



# BIODIVERSITY ASSESSMENT IN PENDERANG, JOHOR

Prepared for

**Penderang Energy Complex**

**13.10  
2021**



# Biodiversity Assessment in Pengerang, Johor

## For Pengerang Energy Complex

For and on behalf of  
EnviroSolutions & Consulting Sdn Bhd,

Approved by,



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October 2021

Project Number: EP21.7052-J.01

Report Version: 00

Rev.	Description	Prepared	Reviewed	Approved	Date
00	Final	ZKM/ST	TMM	ZAR	13/10/2021

### Distribution

☐ Internal

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**TABLE OF CONTENTS**

<b>1</b>	<b>INTRODUCTION</b>	<b>1</b>
1.1	Project Location	1
1.2	Scope of Study	3
1.3	Study Coverage	3
1.4	Methodology	5
1.5	Document Structure	5
<b>2</b>	<b>LEGAL FRAMEWORK</b>	<b>6</b>
<b>3</b>	<b>SITE DESCRIPTION</b>	<b>10</b>
3.1	Site Setting	10
3.2	Site Topography	10
3.3	Geology	10
3.4	Soils	11
3.5	Landuse	12
	3.5.1 Historical Landuse	12
	3.5.2 Sensitive Receptors	14
	3.5.3 Non-Sensitive Receptors	15
3.6	Hydrology & Hydrogeology	15
	3.6.1 Hydrology	15
	3.6.2 Hydrogeology	16
3.7	Climate and Meteorological Conditions	17
	3.7.1 Temperature and Humidity	17
	3.7.2 Rainfall	19
3.8	Air Quality	19
<b>4</b>	<b>BASELINE FLORA AND FAUNA ASSESSMENT</b>	<b>20</b>
4.1	Flora Assessment	20
4.2	Fauna Assessment	22
	4.2.1 Mammal Survey	25
	4.2.2 Avifauna Survey	29
	4.2.3 Ichthyofauna survey	30
	4.2.4 Herpetofauna Survey	32
<b>5</b>	<b>FINDINGS</b>	<b>34</b>
5.1	Flora Assessment	34
5.2	Fauna Assessment	45
	5.2.1 Mammal	48
	5.2.2 Avifauna	48
	5.2.3 Herpetofauna	53
	5.2.4 Ichthyofauna	56
5.3	Conservation Status	59
	5.3.1 Flora	59
	5.3.2 Fauna	60
	5.3.3 Mammal	60
	5.3.4 Avifauna	60

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	5.3.5	Herpetofauna	61
	5.3.6	Ichthyofauna	61
<b>6</b>		<b>BIODIVERSITY MANAGEMENT PLAN</b>	<b>62</b>
6.1		Potential Threats	62
	6.1.1	Habitat Degradation	62
	6.1.2	Human-Wildlife Conflicts	62
	6.1.3	Wildlife Hunting	62
	6.1.4	Pollution	63
	6.1.5	Zoonotic Disease	63
6.2		Mitigation Measures	64
	6.2.1	Habitat Degradation and Pollution	65
	6.2.2	Habitat Enrichment	66
	6.2.3	Zoonotic Disease (Leptospirosis)	67
	6.2.4	Monitoring Programme	68



## LIST OF FIGURES

Figure 1.1 - Site & Study Boundary .....	2
Figure 1.2 - Schematic Land use within 5-km Radius.....	4
Figure 3.1 – Topography within 1 km Radius from Proposed PEC Site.....	10
Figure 3.2 – Geological Map within 1 km Radius and in The Vicinity of Proposed PEC.....	11
Figure 3.3 – Soil Map .....	12
Figure 3.4 – Proposed PEC Site Location within the Pengerang Masterplan .....	13
Figure 3.5 – Tributaries in Surrounding PEC Site .....	16
Figure 3.6 – Areas of Aquifer Potential in Pengerang.....	17
Figure 3.7 – Average Temperatures from 2018 to 2021 in Pengerang .....	18
Figure 3.8 – Average Temperatures and Humidity from 2018 to 2021 in Pengerang .....	18
Figure 3.9 – Average Rainfall Data from 2018 to 2021 in Pengerang.....	19
Figure 4.1 – Sampling sites for flora survey in Pengerang .....	21
Figure 4.2 – Sampling sites for Ichthyofauna (grey), mammals (purple), herpetofauna (brown) and avifauna (orange) in Pengerang .....	24
Figure 4.3 – Sampling location of mammals’ survey .....	25
Figure 4.4 – Footprints left by wildlife as a proof for their existence in that area .....	26
Figure 4.5 – Setting up Mist Nets for bats survey at sampling sites .....	27
Figure 4.6 – Camera traps were tied up on a tree at sampling sites .....	28
Figure 4.7 – Site locations of avifauna surveys.....	29
Figure 4.8 – Site locations of ichthyofaunas ’surveys .....	30
Figure 4.9 – Site locations of ichthyofaunas ’surveys .....	32
Figure 4.10 – Herpetofauna ’surveys at project site.....	33
Figure 5.1 – Location of Rhizophora x annamalayana and Bruguiera heinesii within study area .....	45
Figure 5.2 – Number of individuals recorded in avifauna survey .....	49
Figure 5.3 – Number of genera recorded in avifauna survey .....	53
Figure 5.4 – Number of species herpetofauna recorded by genera.....	56
Figure 5.5 – Number of individuals recorded in fish survey .....	58

## LIST OF TABLES

Table 2.1: Policies and Act Related to Biodiversity Management in Malaysia .....	6
Table 3.1: Identified Settlements Surrounding the Proposed PEC .....	14
Table 3.2: Identified Public Amenities Surrounding the Proposed PEC.....	15
Table 4.1: Sampling sites' location for flora assessment located within 5km radius from project boundary in Pengerang.....	20
Table 4.2: Sampling sites' location for fauna assessment located within 5km radius from project boundary in Pengerang.....	22
Table 5.1: Flora Species Observed During Survey Conducted on 16-20th September 2021 in Pengerang.....	35
Table 5.2: Number of Species Recorded in Each Sampling Sites .....	44
Table 5.3: Types of Flora Observed During the Survey.....	44
Table 5.4: Observation of <i>Rhizophora x annamalayana</i> and <i>Bruguiera heinesii</i> During Survey.....	45
Table 5.5: Faunal Diversity Recorded during Survey in Pengerang .....	46
Table 5.6: Mammals Species Observed in Pengerang .....	47
Table 5.7: Morphometric measurements of bats in Pengerang.....	48
Table 5.8: Avifauna Species Observed in Pengerang .....	50
Table 5.9: Herpetofauna Species Observed in Pengerang.....	54
Table 5.10: Ichthyofauna Species Observed in Pengerang .....	57
Table 5.11: Morphometric Measurements of Fish Caught During Survey .....	58
Table 5.12: Conservation Status based on MyBIS, IUCN and GBIF Data of Fauna Observed in Pengerang .....	59
Table 5.13: Conservation Status based on MyBIS, IUCN and GBIF Data of Fauna Observed in Pengerang .....	60
Table 6.1: Water Quality Monitoring Programme as per EIA Approval Conditions dated 28 <sup>th</sup> November 2019 With DOE Letter Reference No (JAS.600-2/9/5 Jilid 3).....	68
Table 6.2: Air Quality Control and Monitoring Programme as per EIA Approval Conditions dated 28 <sup>th</sup> November 2019 With DOE Letter Reference No (JAS.600-2/9/5 Jilid 3) .....	69

## ACRONYMS

amsl	Above mean sea level
API	Air Pollution Index
APMS	Aquatic Plant Management Society
CBD	Convention on Biological Diversity
CH	Catch by Hand
CT	Camera Trapping
dB(A)	Decibel
dbh	Diameter at breast height
DEIA	Detailed Environmental Impact Assessment
DEM	Digital Elevation Model
DoE	Department of Environment
EIA	Environmental Impact Assessment
ESC	EnviroSolutions & Consulting Sdn Bhd
ESI	Environmental Site Investigation
FA	Forearm
GBIF	Global Biodiversity Information Facility
GPS	Global Positioning System
GN	Gill Nets
INT	Interview Method
IUCN	International Union for Conservation of Nature
JCorp	Johor Corporation
KEJORA	<i>Lembaga Kemajuan Johor Tenggara</i>
Kg	Kampung
Km	Kilometer
LC	Least Concern
LT	Line Transect
LMO	Living Modified Organism
MN	Mist Nets
MyBIS	Malaysia Biodiversity Information System
NCS	National Conservation Strategy
NQWS	National Water Quality Standards for Malaysia
NE	Not Evaluated
NRIP	Not Recorded in Pengerang
NT	Near Threatened
OBS	Observation
PEC	Pengerang Energy Complex
PIP	Pengerang Industrial Park
PIPIC	Pengerang Industrial Park Complex
REA	Rapid Ecological Assessment
RIP	Recorded in Pengerang
Sg	Sungai
T	Tail
TB	Tibia
TP	Totally Protected Species
VU	Vulnerable
WQI	Water Quality Index
WWF	World Wildlife Fund

## 1 INTRODUCTION

EnviroSolutions & Consulting Sdn Bhd (ESC) has prepared a Biodiversity Assessment report for Pengerang Energy Complex (PEC) where a more detail study needs to be conducted to fulfil EP4 requirement. Previously, ESC has conducted a biodiversity desktop study for the proposed project site and its surrounding area including Sungai (Sg) Santi Mangrove Forest as part of the EIA and ESHIA reports. The study was conducted at a high level only as the proposed project location is located on a cleared land with no potential biodiversity risks identified in the area.

The Environmental Impact Assessment (EIA) for Pengerang Energy Complex Sdn Bhd (PEC) was approved on 28<sup>th</sup> November 2019 by Department of Environment (DoE) Malaysia. Subsequently, an Environmental Social Health Impact Assessment (ESHIA) was developed to ensure that the relevant national and international regulatory requirements are met and that the project would be conducted in an environmentally sustainable manner to meet or surpass the environmental and social requirements of relevant authorities in Malaysia, international standards and guideline as well as the lenders requirements.

To prepare the Biodiversity Assessment Report, ESC has conducted a rapid biodiversity assessment also known as Rapid Ecological Assessment (REA) within 5km form project boundary. REA is an important technique for terrestrial, freshwater, marine and estuarine system management, especially in areas where there is very little published or unpublished information. The objective of this assessment is to record the status and conditions of the biodiversity of the area. This 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. ESC is to provide recommendation measures to further enhance biodiversity of the area, and if required, mitigation measures to protect current species identified.

### 1.1 Project Location

The Pengerang Energy Complex (PEC) is to be developed within the proposed Pengerang Industrial Park (PIP) in Pengerang Integrated Petroleum Complex (PIPC), Mukim Pengerang, Daerah Kota Tinggi, Johor Darul Ta'zim. PIP is part of the full PIPC development spearheaded by Johor Corporation (JCorp). Including the PIP, projects in the PIPC (6,277 acres) are as follows:

- Pengerang Integrated Complex (PIC), which includes the Petronas' Refinery and Petrochemical Integrated Development (RAPID) Project, and the Pengerang Deepwater Terminal (PDT)
- The PIPC's 1,355 acres Centralised Tank Farm area including Dialog's bulk storage terminal
- Jetty, which is operated by Pengerang International Terminals (PIT).

The PIP was proposed to convert 787.6 acres of land within Mukim Pengerang, Daerah Kota Tinggi, Johor, into a heavy industrial estate. It consists of industrial, commercial, green areas and as well as supporting facilities (JCorp EIA, 2018). The PEC process plant, inclusive of onsite facilities, is to be located in the western part of the site and will occupy an area of ~67.7 ha or ~167 acres (~67% of the total site area, 250 acres), measuring roughly 1,095m in width and 618m in length.

The proposed location of the complex is within the proposed Pengerang Industrial Park (PIP) in Mukim (Precinct) Pengerang, Kota Tinggi District, Johor, Malaysia is shown in **Figure 1.1** and the schematic land use surrounding a PEC site area within 5km radius shown in the **Figure 1.2**.

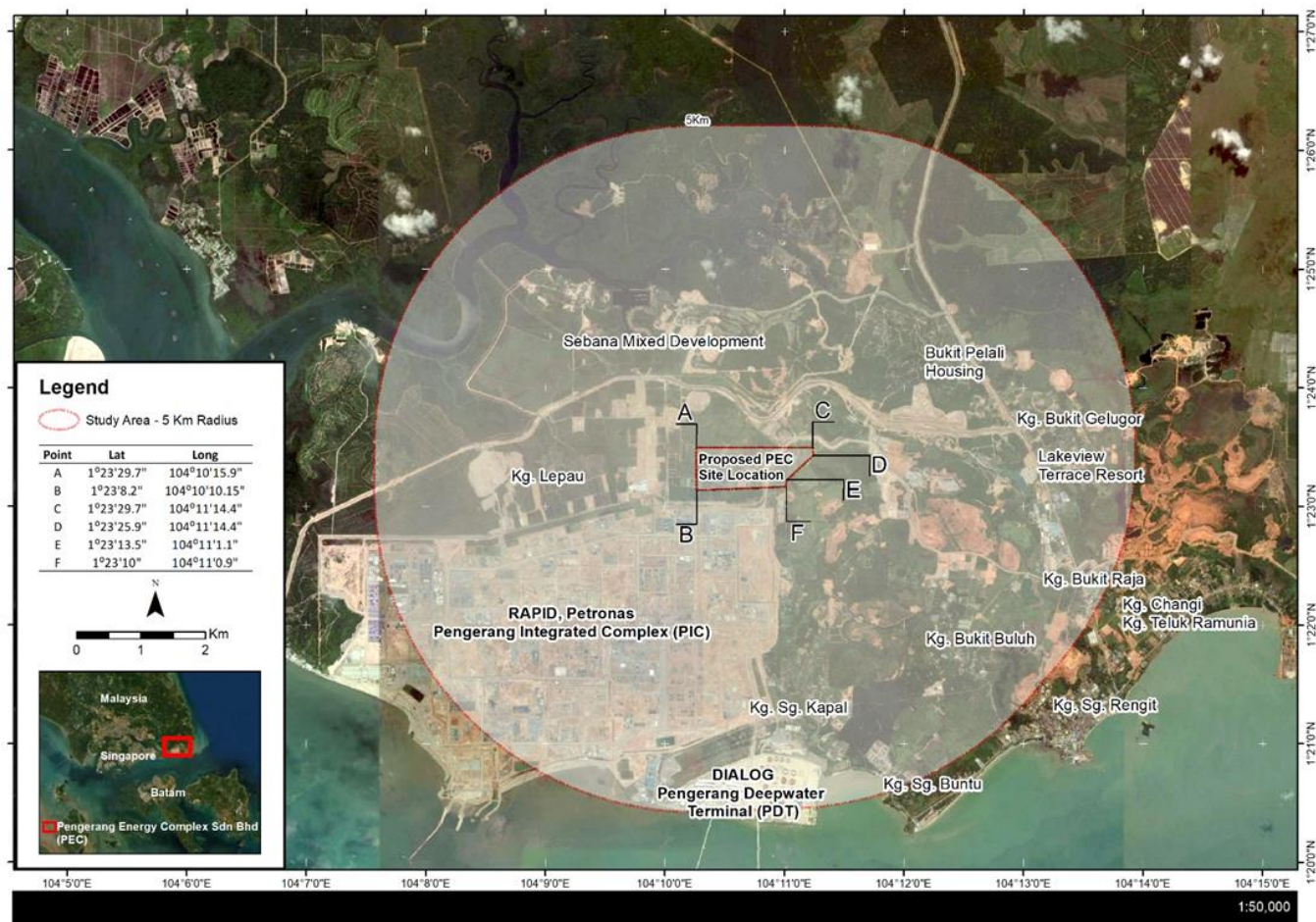


Figure 1.1 - Site &amp; Study Boundary

Source: PEC ESHIA, 2020



## 1.2 Scope of Study

The main focus of this assessment is to assess the current status of ecological conditions within 5 km boundary and develop a Biodiversity Assessment Report to record the status and conditions of the biodiversity of the area. The summary of the biodiversity assessment and its management plan are as follow:

- Identification of surrounding flora types and conditions including mangroves (5 km radius);
- Develop a checklist of the surveyed flora in the area;
- Identification of existing wildlife in the area (5 km radius);
- Develop a checklist of the surveyed wildlife (mammals, birds, fishes, amphibians and reptiles);
- Identification of flora and fauna status using Global Biodiversity Information Facility (GBIF);
- Conduct a comparison from the previous studies of the area and measure the restitution rate (note that this exercise will depend on the availability and availability of the appropriate data); and
- Recommended measures to further enhance the biodiversity of the area, if required, and mitigation measures to protect current species identified, this may include a “What to Do” plan for the residents of the area in case of sightings of endangered or protected fauna/ flora.

## 1.3 Study Coverage

The field survey conducted was a full flora and fauna survey at the PEC site and the surrounding area within 5 km boundary of the project site (refer **Figure 1.2**). The ecological sampling was conducted by ESC flora and fauna experts on 16<sup>th</sup> to 20<sup>th</sup> September 2021. This biodiversity survey was mostly conducted at Sg Santi Mangrove Forest area which is located approximately 3 km from the proposed project. Sg Santi Mangrove Forest covers an area of 3,165 ha which is dominated by estuarine mangrove.

