coromandelianus</i>	2.63±0.11	1.12-6.18
Little heron	<i>B. striatus</i>	2.45±0.76	0.5-11.96
Red-wattled lapwing	<i>V. indius</i>	2.19±0.43	1.48-3.24
White-throated kingfisher	<i>H. smymensis</i>	1.92±0.22	1.51-2.43
Common moorhen	<i>G. chloropus</i>	1.70±0.36	1.10-2.62
White-browed crane	<i>P. cinererea</i>	1.28±0.50	0.57-2.89
Purple heron	<i>A. pupurea</i>	1.05±0.15	0.78-1.40
Schrenck's bittern	<i>I. eurhythmus</i>	0.93±0.35	0.27-3.22
Pintail snipe	<i>G. stenura</i>	0.73±0.19	0.43-1.25
Water cock	<i>G. cinerea</i>	0.53±0.19	0.25-1.13
Cinnamon bittern	<i>I. cinnamoneus</i>	0.51±0.19	0.35-0.74
Common sandpiper	<i>T. hypoleucos</i>	0.42±0.17	0.09-1.94
Little grebe	<i>T. ruficollis</i>	0.35±0.12	0.10-1.24
Black-crowned night heron	<i>N. nycticorax</i>	0.33±0.12	0.02-5.46
Ballion's crane	<i>P. pusilla</i>	0.31±0.13	0.13-0.78
Pheasant-tailed jacana	<i>H. chirurgus</i>	0.26±0.12	0.10-0.71
Grey heron	<i>A. cinerea</i>	0.13±0.05	0.05-0.32

Table 4: Comparison of bird species diversity of terrestrial birds and water birds at paya indah wetland reserve, selangor peninsular Malaysia

Diversity indices	Water birds	Terrestrial birds
Shannon's index (N <sub>1</sub> )	9.56	20.83
Simpson's index (N <sub>2</sub> )	6.62	12.69
Richness indices		
Margalef's index (R <sub>1</sub> )	2.99	7.97
Menhinik's index (R <sub>2</sub> )	0.45	0.72
Evenness indices		
McIntosh's index (E)	0.62	0.73

Table 3: Ranking of terrestrial bird density at paya indah wetland reserve, selangor peninsular Malaysia