There are six (6) ecological field sampling items covered in this Biodiversity Assessment such as:

- Flora;
- Avifauna;
- Bats;
- Mammals;
- Herpetofauna; and
- Fish

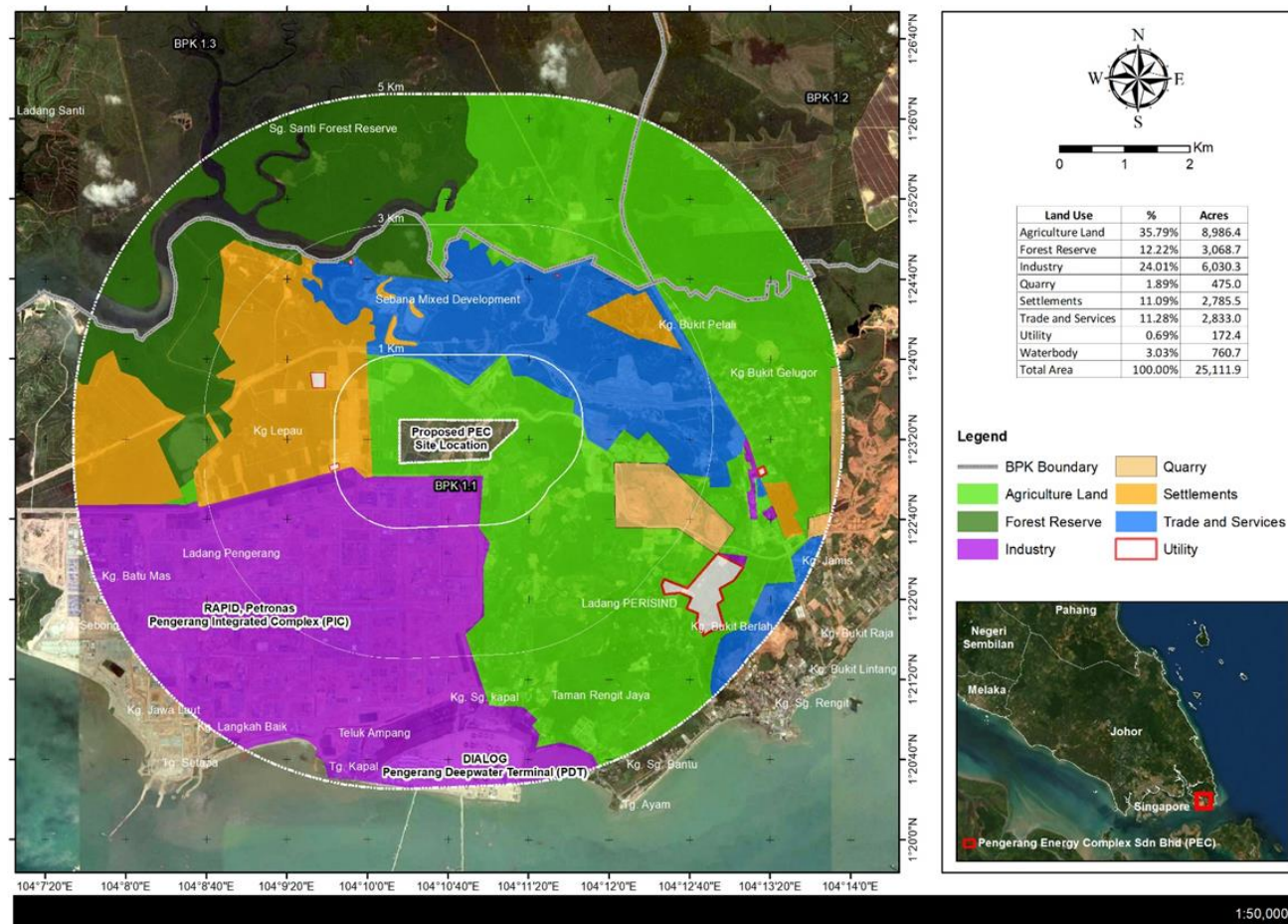


Figure 1.2 - Schematic Land use within 5-km Radius

(Source: PEC ESHIA, 2020)

## 1.4 Methodology

ESC has conducted a full flora and fauna survey at PEC site and its surrounding area within 5 km of the PEC site boundary. The results from these surveys were compared against the GBIF data as well as any data/ information that have been previously recorded in the area. This may include previous EIA, site assessments, flora/ fauna survey or any other ecological survey that may have been conducted. The Biodiversity Assessment has included mitigation measures to ensure that the ecosystem continues to grow in a sustainable manner as well as measures to protect any identified endangered or protected species in the area. The measures include specific instructions for the residents on what should and should not be done to the species encountered.

Detailed of flora and fauna assessment methodology are described in Section 4.0 in this report.

## 1.5 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 – Findings;
- Section 6 - Biodiversity Management Plan;
- References; and
- Appendices

## 2 LEGAL FRAMEWORK

The Malaysian government has developed several policies and act that addressed issues related to biodiversity. These policies provide guidelines and directions on how government agencies, NGOs and the public, in general, react to issues and challenges related to ecological and biodiversity concerns. The policies are further described in **Table 2.1** below.

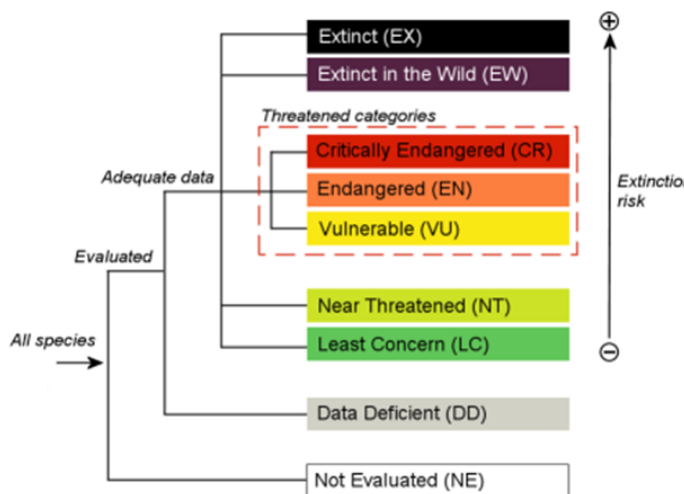
**Table 2.1: Policies and Act Related to Biodiversity Management in Malaysia**

No	Policies and Act	Description
1	National Policy on Biological Diversity 2016 – 2025	<p>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.</p> <p>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:</p> <ul style="list-style-type: none"> <li>• 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;</li> <li>• 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; and</li> <li>• Target 3: By 2025, biodiversity conservation has been mainstreamed into national development planning and sectoral policies and plans.</li> </ul>
2	Wildlife Conservation Act 2010	<p>This Act provides 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:</p> <ol style="list-style-type: none"> <li>a. hunt or keep any protected wildlife;</li> <li>b. take or keep any part or derivative of any protected wildlife;</li> <li>c. collect birds' nests;</li> <li>d. carry on the business of dealing;</li> </ol>

No	Policies and Act	Description
		<p>e. carry on the taxidermy business; or</p> <p>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.</p> <p>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 Act 2010; while "Totally Protected Wildlife" means any wildlife specified in the Second Schedule of the Wildlife Conservation Act 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.</p>
3	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 to conserve natural resources, prepares a sustainable development and to improved efficiency in resource use and management.
4	Pesticides Act 1973	<p>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.</p> <p>According to the Department of Agriculture, the list of banned pesticides include Binapacryl, Butaclor, Dicofof, 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.</p>
5	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 gazettment of forest reserves, their use and management as well as for control of cutting and removal of forest.



No	Policies and Act	Description
6	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.
7	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.
8	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 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.
9	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.
10	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).
11	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.

No	Policies and Act	Description
		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.
12	International Union for Conservation of Nature Red List of Threatened Species	<p>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. 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 <a href="http://www.iucn.org">http://www.iucn.org</a>.</p>  <p>The diagram illustrates the IUCN Red List categories and criteria. It shows a flow from 'All species' to 'Evaluated'. From 'Evaluated', it branches into 'Adequate data' and 'Data Deficient (DD)'. 'Adequate data' further branches into 'Extinct (EX)', 'Extinct in the Wild (EW)', 'Threatened categories' (which includes 'Critically Endangered (CR)', 'Endangered (EN)', and 'Vulnerable (VU)'), 'Near Threatened (NT)', and 'Least Concern (LC)'. 'Threatened categories' are grouped by a dashed red box. A vertical arrow on the right indicates 'Extinction risk' from a plus sign at the top to a minus sign at the bottom. 'Not Evaluated (NE)' is shown at the bottom of the flowchart.</p>
13	Global Biodiversity Information Facility (GBIF)	<p>GBIF arose from a 1999 recommendation by the Biodiversity Informatics Subgroup of the Organization for Economic Cooperation and Development's Megascience Forum. The establishment of a Global Biodiversity Information Facility was made to enable users to “navigate and put to use vast quantities of biodiversity information, advancing scientific research ... serving the economic and quality-of-life interests of society, and providing a basis from which our knowledge of the natural world can grow rapidly and in a manner that avoids duplication of effort and expenditure.”</p> <p>The International Union for Conservation of Nature (IUCN) expert range maps and the GBIF species occurrence data are commonly used to estimate species’ geographic range. Through a Memorandum of Cooperation (MoC), GBIF and IUCN agreed that their respective strengths and specialisms can be used to add significantly to the value of the products and services of both networks, with the strategic implementation of efficient linkages that remain up to date and functional.</p>

### 3 SITE DESCRIPTION

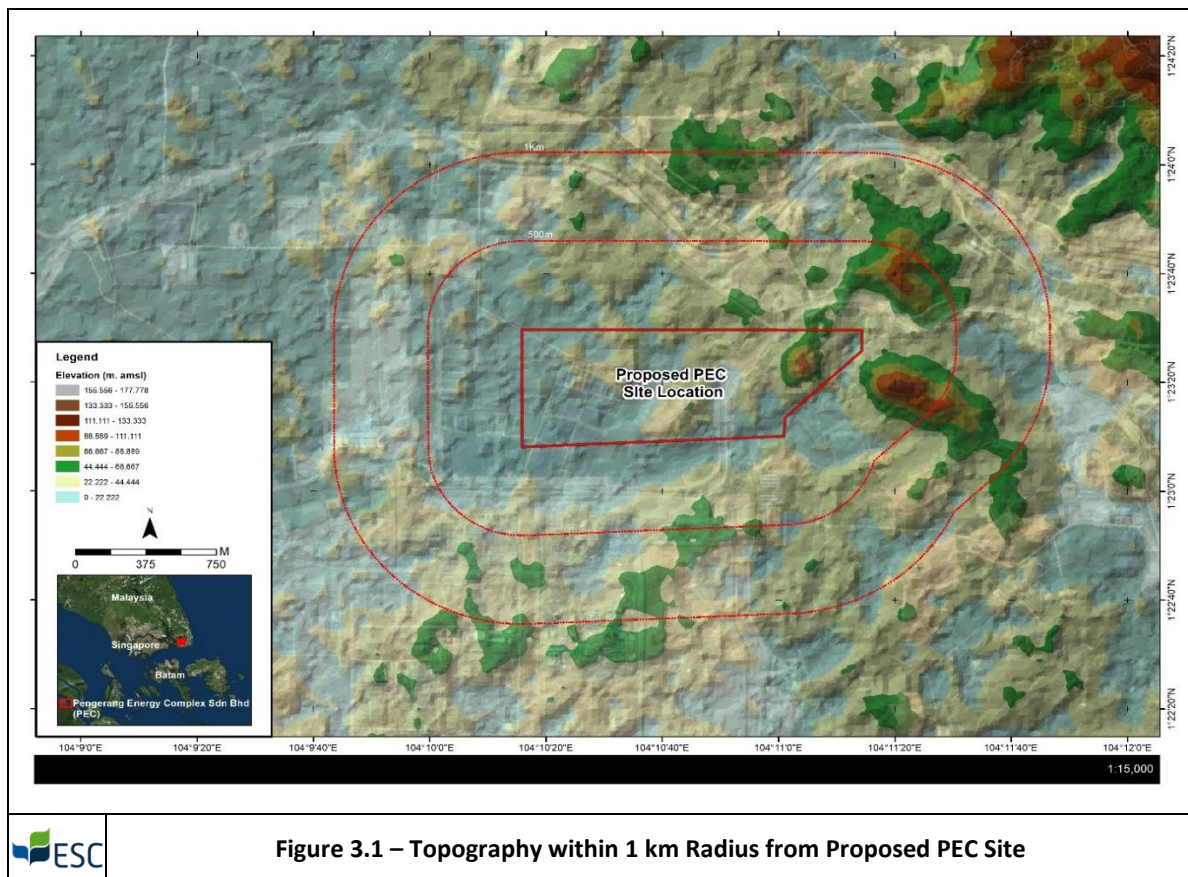
#### 3.1 Site Setting

The PEC site is situated within PIP and located 7.5 km northeast of Pengerang and 6km northwest of Sg Rengit. Singapore's Pulau Tekong and Changi Airport lie 9 km and 17 km east of the site. Highways connect the PIP to Johor Bahru, the state capital, and its airport, Senai. The direct distance between PEC and Johor Bahru, and PEC and Senai Airport is approximately 50 and 67 km, respectively, and it is also accessible by scheduled ferry from Singapore to Pengerang and to larger vessels via the PIPC's Pengerang Deepwater Terminal (PDT). To the south is Petronas's RAPID project.

#### 3.2 Site Topography

The PEC site is situated in a generally low-lying area although the site is hilly and undulating. Originally, based on the Digital Elevation Model (DEM) from ASTGTM2\_N01E104 which uses data from 2011, the elevation of the western part of the site ranges from 10 – 40 m amsl, while the eastern part ranges from 10 – 90 m amsl. Note that these contours as illustrated in **Figure 3.1** dated from 2011 and had been modified for previous plantation activities and the construction activities associated with the temporary RAPID Access Road.

The topography has been changed when JCorp developed the land for PIP. The site has been constructed as a pre-prepared platform with planned levels ranging from 10 to 14 m amsl.



#### 3.3 Geology

Based on the 2014 geological map of Peninsular Malaysia by the Department of Mineral and Geoscience, the PEC project area is characterised by Permian Sedimentary Rocks as part of Palaeozoic rocks that are distributed along east Johor (**Figure 3.2**). These sedimentary rocks consist of phyllite, slate, and shale with subordinate sandstone and schist. In this area, there is a prominent development of limestone and volcanic characteristics; mainly rhyolitic to andesitic in composition.

As it is situated in Pengerang Tuff (Surjono. SS. *et al*, 2004), the tuff and agglomerate with some lava are also present in this area where tuff and agglomerate are bedded as submarine pyroclastic products. This area may also part of unconformable deposited above the Mersing Formation which are clastic sediment (Murau Conglomerate Formation, Dohol Formation) and volcanic rocks (Sedili, Jasin and Pengerang volcanic). The Pengerang volcanic zone along Tanjung Belungkur shows pyroclastic flows forming thick bed succession. The clasts composed of lapili, lithic and re-sedimented of pyroclastic rocks. However, the Pengerang volcanic along Teluk Ramunia and Pengerang showing that they were produced by several volcanic activities such as intrusions, lava flow as well as pyroclastic flows.

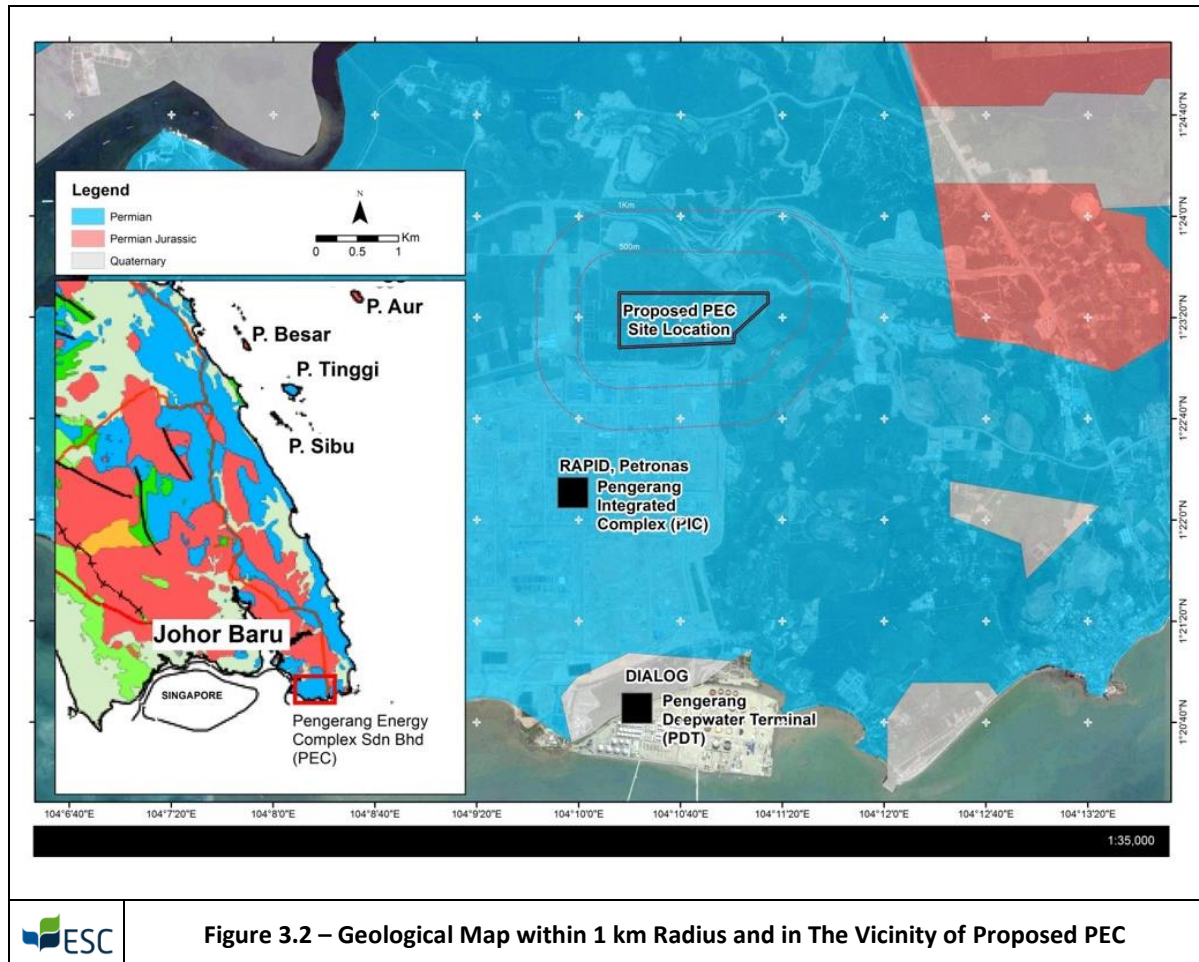


Figure 3.2 – Geological Map within 1 km Radius and in The Vicinity of Proposed PEC

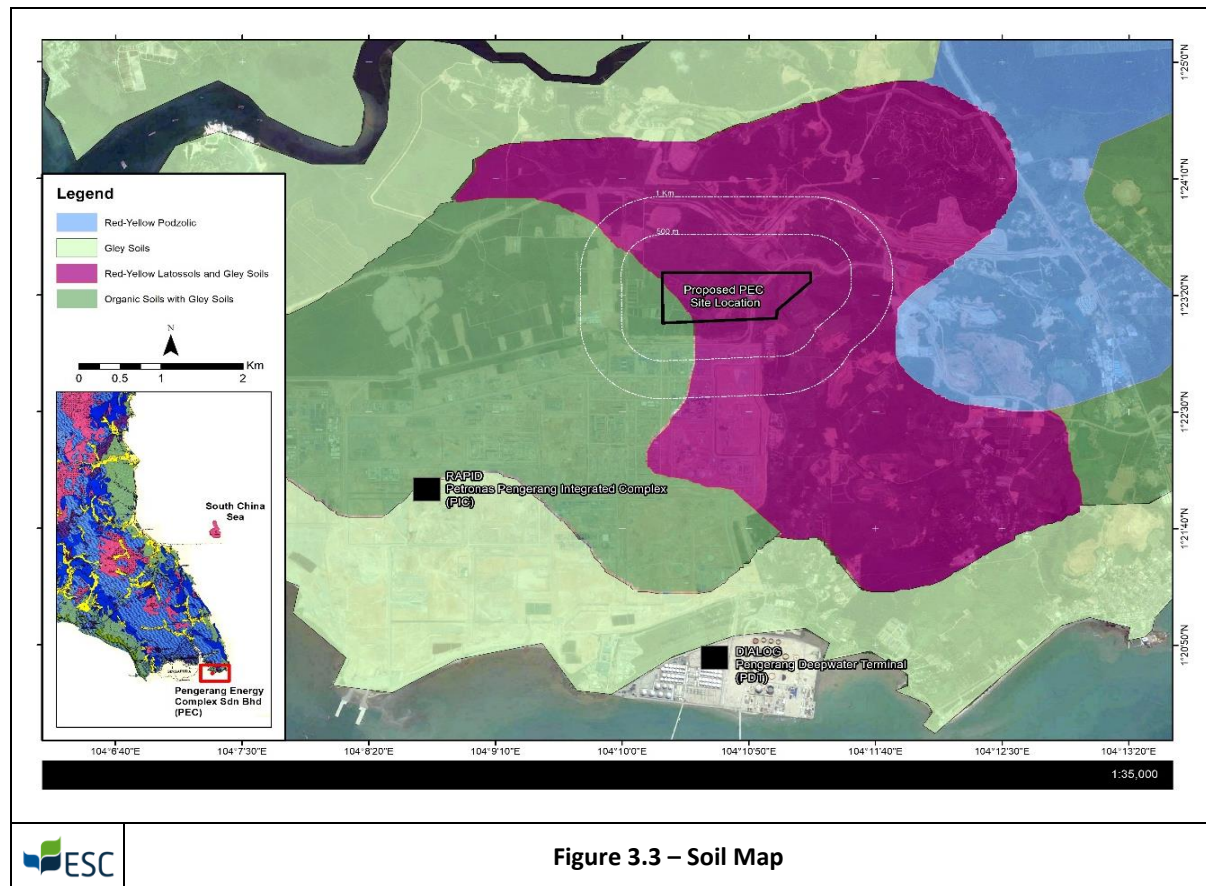
### 3.4 Soils

According to the EIA report for PIP, a soil investigation (SI) study was conducted at the PIP site by Ehwan Bakti Geotechnical & Engineering Service. The SI study was carried out from 16<sup>th</sup> November 2017 to 10<sup>th</sup> January 2018. A total of sixty-one (61) boreholes and twenty-eight (28) Mackintosh probes were conducted at the site. However, the EIA report only summarised the data from ten boreholes; no explanation was given on how the ten were chosen and why the rest were not summarised.

The depth of the 10 boreholes ranged from 7 to 21 mbgl. Generally, the top soil was silty sand with organic matter. Between the topsoil to 9 mbgl, the soil was stiff and made up mostly of sand and silt. Between 9 to 21 mbgl, the soil was dense with high plasticity.

Based on the soil map, the proposed site is located on 2 different soils. The western part of the proposed site is located in soils of the alluvial plains and low terraces with organic soils with Gley soils while the eastern part of the proposed site is located on soils of the intermediate and high terraces with red yellow loatosols and Gley soils on subrecent alluvium.





### 3.5 Landuse

#### 3.5.1 Historical Landuse

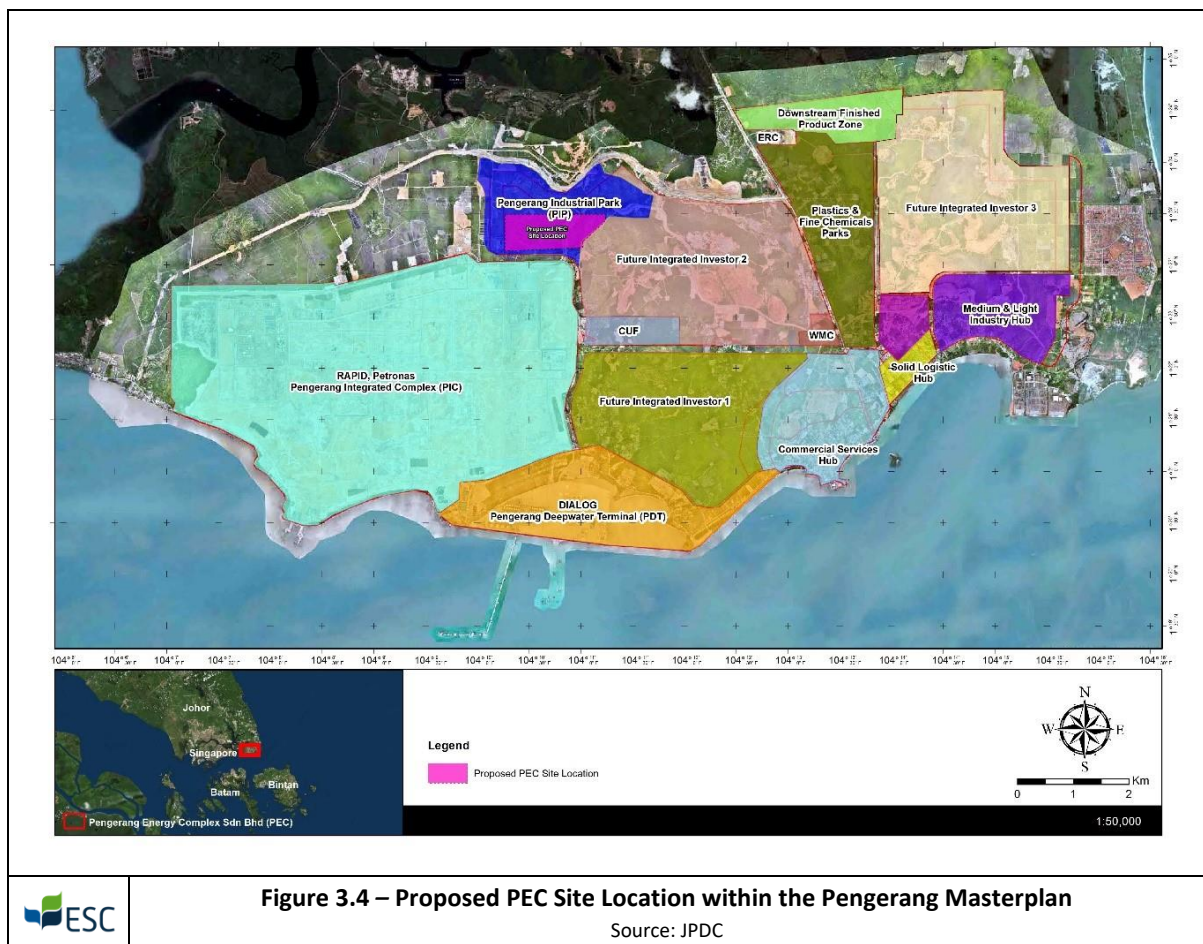
Information gathered during the site visits and from desktop studies has been combined with a review of historical Google Earth satellite images of the site and surrounds from 1984 (noting both images and detail are lacking before 2007) and indicate the following:

- **1984 – 1990:** Much of the site and immediate surroundings at higher elevations were covered with vegetation indicative of a logged-over area, with the exceptions being areas around the course of Sg. Lepau, where darker coloured vegetation suggests a riparian reserve around Sg. Lepau was spared from logging. Organised agricultural activity is not visible at the site;
- **1990:** The image shows much of the site, and areas 1 km north and south has been cleared of vegetation;
- **1993 -1994:** Within the site there are indications of organised farming and construction work to the north indicates construction work at the Seban Cove Resort (now known as Seban Mixed Development) and its Marina were well underway, with work on the golf course evident in 1994;
- **2004:** Tracks and farmed areas are visible at site. The Seban Cove Resort (now known as Seban Mixed Development), its marina and golf course appear operational. Extensive land clearing around Taman Rengit Jaya, proposed for bungalow development (but which reportedly achieved few sales), is visible;
- **2007:** The earliest high-resolution image of the site, shows land use on-site consistent with that observed during the ESI site visit, though at a more concerted level assumed, as currently, for vegetables on about 20% of the site with ponds visible both east and west of the farmed area and tracks entering and exiting the site at four locations. Structures (consistent with chicken farms) are now seen to the south east, but none within the site. Part of the PIC area appears to have been logged over;



- **2012:** Agricultural use continues in the same areas with additional land cleared towards the eastern site boundary. Reclamation of the PDT1 (complete) and PDT2 (incomplete) were observed;
- **2013 - 2015:** Land use at site appears little changed. Site clearance starts and is observed largely completed at both the PIC and Taman Bayu Damai (where resident directly impacted by the PIC were reportedly relocated) is visible. PDT1 appears complete and JPDC access and internal roads, inclusive PIPC ring-road, are seen underway;
- **2016 - 2018:** PIC under construction and new road alignments were cleared and under construction for PIPC Phase 1 development; and
- **2019 – 2021:** Google Earth image dated 25/10/2021 showed that the PIP platform is under development along with its associated ponds.

The land was owned by *Lembaga Kemajuan Johor Tenggara* (KEJORA) and previously registered as Lot PTD 2083 in Mukim Pengerang, Kota Tinggi, Johor. The land has been gazetted under Section 4 of the Land Acquisition Act 1960 by Johor Corporation for industrial development. Approval for land conversion from agriculture to industrial zoning was successfully obtained from the Pengerang Land Development and Planning Department in March 2019.



### 3.5.2 Sensitive Receptors

The sensitive receptors bordering the project site are identified as below:

#### Forest Reserve

The PIP is located less than 2.5 km (PEC less than 3 km) from the Sg Santi Forest Reserve, which is predominantly a mangrove forest. With the development of the PIPC, the major natural and biological resources remaining in the vicinity will be housed in this roughly 30 km<sup>2</sup> reserve, in its mangroves and estuarine waters/ intertidal mudflats and fisheries. These mangrove ecosystems are also now known to provide not just environmental but economic protection too.

#### Settlements

There are no large population centres near (< 5 km) to the PEC other than workers housing at the PIC. The nearest residential settlements/ occupied premises, comprise several small villages (Kg. Lepau being the closest), two resorts, one with residential units under development, and an ongoing residential/ commercial development.

The most sizeable settlements in the immediate area are outside the adopted 5 km EIA study boundary (though they may be close enough to be affected by, say air quality impacts from an industrial area the size of the PIPC); Kg. Sg. Rengit- by a few hundred meters, Pengerang, 7.3 km southwest of the PEC site and Taman Bayu Damai, a constructed settlement built to re-locate those directly impacted by the Phase 1 PIPC/ PIC/ RAPID to the east of the PIPC, near Tanjung Penyusup. Regardless, settlement in the area is not large, and were certainly not so prior to the influx of the tens of thousands of construction workers for the PIC, with the total reported resident population of Pengerang, Pantai Timur and Tanjung Surat sub districts at only 48,600 in 2010.

Some of the villages host temporary workers at the PIC and the resorts accommodate visiting professional staff to the PIC. Both developments actively marketing residential or commercial units are using the PIPC to spur sales and could be said to have been induced by the PIPC to develop or increase its scale.

- **Sebana Mixed Development** is believed to have the closest existing residential units to the PEC, alongside its own golf course situated 1.6 km north of the PEC. On the resort website their property is described as a *'1,200-acre resort township where residential and commercial components are cohesively planned alongside an exclusive private marina and an 18-hole golf course.'* Based on GE imagery, the resort was originally developed in the early 1990s, with all structures then  $\geq 2$  km from the PEC site location. Land clearance around and to the south of its golf course commenced in 2014 and the first of the first of its 'Golf Villas' completed by 2016 and hence it is likely some are occupied. The extent of land clearance, site preparation indicates the closest housing will be ~130m from the PIPC boundary (1.15 km from the PEC), when all cleared land under development is built on.
- **Kg Lepau** is the next nearest settlement confirmed settlement, some 2 km to the west of the site and north of the PIC.
- The 363 acres **Bukit Pelali** development, 2.5 km northeast is offering residential units; terraced and cluster homes together with condominiums; as well as commercial shop lots and offices.

**Table 3.1** shows the list of settlements within a 5 km radius from the proposed PEC site.

**Table 3.1: Identified Settlements Surrounding the Proposed PEC**

Settlement	Distance from Proposed Site	Status in 2020
Sebana Mixed Development	$\pm 1,200$ m (N)	Populated
Kg. Lepau	$\pm 2,000$ m (W)	Populated
Bukit Pelali Housing	$\pm 2,500$ m (NE)	Populated
Kg. Bukit Gelugor	$\pm 3,300$ m (NE)	Populated
Lakeview Terrace Resort	$\pm 3,500$ m (E)	Populated
Kg. Bukit Buluh	$\pm 3,500$ m (SE)	Populated
Kg. Sg Buntu	$\pm 4,700$ m (SE)	Populated

Settlement	Distance from Proposed Site	Status in 2020
Kg. Bukit Raja	± 4,800 m (S)	Populated

#### Public Amenities

**Table 3.2** shows the list of Public Amenities within a 5 km radius from the proposed PEC site.

**Table 3.2: Identified Public Amenities Surrounding the Proposed PEC**

Industries	Distance from Proposed Site	Status in 2020
SK Lepau	± 2000 m (W)	Operational
Masjid Kg Lepau	± 2000 m (W)	Operational
Klinik Perunding (H) Sg Rengit	± 3200 m (E)	Operational
Surau Al Mutasodiqin	± 3700 m (E)	Operational
SMK Tanjung Datuk & Asrama Pusat dan Rumah Guru	± 4100 m (S)	Closed
SJK (C) Yok Poon	± 5000 m (SE)	Operational
SK. Sg Rengit	± 5000 m (SE)	Operational
Surau Al Jamaliah	± 5000 m (E)	Operational
Surau Kg. Sg. Buntu	± 5000 m (E)	Operational
Chinese Temple	± 5000 m (SE)	Operational
Pengerang Presbyterian Church	> 5000 m (SE)	Operational
Sekolah Agama Sg. Rengit	> 5000 m (SE)	Operational
Sri Muneswaran Temple	> 5000 m (SE)	Operational
Bao An Gong Temple	> 5000 m (SE)	Operational
Ma-Zhu Temple	> 5000 m (SE)	Operational
Masjid Kamat	> 5000 m (SE)	Operational

### 3.5.3 Non-Sensitive Receptors

PEC is surrounded by other receptors including the industries and trades such as Industrial Land Use in PIPC Phase 1 (PIPC facility, the Dialog Terminal at the PDT and RAPID supporting facilities).

## 3.6 Hydrology & Hydrogeology

### 3.6.1 Hydrology

Based on remote sensing data sourced from the DEIA report for RAPID, the closest river to the proposed project site is Sg Lepau, located at the southern boundary of the site and flows in the Northeast direction into Sg Santi (**Figure 3.5**). Sg. Lepau is a tributary of Sg. Santi, which ultimately flows into the Straits of Singapore, to the south. Other tributaries in Sg Santi include Sg Sebina, Sg Pelantar, and Sg Jelutong.

The site is located with the Sg. Lepau sub-catchment, which is approximately 12 km<sup>2</sup> in size. Sg Lepau is part of the Sg. Santi river basin, which comprise a total area of 137 km<sup>2</sup>, and flows to the southern boundary of the site and exits west and northwest and flows northwest before draining to mangroves and Sg Santi near its estuary and on to the Singapore Strait. Sg. Santi and Sg. Lepau are influenced by tidal effects.

Kampung (Kg) Lepau is the nearest residential area, situated approximately 3 km northwest of the site. Based on site observations, locals in Kg. Lepau do not use the river water as a source of potable water as the village is provided with city water supply. According to locals, there are several aquaculture farms along Sg. Santi.

According to research studied on the conservation of Sg Santi, the river is covered by mangrove forests along the river bank of Sg Santi and Sg Sebana. The same has been reported in the RAPID DEIA report however, the extent of degradation of the mangrove forest has not been assessed past the RAPID and Sebana Mixed Development projects.



There are no water intake points or water treatment plants located along Sg. Lepau or Sg. Santi. The nearest water intake point to the project site is located at the Sg Lebam water treatment plant ( $1^{\circ} 32' 30''\text{N}$ ,  $104^{\circ}12'13''\text{E}$ ) approximately 17.3 km northeast of the project site in another river catchment.