Common name	Scientific name	Density (birds ha <sup>-1</sup> )	Density at 95% confidence interval (birds ha <sup>-1</sup> )
Yellow-vented bulbul	<i>P. goiavier</i>	12.97±1.05	11.97-15.07
Pink-necked green pigeon	<i>T. vernans</i>	11.40±1.15	9.09-13.66
Peaceful dove	<i>G. striata</i>	9.85±0.96	8.12-11.95
Eurasian tree sparrow	<i>P. montanus</i>	7.85±2.17	2.75-22.41
Rufous-tailed tailorbird	<i>O. sericeus</i>	7.54±1.43	1.89-29.91
Scaly-breasted munia	<i>L. punctulata</i>	7.20±1.25	3.61-14.36
Baya weaver	<i>P. philippinus</i>	6.85±0.40	4.60-10.19
White-headed munia	<i>L. maja</i>	6.13±1.23	2.48-15.19
Spotted dove	<i>S. chinensis</i>	5.16±0.63	4.04-6.58
Black-headed munia	<i>L. maacca</i>	4.77±1.06	2.08-10.90
Common myna	<i>A. tristis</i>	3.56±0.86	2.22-5.71
Orange-breasted green pigeon	<i>T. bicincta</i>	3.54±1.23	1.78-7.07
Jungle myna	<i>A. fuscus</i>	3.28±0.42	2.50-4.30
Pacific swallow	<i>H. tachitica</i>	3.07±0.17	1.41-6.40
Pied fantail	<i>R. javanica</i>	2.94±0.54	2.04-4.24
Philippine glossy starling	<i>A. panayensis</i>	2.64±0.35	1.43-4.89
Blue-breasted quail	<i>C. chinensis</i>	2.63±0.58	0.61-11.39
Richard's pipit	<i>A. richardi</i>	2.38±0.56	1.48-3.80
Mangrove whistler	<i>P. grisola</i>	2.36±0.87	0.48-11.70
Blue-tailed bee-eater	<i>M. philippinus</i>	2.36±0.82	1.21-4.63
Oriental reed warbler	<i>A. orientalis</i>	2.10±0.50	1.30-3.37
Common Iora	<i>A. tiphia</i>	2.00±0.45	1.19-3.06
White-vented myna	<i>A. grandis</i>	1.93±0.55	1.08-3.44
Yellow-bellied prinia	<i>P. flaviventris</i>	1.86±0.27	1.39-2.49
Green iora	<i>A. viridissima</i>	1.86±0.24	1.43-2.43
Oriental magpie robin	<i>C. saularis</i>	1.83±0.32	1.29-2.62
Ashy tailorbird	<i>O. ruficeps</i>	1.81±0.62	0.92-3.57
Dollar bird	<i>E. orientalis</i>	1.59±0.73	0.59-4.30
Large-tailed nightjar	<i>C. macrurus</i>	1.55±0.66	0.65-3.71
Little green pigeon	<i>T. olax</i>	1.55±0.27	0.59-4.03
Black-napped oriole	<i>O. chinensis</i>	1.45±0.54	1.12-1.88
Brown-throated sunbird	<i>A. malacensis</i>	1.36±0.65	0.54-3.42
Brown shrike	<i>L. cristatus</i>	1.34±0.15	1.07-1.68
Little bronze cuckoo	<i>C. minutillus</i>	1.30±0.46	0.63-2.67
Pied triller	<i>L. nigra</i>	1.26±0.31	0.77-2.04
Blue-throated bee-eater	<i>M. viridus</i>	1.22±0.39	0.65-2.32
Common flameback	<i>D. javanense</i>	1.20±0.26	0.77-1.85
Olive-winged bulbul	<i>P. plumosus</i>	1.07±0.42	0.27-1.46
House crow	<i>C. splendens</i>	0.98±0.37	0.19-5.06
Zitting cisticola	<i>C. juncidis</i>	0.96±0.13	0.49-1.89
Hill myna	<i>G. religiosa</i>	0.94±0.56	0.23-3.83
Barred button quail	<i>T. suscitator</i>	0.92±0.35	0.43-1.94
Savanna nightjar	<i>C. affinis</i>	0.86±0.25	0.30-2.52
Lesser coucal	<i>C. bengalensis</i>	0.82±0.13	0.59-1.15
Plaintive cuckoo	<i>C. merulinus</i>	0.79±0.26	0.40-1.55
Common tailorbird	<i>O. sutorius</i>	0.71±0.13	0.48-1.04
Large-billed crow	<i>C. macrorhynchos</i>	0.65±0.27	0.28-1.52
Red junglefowl	<i>G. gallus</i>	0.64±0.13	0.42-0.96
Olive-backed sunbird	<i>N. jugularis</i>	0.63±0.26	0.28-4.07
Plain sunbird	<i>A. simplex</i>	0.58±0.14	0.15-2.36
Black-shouldered kite	<i>E. caeruleus</i>	0.54±0.31	0.18-1.61
Asian brown flycatcher	<i>M. dauica</i>	0.43±0.18	0.19-0.99
Black-throated sunbird	<i>A. saturate</i>	0.41±0.19	0.14-1.19
Rufous woodpecker	<i>C. brachyurus</i>	0.40±0.14	0.10-1.52
Greater coucal	<i>C. sinensis</i>	0.39±0.15	0.18-0.85
Little spiderhunter	<i>A. longirostra</i>	0.34±0.12	0.05-2.54
Ashy minivet	<i>P. divaricatus</i>	0.31±0.18	0.09-1.09