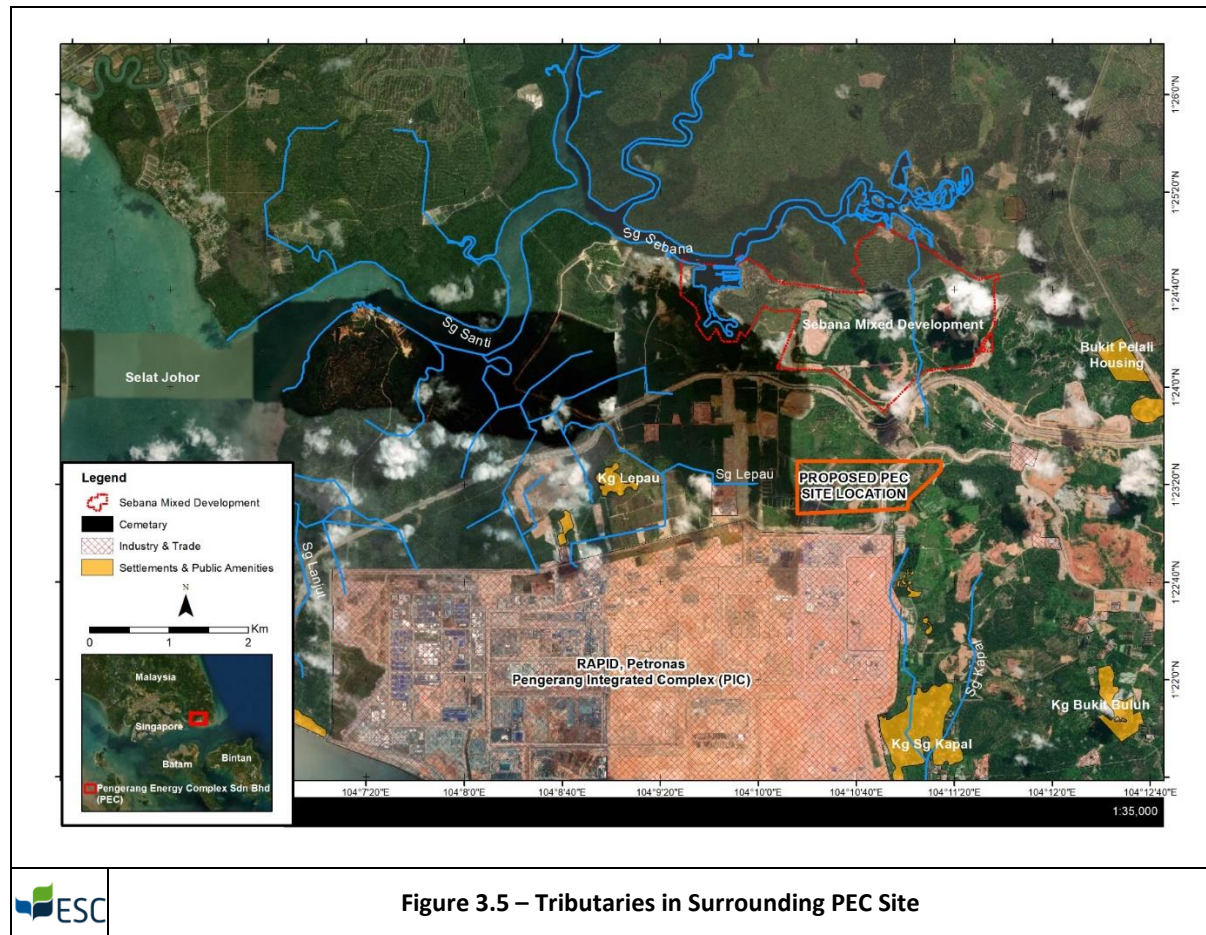


Figure 3.5 – Tributaries in Surrounding PEC Site

### 3.6.2 Hydrogeology

Groundwater quality plays a vital part in developing a healthy environment as it is one of the natural sources of fresh water. Almost all areas of Pengerang, including the proposed project site, are overlaid on a high aquifer region (**Figure 3.6**). Based on the Hydrogeological Map of Johor, recorded by the Mineral and Geoscience Department of Malaysia in 2008, no groundwater abstraction or monitoring wells are installed in the areas of Pengerang. No groundwater usage was observed in the nearby residential areas during the site visit in 2018.

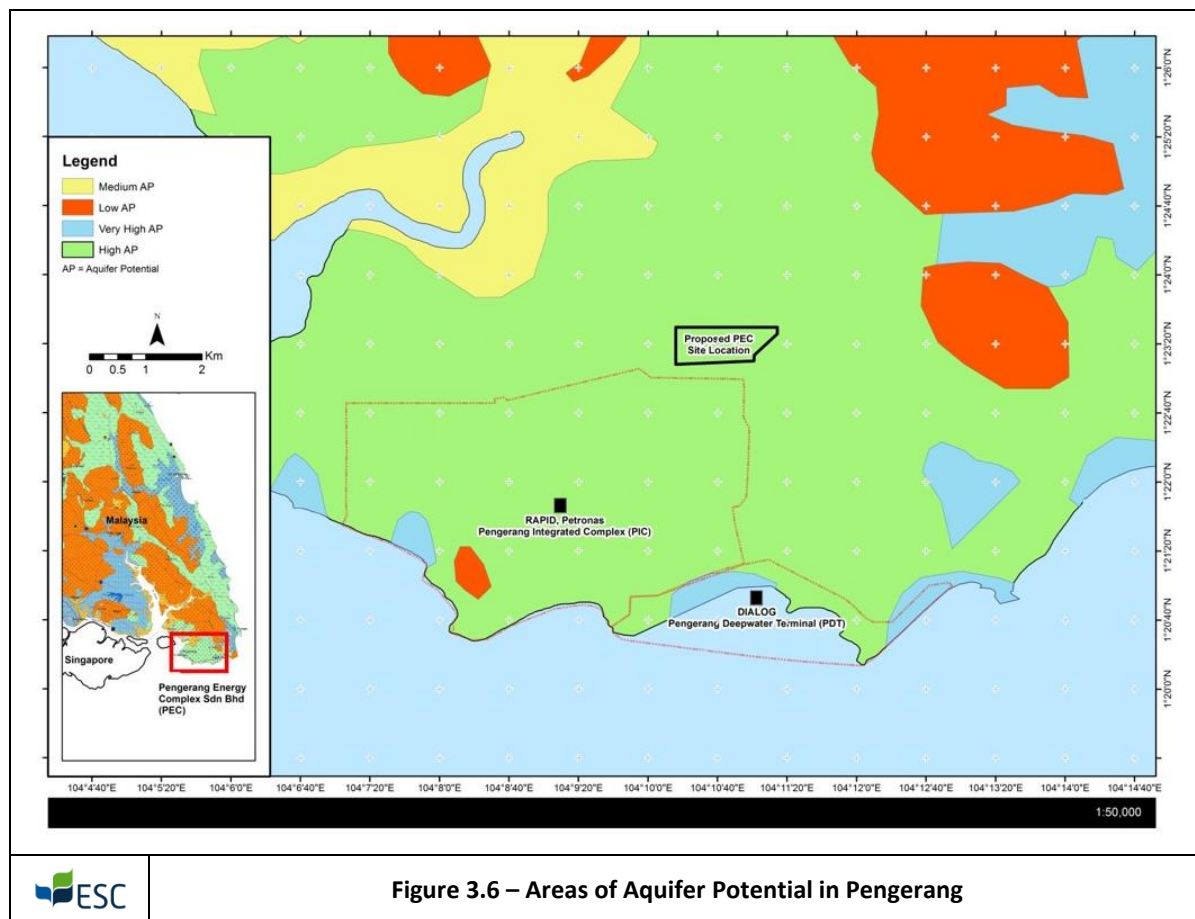


Figure 3.6 – Areas of Aquifer Potential in Pengerang

### 3.7 Climate and Meteorological Conditions

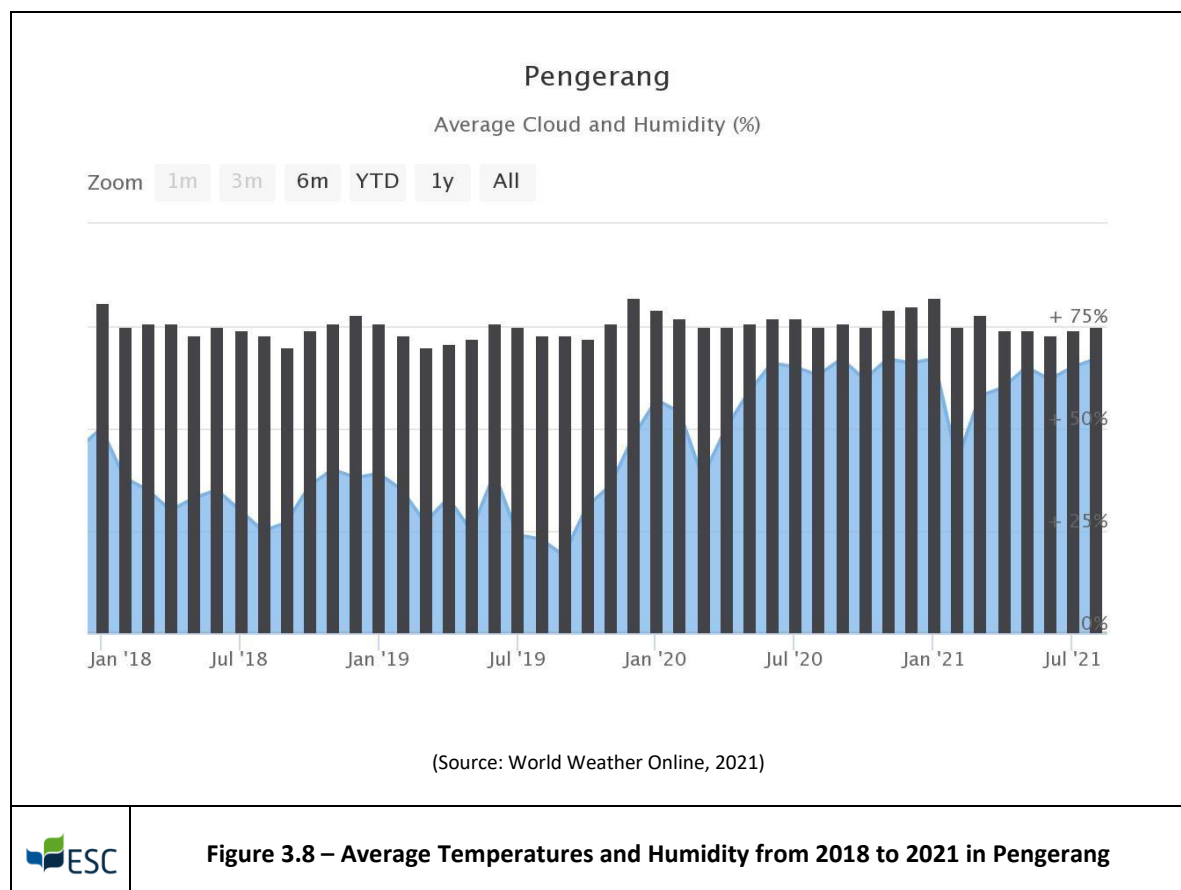
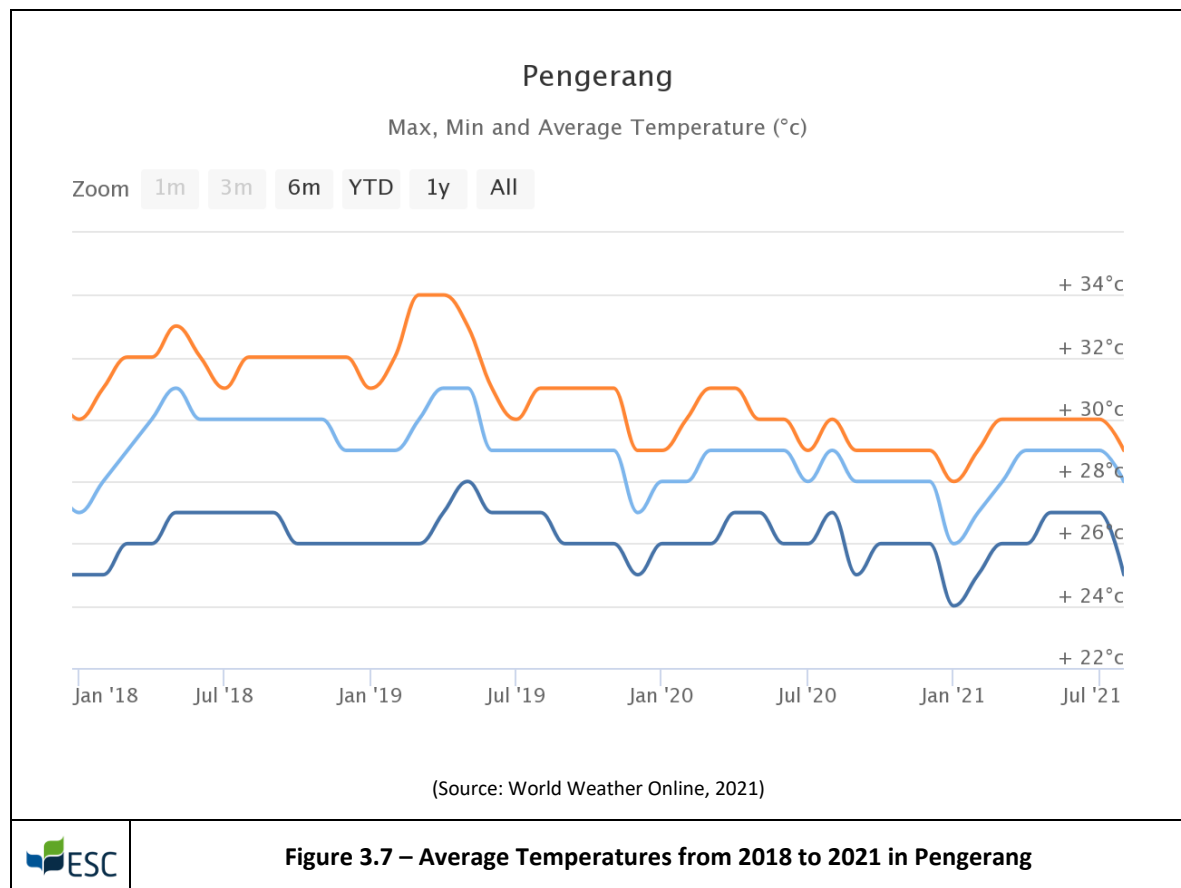
Data for the annual rainfall, temperatures and humidity were extracted from a secondary source, i.e., World Weather Online.

#### 3.7.1 Temperature and Humidity

Temperature trends from 2018 - 2021 illustrated in **Figure 3.7** below show average temperatures of the Pengerang Sub-district ranging from a minimum of 25°C (2018) to a maximum of 30°C (2021). Further analysis of the graph shows a repeated trend of decrease in temperature from the months of October to January.

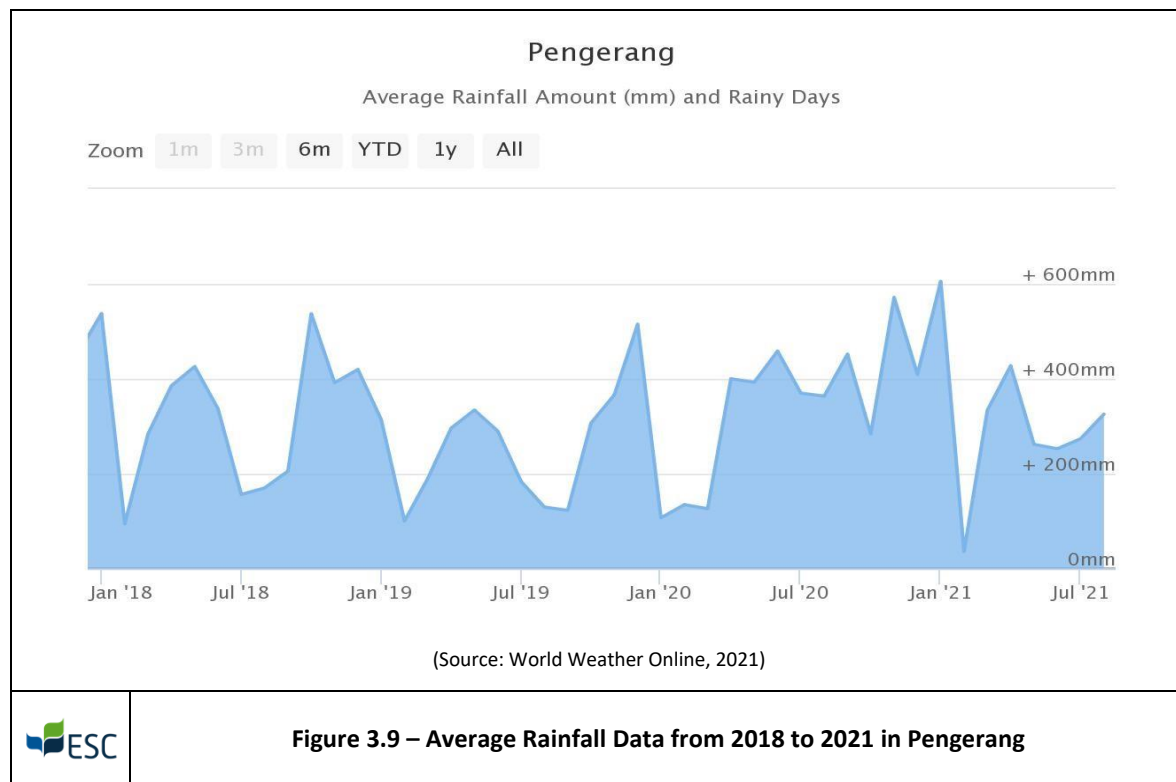
Change in temperature is relative to the change in humidity. As seen in **Figure 3.8** the average humidity ranges from a minimum of 73% (2018) to a maximum of 82% (2021). The graph below shows similar trends to that of the temperature as mentioned above.





### 3.7.2 Rainfall

During the period of 2018 to 2021, the rainfall data showed that the average annual rainfall at 421 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 January 2021 at a level of 605.2 mm.



### 3.8 Air Quality

The Department of Environment (DoE) monitors ambient air condition throughout Johor 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.

According to the Environmental Quality Report (2019) by the DoE, the Pengerang monitoring station have reported recording 111 days of good air quality index throughout the year. The majority air quality index recorded in Pengerang in the year of 2019 occurred to be moderate by 250 days was recorded and four (4) days were recorded as unhealthy air quality.

## 4 BASELINE FLORA AND FAUNA ASSESSMENT

### 4.1 Flora Assessment

Flora assessment was conducted at nine (9) sampling sites within 5km radius from the project (PEC) boundary. There are seven (7) different zones within the study area namely Agriculture Zone, Industrial Zone, Forest Reserve Zone, Trade and Services Zone, Quarry Zone, Utility Zone, and Settlements Zone. Detailed of sampling sites are described in **Table 4.1** and **Figure 4.1**. Flora survey was conducted using direct observation by analysing trees' leaf, bark, flower and fruit structure, odor or coloration at sampling sites. Since mangrove areas are not accessible by foot, a boat has been used to observed flora along Sg Sebina, Sg Sebana, Sg Santi and Sg Jelutong.

**Table 4.1: Sampling sites' location for flora assessment located within 5km radius from project boundary in Pengerang**

No	Sampling Site	Sampling ID	Coordinate
1	Sg Santi	Sg Santi	1°24'40.0"N 104°07'23.0"E
2	Sg Sebina	Sg Sebina	1°24'58.4"N 104°09'57.6"E
3	Sg Jelutong	Sg Jelutong	1°25'10.6"N 104°09'2.9"E
4	Sg Lepau	Sg Lepau	1°24'11.2"N 104°08'15.9"E
5	Ramunia	Swampy 1	1°22'50.5"N 104°14'24.7"E
6	Sebana Cove Fire and Rescue Station	Swampy 2	1°24'38.6"N 104°12'55.1"E
7	Kg Lepau (Swampy 3)	Swampy 3	1°24'02.1"N 104°09'35.5"E
8	Persiaran Flora, Sebana Cove- Desa Selatan	Forest 2 (F2)	1°24'10.6"N 104°11'12.9"E
9	Persiaran Flora, Sebana Cove- Desa Selatan	Forest 1 (F1)	1°23'56.8"N 104°11'36.9"E



Figure 4.1 – Sampling sites for flora survey in Pengerang

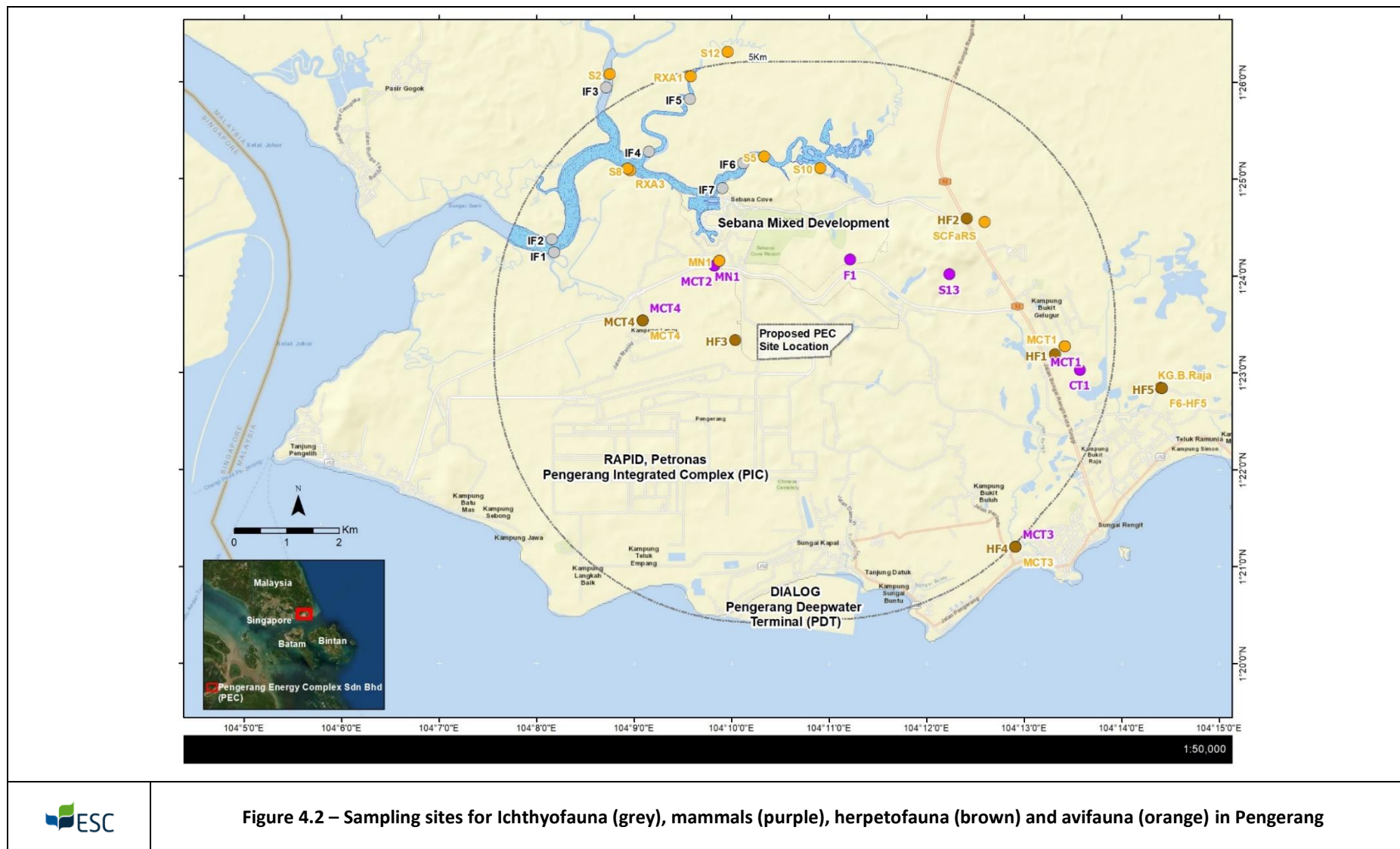
## 4.2 Fauna Assessment

A total of 36 sampling sites were selected to assessed fauna within 5km from project boundary. Details of sampling sites are shown in **Table 4.2** and is further illustrate in **Figure 4.2**.

**Table 4.2: Sampling sites' location for fauna assessment located within 5km radius from project boundary in Pengerang.**

No	Survey	Sampling sites	Site Coordinate	Sampling ID
1	Mammal	Kg Bukit Gelugor (Agriculture land-forest)	1°23'16.2"N 104°13'25.0"E	MCT1
2			1°23'1.8"N 104°13'34.4"E	CT1
3		Desa Selatan (Southern Village) (settlement-urban)	1°24'06.1"N 104°09'49.4"E	MCT2
4			1°24'09.1"N 104°09'52.5"E	MN1
5		Sg Kapal (Agriculture land-mangrove)	1°21'12.1"N 104°12'54.8"E	MCT3
6		Kg Lepau (settlements-rural)	1°23'32.2"N 104°09'05.2"E	MCT4
7		Bukit Pelali (agriculture land)	1°24'00.9"N 104°12'14.2"E	S13
8		Persiaran Flora, Seban Cove- Desa Selatan (trade services area-forest)	1°24'10.0"N 104°11'13.1"E	F1
1	Avifauna	Kg Bukit Gelugor (agriculture land -forest)	1°23'16.2"N 104°13'25.0"E	MCT1
2		Sg Kapal (agriculture land-mangrove)	1°21'12.1"N 104°12'54.8"E	MCT3
3		Kg Lepau (settlements-rural)	1°23'32.2"N 104°09'05.2"E	MCT4
4		Desa Selatan (Southern Village) (settlement-urban)	1°24'09.1"N 104°09'52.5"E	MN1
5		Sg Santi (forest reserve-mangrove)	1°26'55.9"N 104°08'35.5"E	S1
6		Sg Santi - Sg Boyang (forest reserve-mangrove)	1°26'04.8"N 104°08'44.9"E	S2
7		Sg. Santi-Teluk Sengat- Seban Cove Resort (forest reserve-mangrove)	1°26'18.4"N 104°09'57.6"E	S12
8			1°26'03.3"N 104°09'35.0"E	RXA1
9		Near Jalan Kota Tinggi-Pengerang roundabout (settlements-swamp)	1°22'50.5"N 104°14'24.7"E	F6-HF5
10		Sg Sebina (Forest reserve-mangrove)	1°25'06.1"N 104°08'56.1"E	RXA3
11			1°25'05.2"N 104°08'57.5"E	S8
12			1°25'13.8"N 104°10'20.2"E	S5
13		Suria Seban Cove (Agriculture land-forest)	1°25'06.5"N 104°10'54.7"E	S10

No	Survey	Sampling sites	Site Coordinate	Sampling ID
14		Sebana Cove Fire and Rescue Station (agriculture land-swamp)	1°24'33.1"N 104°12'35.7"E	SCFaRS
15		Jalan Kg Punggal-Desaru (Settlements-forest)	1°22'50.7"N 104°14'24.0"E	KG.B.Raja
1	Ichthyofauna	Sg Sebana	1°24'14.4"N 104°08'10.8"E	IF1
2		Sg Lepau	1°24'22.5"N 104°08'09.3"E	IF2
3		Sg Jelutong	1°25'16.7"N 104°09'09.0"E	IF4
4			1°25'49.3"N 104°09'34.2"E	IF5
5		Sg Sebina	1°24'54.0"N 104°09'54.3"E	IF7
6			1°25'09.6"N 104°10'07.3"E	IF6
7		Sg Santi	1°25'56.4"N 104°08'42.8"E	IF3
1	Herpetofauna	Kg Bukit Gelugor (Agriculture land-forest)	1°23'11.2"N 104°13'19.0"E	HF1
2		Desa Selatan (Southern Village) (settlement-urban)	1°23'20.1"N 104°10'02.2"E	HF3
3		Sg Kapal (Agriculture land-mangrove)	1°21'12.1"N 104°12'54.8"E	HF4
4		Kg Lepau (settlements-rural)	1°23'32.2"N 104°09'05.2"E	MCT4
5		Sebana Cove Fire and Rescue Station (agriculture land-swamp)	1°24'35.5"N 104°12'24.7"E	HF2
6		Ramunia (settlements-swamp)	1°22'50.5"N 104°14'24.7"E	HF5





Three (3) types of method were used to survey mammals within project site namely Observation (OBS), Mist Netting (MN) and Camera Trapping (CT). The location of mammals' survey was shown in **Figure 4.3** below.



Observation of mammals was conducted either by walking, driving or boating during daytime from 8.30 am to 12 pm and from 3.30 pm to 7 pm. Two (2) types of observation were applied in this study. The first was direct observation and the second was indirect observation. Direct observation is the observation where the animal's figure is directly seen by the researcher while indirect observation, the presence of the animals is only based on scats, footprints, claw marks, odour or other evidence left by the animals (**Figure 4.4**) and by interviewing the locals. For direct observation, only photo of the animals was taken if possible while for indirect observation, the evidence samples or photos of their presence were taken if possible. For evidence that cannot be sampled like footprints and claw marks, photo with ruler or tools which have a standard measurement such as coin or pen were used as a comparison (**Figure 4.4**) (David, 2017).



**Figure 4.4 – Footprints left by wildlife as a proof for their existence in that area**

#### 4.2.1.2 Mist Net Method

Mist nets (MN) were left opened from 16 to 20 September 2021 and MN were checked every day around 7.00 am or 7.30 am. Bats that were trapped in the MN immediately using forceps, placed in cloth bags and brought home for identification and photo taking. Measurements of the bats such as their weight and, the length of the forearm (FA), tail (T), ear (E) and tibia (TB) were taken using an electronic balance and an electronic calliper respectively. The measurement taken is crucial for bat species identification (Muhammad Hafiz & Chong, 2011). Additional information of the bats such as sex, maturity, pregnancy, lactation or parasite infection was also reported to give an insight about the health status and population dynamics info of bats community in studied sites. After measurement and identification process, bats were given sugar syrup prior to replace loss of energy after being trapped during foraging at night and since the bats were only being released during dusk, so it is vital to give sugary water to the bats.



Size of Mist Net used during the sampling









Mist Net erected at Kg Bukit Gelugor



#### 4.2.1.3 Camera Trapping

Camera Trapping (CT) is the easiest passive sampling technique where less energy is used. Throughout the sampling, five (5) camera traps were set up at Kg Bukit Gelugor (two cameras), Desa Selatan (one camera), Kg Lepau (one camera) and Sg Kapal (one camera) (**Figure 4.6**). The sites were chosen based on several criteria namely near water bodies, near wildlife trail and far from human settlements. After the survey areas have been identified, the camera was tied on tree and the height from the ground ranging from 2.5 to 3 feet. The height of the camera is crucial for the camera to capture clear image of the animals. To attract animals come near the camera, baits were used. Baits were placed near the camera. During the sampling, two types of baits were used, salt and human leftovers. Since most of the animal needs Sodium Chloride (NaCl) to maintain their body function, salt was selected as the main bait due to its nature that can act as a universal attractant where many types of animals will be attracted to it. After the camera was on, it was left until the last day of the sampling. Mammals identification was done using several sources as a reference (Shepherd, & Shepherd, 2012; Francis, 2008; Payne, J., Francis & Phillipps, 2007; Kingston, et al., 2006).



 <p>First camera trap was set up at Kg Bukit Gelugor</p>	 <p>Second camera trap was set up at Kg Bukit Gelugor</p>
 <p>Camera trap was set up at Desa Selatan</p>	 <p>Camera trap was set up at Kg Lepau</p>
 <p>Camera trap set up at Sg Kapal</p>	
	<p><b>Figure 4.6 – Camera traps were tied up on a tree at sampling sites</b></p>

## 4.2.2 Avifauna Survey

There were two (2) types of method used in avifauna survey namely Observation (OBS) and Mist Netting (MN). Both methods are the most commonly used method by the researcher worldwide. The MN set up location for avifauna survey and bats survey are similar (**Figure 4.5**)

### 4.2.2.1 Observation Method

In this method, researcher had identified four (4) categories of birding sites namely; i) urban area, ii) rural area, iii) forest area and iv) mangrove area (**Figure 4.7**). Observation method requires researchers to walk along the trail and boating along the river to observe the avifauna starting from 7.30am until 11.30am and between 4pm to 7pm during sampling period. This time was chosen due to the behaviour of birds to forage within this time range will return to their nest before dusk. Birding process was observed by using a binocular to locate the birds' location and the camera to capture the birds' photo.

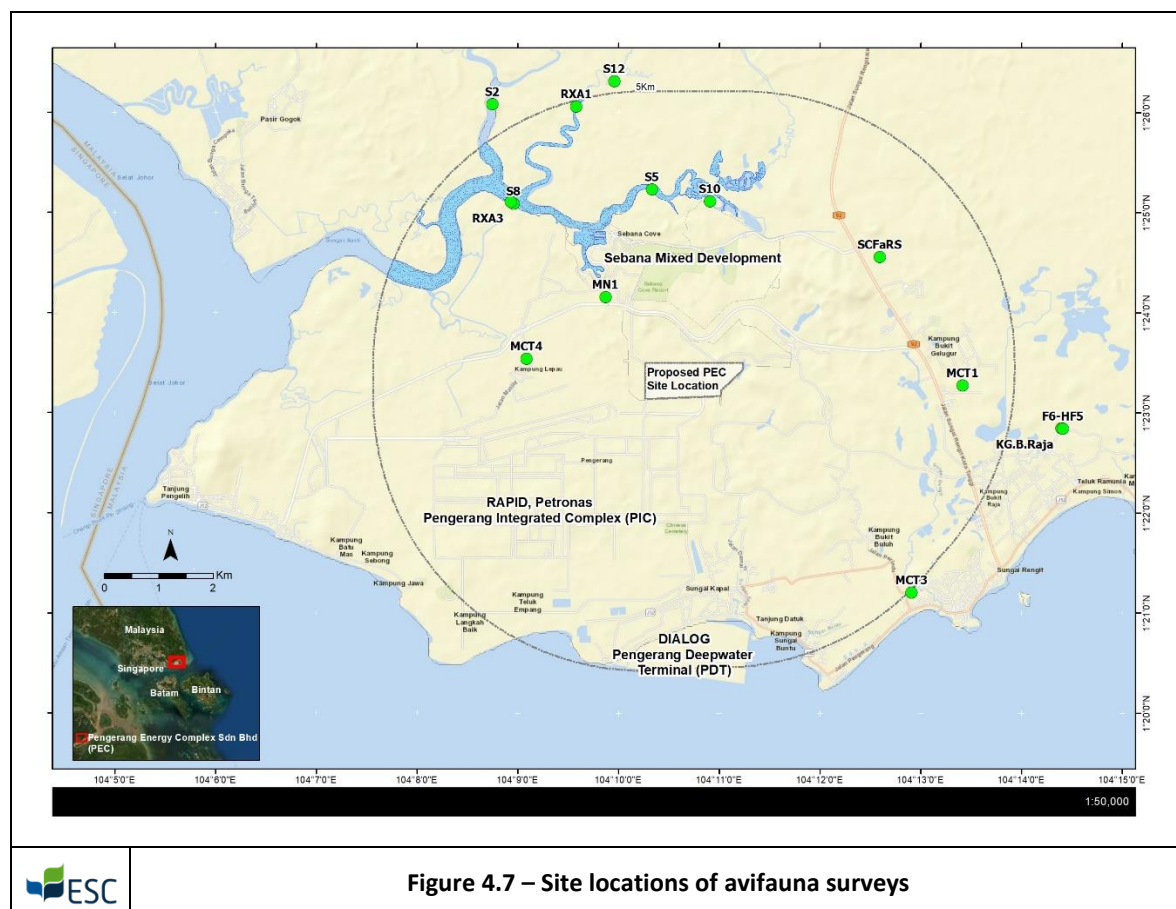


Figure 4.7 – Site locations of avifauna surveys

### 4.2.2.2 Mist Net Method

The sites for Mist Nets (MN) were chosen near forest fringe, water bodies, tree with fruits or flower. MN were left opened from 16 to 20 September 2021. For MN, five mist nets with 9m length, 4m height and 2.5cm mesh size were used. A single MN was erected at Kg Bukit Gelugor (MCT1), Sg Kapal (MC3) and Kg Lepau (MCT4) while two MN were erected at Desa Selatan (MCT2 and MN1) (**Figure 4.5**).

The MN placed at site locations were checked from 7.30am to 12pm and from 4pm to 7pm. Trapped birds were released immediately using forceps and were placed in cloth bags and brought home for identification purposes and photo taking. Birds that were trapped in the morning were released immediately while birds trapped in late afternoon were released on the next day.



### 4.2.3 Ichthyofauna survey

Fish survey has been conducted at five (5) rivers within the project site namely Sg Sebana, Sg Lepau, Sg Jelutong, Sg Sebina and Sg Santi using Gill Nets (GN) (**Figure 4.8**). Based on the geomorphological conditions at proposed study sites, GN is the most suitable gear to be utilized at pool or river area where water is deep but the water flow is stagnant (Mohd-Azham and Singh, 2019; Zulkafli *et al.*, 2015).

A total of 16 GNs have been deployed where five (5) GNs were set up at Sg. Jelutong, five (5) GNs at Sg. Santi, three (3) GNs at Sg. Lepau, two (2) GNs at Sg. Sebina and one (1) GN at Sg. Sebana. Gill Nets (GN) with 45m length, 30m depth, 0.3mm twine and 70mm mesh size has been deployed and were left for whole night to trap fish in the river.

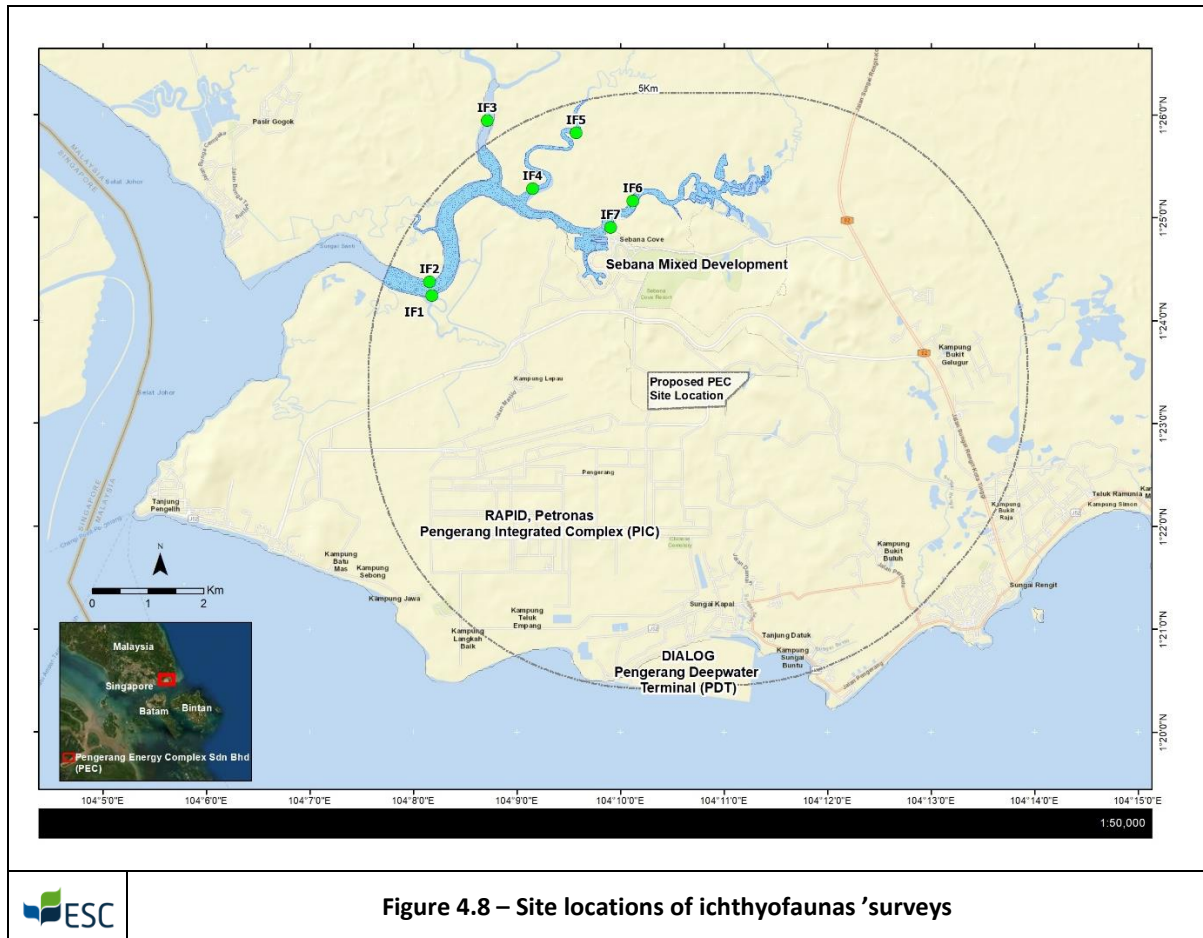
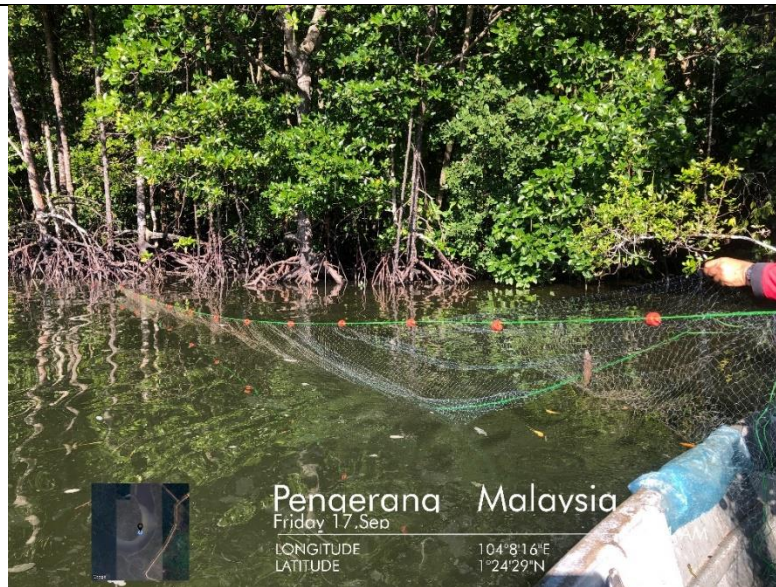


Figure 4.8 – Site locations of ichthyofaunas 'surveys



Gill Nets of 45m length was deployed at Sg Santi



Gill Nets of 45m length was deployed at Sg Lepau



Gill Nets of 45m length was deployed at Sg Sebina





Fish catches collected at Gill Nets



Fish captured were brought back for identification

**Figure 4.9 – Site locations of ichthyofaunas 'surveys**

#### 4.2.4 Herpetofauna Survey

Two types of survey method were used for herpetofauna survey namely Observation (OBS) and Catch by hand (CH). Five sampling sites were chosen (**Table 4.2**) near drainage, swampy area, puddles, creek, river or pond. Since herpetofauna is a cold-blooded animal, they cannot regulate their body temperature. Thus, to maintain their body temperature, some of them like reptilian must rely on water to reduce body heat and do basking (sunbathing to increase body heat). Furthermore, some herpetofauna such as frogs relies on water for reproduction purpose, for example to lay their eggs.

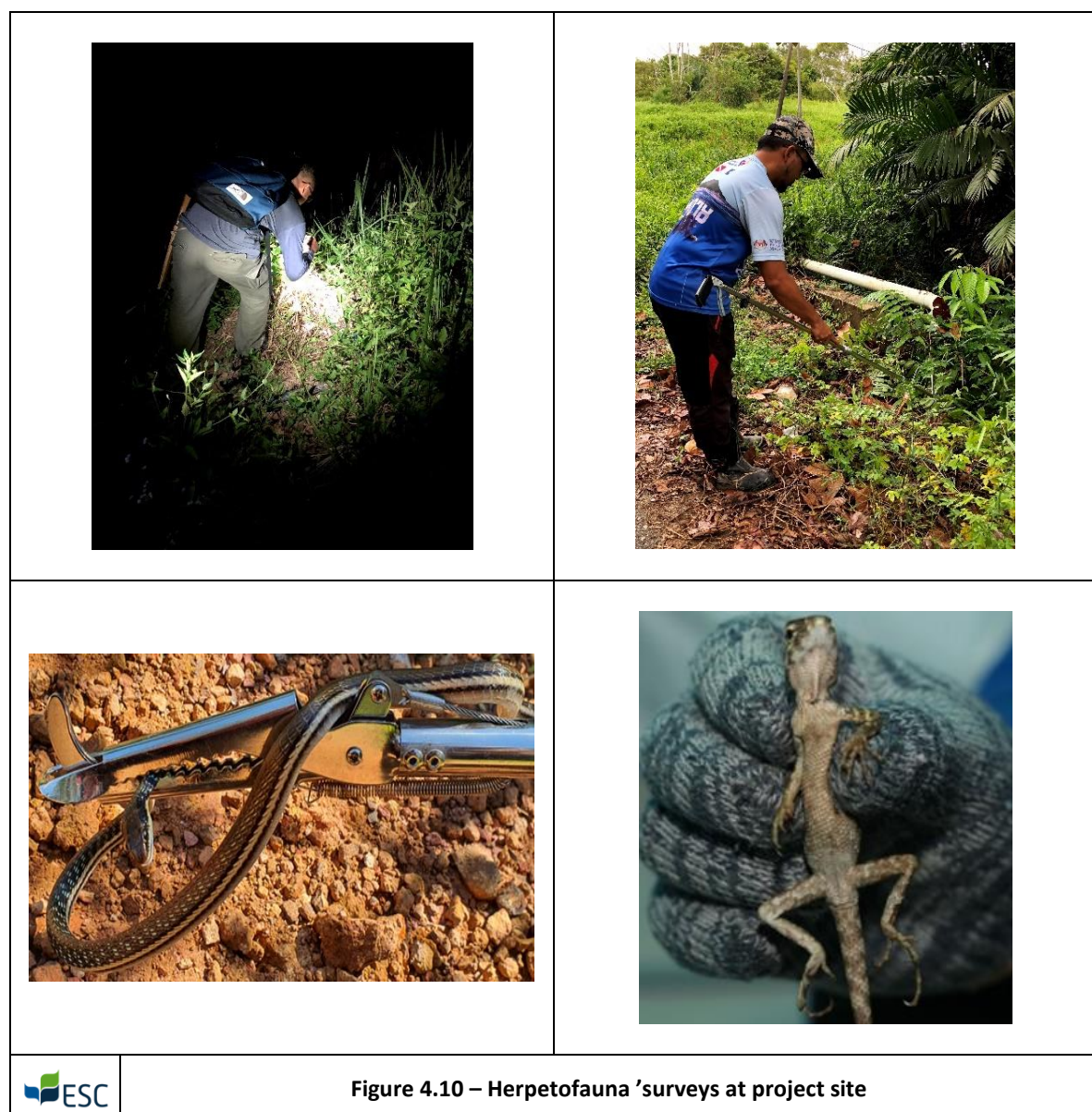
##### 4.2.4.1 Observation Method

Visual sampling surveys are considered one of the best ways to monitor populations of reptiles and amphibians in a given area. This methodology is extremely simple, requiring herpetologists to walk down a transect, a straight piece of trail around 1-2 km long and record every herp researchers found along the way. The survey was done during the day and during the night to capture the difference between diurnal and nocturnal species.

Herpetofauna sampling was conducted from 8.30 pm to 10 pm and from 7.30 am to 11 am. For visual sampling, researchers used headlamp or torchlight and walked extremely slowly to scanned the survey site for signs of life, often looking for bright spots called eyeshine, where animals tapetum (the back of the eye) reflects back at human. With each step, researchers scanned the forest floor, the undergrowth, branches because herps can be small and well hidden.

#### 4.2.4.2 Catch by Hand Method

Herpetofauna like a lizard, skink and small snakes makes their home at logs or boulders. So, these two places were inspected during the daytime. Any herpetofauna found was photographed and measured for identification. At night, the perfect areas to capture the herpetofauna were near water bodies, tree bark and on the leaves of the tree. Frogs, toads, geckos and snakes are commonly active in the aforementioned areas. Since some herpetofauna is poisonous, suitable equipment was used such as protective gloves and shoes, and snake catcher. Unidentified herpetofauna except for snakes will be brought back for further identification. All specimens were released immediately at the same spot where it was captured to decrease mortality rate. The number of individuals for each species was recorded to obtain species abundance and richness.



## 5 FINDINGS

### 5.1 Flora Assessment

Development in Pengerang has mainly occupied terrestrial area with little fragmented forests left while mangrove areas within the project site especially in Sg Santi Forest Reserve were remained untouched. A total of 163 species of flora belong to 122 genera and 67 families were recorded in this study (**Table 5.1**). Family Rhizophoraceae has the highest number of species recorded which are 12 species followed by Rubiaceae with eleven (11) species, Myrtaceae with nine (9) species, Fabaceae with eight (8) species, Calophyllaceae with seven (7) species, Cyperaceae six (6) species while Euphorbiaceae and Moraceae recorded five (5) species each. Four (4) families recorded four (4) species namely Apocynaceae, Fagaceae, Malvaceae and Poaceae meanwhile six (6) families recorded three (3) species including Acanthaceae, Anacardiaceae, Lamiaceae, Lauraceae, Melastomataceae and Phyllanthaceae. Thirteen (13) families have recorded two (2) species while the remaining 36 families have single species only. Photographs of flora species observed during the survey are provided in Appendix A.

The result shows that Rhizophoraceae, a type of mangrove trees was found to be the most diverse flora family. *Syzigium spp* recorded the highest number of mangrove species observed with 120 species in total. Even though mangrove trees distribution was found along Sg Santi Forest Reserve, it does not mean the mangrove ecosystem is healthy because most of the nearby forest has already been disturbed. According to Guo et al. (2018), low genetically diverse mangrove species will be facing the greatest challenge to thrive in the future. This situation could be attributed to limited gene flow and increased genetic drift among the population. Typically, genetic drift occurs in small populations, where infrequently-occurring alleles face a greater chance of being lost. Once it begins, genetic drift will continue until the involved allele is either lost by a population or is the only allele present at a particular gene locus within a population. Both possibilities decrease the genetic diversity of a population.

Genetic drift is common after a population experiences a population bottleneck. A population bottleneck arises when a significant number of individuals in a population die or are otherwise prevented from breeding, resulting in a drastic decrease in the size of the population. Genetic drift can result in the loss of rare alleles, and can decrease the size of the gene pool. Genetic drift can also cause a new population to be genetically distinct from its original population, which has led to the hypothesis that genetic drift plays a role in the evolution of new species.



Table 5.1: Flora Species Observed During Survey Conducted on 16-20th September 2021 in Pengerang

No.	Family	Genus	Species	Local/English name	Type	Conservation Status			Sampling sites								
						MyBIS	IUCN	GBIF	Sg Lepau	Sg. Santi	Sg Sebina	Sg Jelutong	Swampy 1	Swampy 2	Swampy 3	Forest 1	Forest 2
1	Acanthaceae	Avicennia	<i>A. alba</i>	Api-api putih	Tree	NE	LC	NRIP	/	/	/	/					
			<i>A. officinalis</i>	Api-api ludat	Tree		LC	NRIP	/	/	/	/					
			<i>A. rumphiana</i>	Api-api bulu	Tree	NE	LC	NRIP	/	/	/	/					
2	Anacardiaceae	Buchanania	<i>B. arborescens</i>	Otak udang tumpul	Tree	NE	NE	NRIP		/	/			/	/	/	
		Camptosperma	<i>C. coriaceum</i>	Terentang simpoh	Tree	NE	NE	NA						/			
		Swintonia	<i>S. schwenkii</i>	Merpauh	Tree	NE	NE	NRIP								/	
3	Annonaceae	Drepananthus	<i>D. carinatus</i>	Pisang-pisang	Tree	NE	NE	NRIP									/
		Xylopia	<i>X. ferruginea</i>	Jangkang	Tree	NE	NE	NA						/			
4	Anisophylleaceae	Anisophyllea	<i>A. disticha</i>	Raja berangkat	Tree	NE	NE	NRIP								/	
5	Apocynaceae	Alstonia	<i>A. angustifolia</i>	Pulai	Tree	NE	NE	NRIP									/
		Finlaysonia	<i>F. obovata</i>	Kalak kambing	Climber	NE	NE	NRIP		/							
		Tylophora	<i>T. flexuosa</i>	Akar banok	Climber		NE	NRIP			/						
		Willughbeia	<i>W. coriacea</i>	Kubul madu	Climber	NE	NE	NRIP								/	
6	Asteraceae	Melanthera	<i>M. biflora</i>	Serunai laut	Herb	NE	NE	NRIP	/	/							
		Pluchea	<i>P. indica</i>	Beluntas	Herb	NE	NE	NRIP			/						
7	Aquifoliaceae	Ilex	<i>I. cymosa</i>	Mensirah	Tree	NE	NE	NRIP	/	/				/	/		
8	Arecaceae	Calamus	<i>C. erinaceus</i>	Rotan bakau	Palm	NE	NE	NRIP	/		/						
		Eleiodoxa	<i>E. conferta</i>	Kelubi	Palm	NE	NE	NRIP						/			
		Korthalsia	<i>K. flagellaris</i>	Rotan udang	Palm	NE	NE	NRIP						/			

No.	Family	Genus	Species	Local/English name	Type	Conservation Status			Sampling sites								
						MyBIS	IUCN	GBIF	Sg Lepau	Sg. Santi	Sg Sebina	Sg Jelutong	Swampy 1	Swampy 2	Swampy 3	Forest 1	Forest 2
		Nypa	<i>N. fruticans</i>	Nipah	Herb	NE	LC	NRIP	/								
		Oncosperma	<i>O. tigillarum</i>	Nibung	Palm	NE	NE	NRIP		/				/			
9	Aizoaceae	Sesuvium	<i>S. portulacastrum</i>	Gelang pasir	Herb	NE	NE	NRIP	/		/						
10	Bignoniaceae	Dolichandrone	<i>D. spathacea</i>	Tui	Tree	NE	LC	NRIP			/						
11	Blechnaceae	Stenochlaena	<i>S. palustris</i>	Pucuk Miding	Fern	NE	NE	NRIP	/		/		/	/	/		
		Telmatoblechnum	<i>T. indicum</i>	Swamp fern	Fern	NE	NE	NRIP						/	/		
12	Bonenetiaceae	Ploiarium	<i>P. alternifolium</i>	Riang-riang	Small tree	NE	NE	NRIP			/			/	/		/
13	Burseracaae	Dacryodes	<i>D. rostrata</i>	Kedondong	Tree		NE	NRIP								/	/
14	Calophyllaceae	Calophyllum	<i>C. rupicola</i>	Bintangor	Tree	NE	NE	NA									/
			<i>C. rufigemmatum</i>	Bintangor	Tree	NE	NE	NA									/
			<i>C. sclerophyllum</i>	Bintangor jangkang	Tree	NE	NE	NA						/			
			<i>C. soulattri</i>	Bintangor bunut	Tree	NE	NE	NA								/	/
			<i>C. tetrapterum</i>	Bintangor	Tree	NE	NE	NRIP								/	
			<i>C. teysmannii</i>	Bintangor paya	Tree	NE	NE	NRIP						/		/	
			<i>C. wallichianum</i>	Bintangor	Tree	NE	NE	NA								/	
15	Cannabaceae	Trema	<i>T. tomentosa</i>	Mengkirai	Tree	NE	NE	NRIP					/		/		
		Rourea	<i>R. fulgens</i>	Akar	Climber	NE	NE	NRIP								/	/
16	Centroplacaceae	Bhesa	<i>B. paniculata</i>	Biku-biku	Tree	NE	LC	NRIP						/			
17	Chrysobalanaceae	Parastemon	<i>P. urophyllus</i>	Nyalas	Tree	NE	NE	NRIP									/
18	Combretaceae	Lumnitzera	<i>L. littorea</i>	Teruntum merah	Tree	NE	LC	NRIP	/	/	/	/					
		Terminalia	<i>T. catappa</i>	Ketapang	Tree	NE	NE	NRIP	/		/						

No.	Family	Genus	Species	Local/English name	Type	Conservation Status			Sampling sites								
						MyBIS	IUCN	GBIF	Sg Lepau	Sg. Santi	Sg Sebina	Sg Jelutong	Swampy 1	Swampy 2	Swampy 3	Forest 1	Forest 2
19	Clusiaceae	Garcinia	<i>G. nigrolineata</i>	Beruas	Tree	NE	NE	NRIP						/		/	
20	Cyperaceae	Cyperus	<i>C. javanicus</i>	Javanese flatsedge	Sedge	NE	NE	NRIP	/	/							
		Eleocharis	<i>E. ochrostachys</i>	Spike rush	Sedge	NE	NE	NRIP					/				
		Fimbristylis	<i>F. cymosa</i>	Seashore Fimbristylis	Sedge	NE	NE	NRIP	/	/	/						
		Lepironia	<i>L. articulata</i>	Purun	Sedge	NE	NE	NRIP					/	/	/		
		Scleria	<i>S. ciliaris</i>	Rumput segi tiga	Sedge	NE	NE	NRIP					/		/		
			<i>S. sumatrensis</i>	Beluncas	Sedge	NE	NE	NRIP					/				
21	Dennstaedtiaceae	Pteridium	<i>P. esculentum</i>	Bracken fern/Paku rotan	Fern	NE	NE	NRIP	/								
22	Dilleniaceae	Dillenia	<i>D. suffruticosa</i>	Simpoh air	Shrub	NE	NE	NRIP			/		/	/	/		
23	Ebenaceae	Diospyros	<i>D. lanceifolia</i>	Arang	Tree	NE	NE	NRIP								/	
24	Euphorbiaceae	Excoecaria	<i>E. agallocha</i>	Buta-buta	Tree	LC	LC	NRIP	/	/							
		Macaranga	<i>M. heynei</i>	Mahang api	Tree	NE	NE	NA					/	/		/	/
			<i>M. pruinosa</i>	Mahang putih paya	Tree	NE	NE	NA					/				
			<i>M. recurvata</i>	Mahang	Tree	NE	NE	NA					/				
		Pimelodendron	<i>P. griffithianum</i>	Perah ikan	Tree	NE	NE	NRIP								/	
25	Fabaceae	Acacia	<i>A. auriculiformis</i>	Akasia kuning	Tree	NE	NE	NRIP	/				/				
			<i>A. mangium</i>	Akasia daun lebar	Tree	NE	NE	NRIP	/	/	/		/		/		
		Aganope	<i>A. heptaphylla</i>	Omis-omis	Climber	NE	NE	NRIP	/								
		Dalbergia	<i>D. candenatensis</i>	Ketui kecil	Climber	NE	NE	NRIP	/								

No.	Family	Genus	Species	Local/English name	Type	Conservation Status			Sampling sites								
						MyBIS	IUCN	GBIF	Sg Lepau	Sg. Santi	Sg Sebina	Sg Jelutong	Swampy 1	Swampy 2	Swampy 3	Forest 1	Forest 2
		Derris	<i>D. trifoliata</i>	Ketui	Climber	NE	NE	NRIP	/	/	/						
		Intsia	<i>I. bijuga</i>	Ipil	Tree	VU	VU	NRIP	/								
		Leucaena	<i>L. leucocephala</i>	Petai belalang	Small tree	NE	NE	NRIP			/		/				
		Ormosia	<i>O. bancana</i>	Saga hutan	Tree	NE	NE	NRIP									/
26	Fagaceae	Castanopsis	<i>C. lucida</i>	Berangan babi	Tree	NE	NE	NRIP									/
			<i>C. megacarpa</i>	Berangan	Tree	NE	NE	NRIP							/		
		Lithocarpus	<i>L. conocarpus</i>	Mempening	Tree	NE	NE	NRIP								/	
			<i>L. ewyckii</i>	Mempening	Tree	NE	NE	NRIP									/
27	Flagellariaceae	Flagellaria	<i>F. indica</i>	Rotan dini	Climber	NE	NE	NRIP	/		/						
28	Gentianaceae	Fagraea	<i>F. racemosa</i>	Dada kura	Tree	NE	NE	NRIP									
29	Gleicheniaceae	Dicranopteris	<i>D. linearis</i>	Paku resam	Fern	NE	NE	NRIP	/		/		/	/	/	/	/
30	Goodeniaceae	Scaevola	<i>S. taccada</i>	Ambong-ambong	Shrub	NE	NE	NRIP			/						
31	Hydrocharitaceae	Enhalus	<i>E. acoroides</i>	Rumput laut/Sea grass	Herb	NE	LC	NRIP		/							
32	Hypericaceae	Cratoxylum	<i>C. arborescens</i>	Derum	Tree	NE	NE	NRIP						/			/
			<i>C. glaucum</i>	Mempat	Tree	NE	NE	NRIP							/		
33	Ixonanthaceae	Ixonanthes	<i>I. icosandra</i>	Pagar anak	Tree	NE	NE	NRIP								/	/
34	Lamiaceae	Clerodendron	<i>C. inerme</i>	Lampin budak	Shrub	NE	NE	NA	/	/	/						
		Premna	<i>P. serratifolia</i>	Buas-buas	Tree	NE	NE	NRIP	/	/	/		/				
		Vitex	<i>V. pinnata</i>	Leban	Tree	NE	NE	NRIP	/	/	/		/				/
35	Lauraceae	Cassytha	<i>C. filiformis</i>	Cemar batu	Parasite	NE	NE	NRIP	/		/		/				

No.	Family	Genus	Species	Local/English name	Type	Conservation Status			Sampling sites								
						MyBIS	IUCN	GBIF	Sg Lepau	Sg. Santi	Sg Sebina	Sg Jelutong	Swampy 1	Swampy 2	Swampy 3	Forest 1	Forest 2
		Lindera	<i>L. lucida</i>	Medang	Tree	NE	LC	NRIP									/
		Nothaphoebe	<i>N. coriacea</i>	Medang	Tree	NE	NE	NRIP						/			
36	Loganiaceae	Norrisia	<i>N. malaccensis</i>	Simpapait	Tree	NE	NE	NRIP									/
37	Lycopodiaceae	Lycopodiella	<i>L. cernua</i>	Sorok-sorok	Fern-allies	NE	NE	NRIP					/		/		
38	Lythraceae	Sonneratia	<i>S. alba</i>	Perepat	Tree	NE	LC	NRIP	/	/	/	/					
39	Malpiginaceae	Tristellateia	<i>T. australasiae</i>	Mek cemburu	Climber	NE	NE	NRIP	/								
40	Malvaceae	Commersonia	<i>C. bartramia</i>	Angkut-angkat	Tree	NE	NE	NRIP			/		/				
		Heritiera	<i>H. littoralis</i>	Dungun	Tree	NE	LC	NRIP		/	/						
			<i>H. simplicifolia</i>	Mengkulang	Tree	NE	NE	NRIP								/	
		Talipariti	<i>T. tiliaceum</i>	Baru-baru	Tree	NE	NE	NRIP	/	/	/						
41	Melastomataceae	Melastoma	<i>M. malabathricum</i>	Senduduk	Shrub	NE	NE	NRIP					/	/	/		
		Memecylon	<i>M. amplexicaule</i>	Nipis kulit	Tree	NE	NE	NRIP								/	
			<i>M. edule</i>	Delek air	Tree	NE	NE	NRIP			/						
42	Meliaceae	Xylocarpus	<i>X. moluccensis</i>	Nyireh batu	Tree	NE	LC	NRIP		/							
			<i>X. granatum</i>	Nyireh bunga	Tree	NE	LC	NRIP	/	/	/	/					
43	Moraceae	Artocarpus	<i>A. lakoocha</i>	Tampang wangi	Tree	NE	NE	NRIP									/
			<i>A. scortechinii</i>	Terap hitam	Tree	NE	NE	NRIP								/	
		Ficus	<i>F. grossularioides</i>	Ara	Small tree	NE	NE	NRIP					/	/		/	
			<i>F. fistulosa</i>	Ara	Tree	NE	NE	NRIP									
			<i>F. microcarpa</i>	Ara	Tree	NE	NE	NRIP	/								
44	Myricaceae	Myrica	<i>M. esculenta</i>	Telor cicak	Tree	NE	NE	NRIP									/



No.	Family	Genus	Species	Local/English name	Type	Conservation Status			Sampling sites									
						MyBIS	IUCN	GBIF	Sg Lepau	Sg. Santi	Sg Sebina	Sg Jelutong	Swampy 1	Swampy 2	Swampy 3	Forest 1	Forest 2	
45	Myrtaceae	Rhodamnia	<i>R. cineria</i>	Mempoyan	Tree	NE	NE	NA									/	/
		Syzygium	<i>S. antisepticum</i>	Kelat nenasi	Tree	NE	NE	NRIP					/	/	/			
			<i>S. caudatum</i>	Kelat	Tree	NE	NE	NRIP								/		
			<i>S. glabratum</i>	Kelat	Tree	NE	NE	NRIP								/		
			<i>S. grande</i>	Jambu laut	Tree	NE	NE	NRIP		/								
			<i>S. oblatum</i>	Kelat	Tree	NE	NE	NRIP		/	/			/	/			
			<i>S. muelleri</i>	Kelat	Tree	NE	NE	NRIP						/	/			
			<i>S. pustulatum</i>	Kelat	Tree	NE	NE	NRIP								/		
			<i>S. zeylanicum</i>	Kelat nasi	Tree	NE	NE	NRIP		/	/		/	/	/			
46	Myristicaceae	Horsfieldia	<i>H. wallichii</i>	Penarahan	Tree	NE	LC	NRIP						/				
47	Nepenthaceae	Nepenthes	<i>N. gracilis</i>	Periok kera	Climber	NE	LC	NRIP					/	/	/			
			<i>N. rafflesiana</i>	Periok kera	Climber	NE	LC	NRIP									/	
48	Ochnaceae	Brackenridgea	<i>B. hookeri</i>	Kayu luru	Tree	NE	LC	NRIP								/		
		Euthemis	<i>E. leucocarpa</i>	Pelawan beruk	Tree	LC	LC	NRIP								/		
49	Olacaceae	Ochanostachys	<i>O. amentacea</i>	Petaling	Tree	LC	DD	NRIP									/	
50	Oleandraceae	Nephrolepis	<i>N. auriculata</i>	Paku lipan	Fern	NE	NE	NRIP					/					
51	Pandanaaceae	Pandanus	<i>P. artocarpus</i>	Mengkuang paya	Shrub	NE	NE	NA					/	/				
			<i>P. tectorius</i>	Mengkuang laut	Shrub	NE	NE	NRIP	/		/							
52	Pentaphylacaceae	Adinandra	<i>A. dumosa</i>	Tetiup	Tree	NE	NE	NRIP/		/			/	/	/		/	
		Eurya	<i>E. acuminata</i>	Jirak	Tree	NE	NE	NRIP									/	
53	Polygalaceae	Xanthophyllum	<i>X. eurhynchum</i>	Minyak berok	Tree	NE	NE	NRIP								/		

No.	Family	Genus	Species	Local/English name	Type	Conservation Status			Sampling sites									
						MyBIS	IUCN	GBIF	Sg Lepau	Sg. Santi	Sg Sebina	Sg Jelutong	Swampy 1	Swampy 2	Swampy 3	Forest 1	Forest 2	
54	Phyllanthaceae	Breynia	<i>B. racemosa</i>	Hujan panas	Shrub	NE	NE	NRIP			/							
		Glochidion	<i>G. littorale</i>	Jambu kera	Shrub	NE	NE	NRIP	/						/			
			<i>G. superbum</i>	Tembagau gajah	Tree	NE	NE	NRIP									/	
55	Poaceae	Ischaemum	<i>I. muticum</i>	Rumput lipan	Herb	NE	NE	NRIP	/				/		/			
		Imperata	<i>I. cylindrica</i>	Lalang	Herb	NE	NE	NRIP					/					
		Pennisetum	<i>P. polystachion</i>	Napier grass	Herb	NE	NE	NRIP					/					
		Themeda	<i>T. villosa</i>	Riong	Herb	NE	NE	NRIP					/					
56	Pteridaceae	Acrostichum	<i>A. aureum</i>	Piai raya	Fern	NE	LC	NRIP	/	/	/	/						
			<i>A. speciosum</i>	Piai lasa	Fern	NE	LC	NRIP	/	/	/	/						
57	Rhizophoraceae	Bruguiera	<i>B. gymnorrhiza</i>	Tumu merah	Tree	NE	LC	NRIP	/	/	/	/						
			<i>B. cylindrica</i>	Berus-berus	Tree	NE	LC	NRIP	/	/	/	/						
			<i>B. hainesii</i>	Berus mata buaya	Tree	NE	CR	NRIP			/	/						
			<i>B. parviflora</i>	Lenggadai	Tree	NE	LC	NRIP	/	/	/	/						
			<i>B. sexangula</i>	Tumu putih	Tree	NE	LC	NRIP	/									
		Ceriops	<i>C. tagal</i>	Tengar	Tree	NE	LC	NRIP	/	/	/	/						
			<i>C. zippeliana</i>	Tengar	Small tree	NE	LC	NRIP	/	/	/	/						
		Gynotroches	<i>G. axillaris</i>	Mata keli	Tree	NE	NE	NRIP					/	/	/			
		Pellacalyx	<i>P. axillaris</i>	Membuluh	Tree	NE	NE	NRIP									/	/
			<i>Rhizophora annamalayana</i> ×	Bakau hibrid	Tree	NE	NE	NRIP	/	/	/	/						
		Rhizophora	<i>R. apiculata</i>	Bakau minyak	Tree	NE	LC	NRIP	/	/	/	/						

No.	Family	Genus	Species	Local/English name	Type	Conservation Status			Sampling sites								
						MyBIS	IUCN	GBIF	Sg Lepau	Sg. Santi	Sg Sebina	Sg Jelutong	Swampy 1	Swampy 2	Swampy 3	Forest 1	Forest 2
			<i>R. mucronata</i>	Bakau kurap	Tree	NE	LC	NRIP	/	/	/	/					
58	Rubiaceae	Diplospora	<i>D. malaccensis</i>	Gading-gading	Tree	NE	NE	NRIP								/	
		Gynochthodes	<i>G. sub lanceolata</i>	Akar lampai hitam	Climber	NE	NE	NRIP					/	/	/		
		Mussaendopsis	<i>M. beccariana</i>	Malabera	Tree	NE	NE	NRIP						/			
		Morinda	<i>M. citrifolia</i>	Mengkudu	Tree	NE	NE	NRIP	/								
			<i>M. elliptica</i>	Mengkudu kecil	Tree	NE	NE	NRIP		/	/						
			<i>M. umbellata</i>	Mengkudu akar	Climber	NE	NE	NA	/		/		/		/	/	/
		Oxyceros	<i>O. longiflorus</i>	Akar bedara laut	Climber	NE	NE	NRIP	/	/	/				/		
		Porterandia	<i>P. anisophyllea</i>	Tinjau belukar	Tree	NE	NE	NA									/
		Psychotria	<i>P. sarmentosa</i>	Akar jalar	Climber	NE	NE	NRIP		/	/						
		Scyphiphora	<i>S. hydrophyllacea</i>	Chengam	Small tree	NE	LC	NA	/	/	/	/					
		Timonius	<i>T. wallichianus</i>	Mengkong	Tree	NE	NE	NRIP								/	/
59	Sapindaceae	Allophylus	<i>A. cobbe</i>	Tit-berry	Shrub	NE	NE	NRIP	/	/	/						
		Guioa	<i>G. bijuga</i>	Senyamok	Tree	NE	NE	NRIP		/	/						/
60	Salicaceae	Scolopia	<i>S. macrophylla</i>	Melimau	Tree	NE	NE	NRIP	/								
61	Sapotaceae	Planchonella	<i>P. obovata</i> (R. Br.)pierre	Nenasi	Tree	NE	NE	NRIP	/	/	/						
62	Schizaeaceae	Lygodium	<i>L. microphyllum</i>	Paku ribu-ribu	Fern	NE	NE	NRIP			/		/	/	/		
63	Simaroubaceae	Eurycoma	<i>E. longifolia</i>	Tongkat Ali	Tree	NE	NE	NRIP								/	
64	Smilicaceae	Smilax	<i>S. setosa</i>	Akar banar	Climber	NE	NE	NRIP			/						
65	Verbenaceae	Stachytarpheta	<i>S. jamaicensis</i>	Selasih dandi	Shrub	NE	NE	NRIP	/								

No.	Family	Genus	Species	Local/English name	Type	Conservation Status			Sampling sites								
						MyBIS	IUCN	GBIF	Sg Lepau	Sg. Santi	Sg Sebina	Sg Jelutong	Swampy 1	Swampy 2	Swampy 3	Forest 1	Forest 2
66	Vitaceae	Cayratia	<i>C. trifolia</i>	Lakum	Climber	NE	NE	NRIP			/						
67	Podocarpaceae	Podocarpus	<i>P. polystachyus</i>	Podo laut	Tree	LC	VU	NRIP									

## Note:

- RIP : Recorded in Pengerang
- NRIP : Not Recorded in Pengerang
- VU : Vulnerable
- NE : Near Threatened
- LC : Least Concern
- NA : Not Available



**Table 5.2: Number of Species Recorded in Each Sampling Sites**

Total	Sampling Site								
	Sg Lepau	Sg Santi	Sg Sebina	Sg Jelutong	Swampy 1	Swampy 2	Swampy 3	Forest 1	Forest 2
No. of species	54	44	57	18	33	36	26	35	32
% of the total	33.1	27	35	11	20.2	22.1	16	21.5	19.6

As shown in **Table 5.2**, Sg. Sebina recorded the highest number of flora species identified with 57 species (35%) followed by Sg. Lepau with 54 species (33.1%), Sg. Santi with 44 species (27%), Swampy 2 with 36 species (22.1%), Forest 1 with 35 species (21.5%), Swampy 1 with 33 species (20.2%), Forest 2 with 32 species (19.6%) and Swampy 3 with 26 species (16%). Sg. Jelutong reported the least number of flora species observed during the survey with 18 species or 11% in total.

**Table 5.3: Types of Flora Observed During the Survey**

Data Category	Flora types									
	Tree	Climber	Shrub	Herb	Fern	Sedge	Small tree	Palm	Parasite	Fern-allies
	No. of species									
	101	17	10	9	8	6	6	4	1	1

Results in **Table 5.3**, shows that ten (10) types of flora were recorded namely tree, climber, shrub, herb, fern, sedge, small tree, palm, parasite and fern-allies. The dominant flora types recorded within the survey areas were trees with 101 species, followed by the climber (17 species), shrub (10 species), herb (9 species), fern (8 species), sedge and small tree with (6 species) each and palm (4 species). Other types of flora such as parasite and fern-allies recorded one (1) species each.

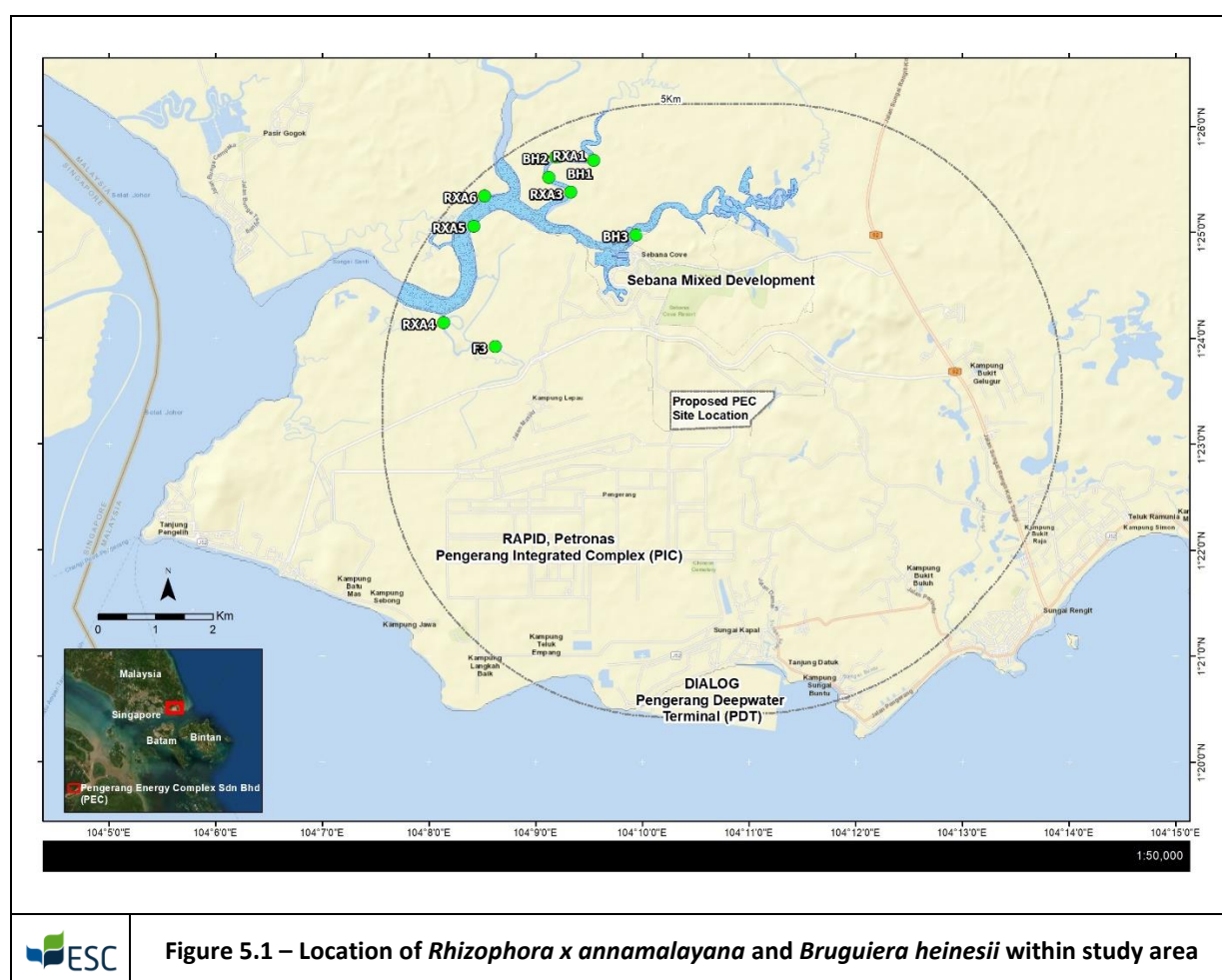
Study has identified two (2) mangrove species such as of *Rhizophora x annamalayana* and *Bruguiera heinesii* that can be considered as significant were observed in the area. *Rhizophora x annamalayana* is a species under genus *Rhizophora* where only seven (7) species of *Rhizophora* have been identified worldwide. Among that 7 species, three (3) species were identified as hybrid species where *Rhizophora x annamalayana* is one of them. *Rhizophora x annamalayana* is a hybrid between *Rhizophora apiculata* and *Rhizophora mucronate* (Setyawan et al., 2014). The hybridization process has occurred naturally (Setyawan et al., 2014) and is considered as rare and endangered species (Wan Juliana et al., 2014). In Sg Santi Forest Reserve, this species has been observed at Sg Lepau, Sg Santi and Sg Jelutong.

*Bruguiera heinesii* also known as *Berus Mata Buaya* is also considered as rare mangrove species. The population of this species is only 200 individuals worldwide. Based on IUCN, *Bruguiera heinesii* is categorized under Critically Endangered (CR) category. *B. heinesii* has been sighted along Sg Jelutong and Sg Sebina. This finding shows that Sg Santi Forest Reserve must be protected and preserved at all cost to ensure rare and endangered mangrove species will not extinct.

**Table 5.4** and **Figure 5.1** shows the location where of *Rhizophora x annamalayana* and *Bruguiera heinesii* were observed during the survey.

**Table 5.4: Observation of *Rhizophora x annamalayana* and *Bruguiera heinesii* During Survey**

No	Site Location	Location ID	Coordinate
1	Sg Jelutong	RXA1	1°25'40.4"N 104°09'32.7"E
2	Sg Jelutong	BH1	1°25'42.5"N 104°09'13.5"E
3	Sg Jelutong	BH2	1°25'42.4"N 104°09'11.3"E
4	Sg Jelutong	RXA2	1°25'30.7"N 104°09'07.5"E
5	Sg Jelutong	RXA3	1°25'22.4"N 104°09'19.9"E
6	Sg Sebina	BH3	1°24'58.2"N 104°09'56.6"E
7	Sg Lepau	F3	1°23'55.2"N 104°08'37.3"E
8	Sg Lepau	RXA4	1°24'08.5"N 104°08'08.2"E
9	Sg Santi	RXA5	1°25'03.2"N 104°08'25.2"E
10	Sg Santi	RXA6	1°25'20.3"N 104°08'31.4"E



## 5.2 Fauna Assessment

Table 5.5 shows a simplified results of faunal families, genera and species recorded during mammals' survey in Pengerang. A total of six (6) mammals families belonging to nine (9) genera and nine (9) species were recorded for this study (**Table 5.5**). Details of fauna species observed are further discussed in the next section while their photos are provided in Appendix C.

**Table 5.5: Faunal Diversity Recorded during Survey in Pengerang**

Classification	Survey category			
	Mammals	Avifauna	Ichthyofauna	Herpetofauna
Families	6	27	14	10
Genera	9	47	14	15
Species	9	55	14	17

**Table 5.6: Mammals Species Observed in Pengerang**

No	Family	Genus	Species	Common name	Local name	Methods	Conservation status		
							MyBIS	IUCN	GBIF
1	Cercopithecidae	<i>Macaca</i>	<i>M. fascicularis</i>	Long-tailed Macaque	Kera	OBS	VU	NT	NRIP
2		<i>Trachypithecus</i>	<i>T. obscurus</i>	Dusky Leaf Monkey	Lotong Bercelak	INT	EN	NT	NRIP
3	Mustelidae	<i>Lutrogale</i>	<i>L. perspicillata</i>	Smooth-coated Otter	Memerang Licin	OBS	VU	VU	NRIP
4	Suidae	<i>Sus</i>	<i>S. scrofa</i>	Wild Swine	Babi Hutan	OBS&CT	LC	LC	NRIP
5	Tupaiaidae	<i>Tupaia</i>	<i>T. glis</i>	Tree Shrew	Tupai Muncung Besar, Kencong	OBS	LC	LC	NRIP
6	Viverridae	<i>Paradoxurus</i>	<i>P. hermaphroditus</i>	Common Palm Civet	Musang Pandan	OBS	NE	LC	NRIP
7	Pteropodidae	<i>Cynopterus</i>	<i>C. brachyotis</i>	Lesser Short-nose Fruit Bat	Cecadu Pisang	MN	LC	LC	NRIP
8		<i>Macroglossus</i>	<i>M. sobrinus</i>	Greater Long-nosed Fruit Bat	Cecadu Madu Besar	MN	LC	LC	NRIP
9		<i>Eonycteris</i>	<i>E. spelaea</i>	Lesser Dawn Bat	Cecadu Gua	MN	LC	LC	NRIP

**Note:**

- OBS : Observation
- INT : Interview
- MN : Mist Netting
- CT : Camera Trapping
- RIP : Recorded in Pengerang
- NRIP : Not Recorded in Pengerang
- EN : Endangered
- VU : Vulnerable
- NT : Near Threatened
- LC : Least Concern
- NA : Not Available

### 5.2.1 Mammal

The number of bats caught using Mist Netting (MN) was 37 individuals in total. *Cynopterus brachyotis* was a dominant bat species recorded in this survey. This species is known to have an excellent adaptation ability to their surroundings and can adapt to human disturbance. There are two lineages of the species namely Forest and Sunda lineages (Kingston *et al.*, 2006). Both lineages have their own habitat preference where Forest lineage prefer primary and mature secondary forest while Sunda lineage prefer agricultural area. In this survey, only Sunda lineage was recorded that is in line with the environment conditions in Pengerang where forest has been degraded due to the changed of land use to make way for development, settlements or agriculture purposes.

Second highest number of bats recorded was *Eonycteris spelaea*. This bat species can travel up to 60km in a night for foraging (Kingston *et al.*, 2006). As a cave dweller, *E. spelaea* is known to live in a huge colony where thousands of individuals live together. However, only two (2) individuals were caught during the survey and might due to few possibilities. Firstly, there is no cave located within 60km radius from Pengerang. Secondly, the species population is almost locally extinct due to habitat loss or depleting of food resources. The whole population may have not totally extinct, but majority of them have migrated to new habitat and only a small group are left behind living in crevices or small caves. The other possibility was that researcher might have missed the main route used by the bat colony to forage.

Morphometric measurements and physical conditions for Pteropodidae family showed that forearm (FA) for *C. brachyotis* in this study was larger compared to bats observed in Kingston *et al.* (2006) (**Table 5.7**). Tibia (TB) and weight measured showed a similar measurement whereas, tail and ear measurements are larger when compared to Kingston *et al.* (2006).

Morphometric measurements for *E. spelaea* showed that forearm, tibia, ear and weight were all in line with Kingston *et al.* (2006) study except for tail measurement where majority of *E. spelaea* in study site has a very short tail. As for *M. sobrinu*, their forearm, tibia and tail measurement fall within measurement range for *M. sobrinus* recorded by Kingston *et al.* (2006) except for body weight and ear where the captured species had longer ear and heavier body weight. Similarities and differences of morphometric measurements showed that similar or different populations may share similar genetic code with unique appearance.

**Table 5.7: Morphometric measurements of bats in Pengerang**

Species	No of Individuals caught	FA (mm)	Tibia (mm)	Weight (g)	Tail (mm)	Ear (mm)
<i>Cynopterus brachyotis</i>	33	61.84 (57.04-68.73)	23.71 (20.87-25.95)	33 (24-40)	8.87 (6.15-12.89)	13.78 (12.09-16.44)
<i>Eonycteris spelaea</i>	2	68.36 (67.7-69.01)	32.21 (28.87-35.55)	55 (47-63)	10.14 (9.8-10.47)	16.2 (15-17.4)
<i>Macroglossus sobrinus</i>	2	41.88 (41-84-41.92)	17.82 (17.49-18.16)	12.5 (11-14)	3.27 (2.92-3.62)	13.06 (12.91-13.21)

### 5.2.2 Avifauna

A total of 375 individuals was successfully recorded in the avifauna survey (**Table 5.8**). The highest number of individuals recorded are 81 individuals with 21.6% (**Figure 5.3**) belongs to *Aplonis panayensis* also known as Asian Glossy Starling. The factors that contribute to its high number is because of their high adaptation ability. This bird naturally lives in subtropical, tropical lowland forest and mangrove forest but they can also live-in abandoned buildings and in urban area. This bird has the ability to adapt with changed environment and surrounding easily which makes them the most dominant species observed during the survey.



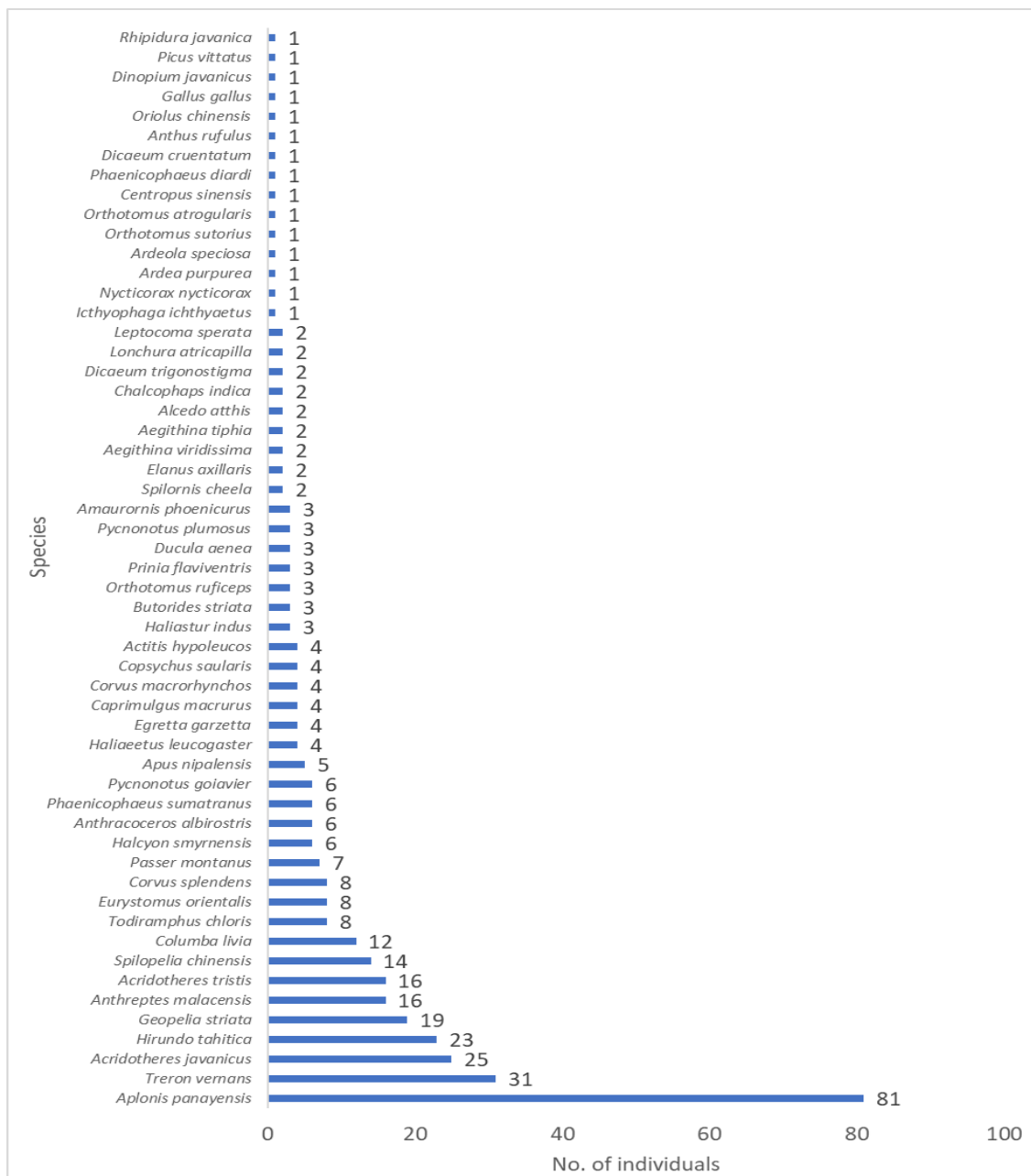


Figure 5.2 – Number of individuals recorded in avifauna survey

Table 5.8: Avifauna Species Observed in Pengerang

No.	Family	Genus	Scientific Name	Local Name	Methods	IUCN Status	Conservation Status			No. of individuals
							MyBIS	WCA 2010	GBIF	
1	Accipitridae	<i>Spilornis</i>	<i>S. cheela</i>	Crested Serpent-eagle	OBS	LC	LC	TP	NRIP	2
2		<i>Elanus</i>	<i>E. axillaris</i>	Black-shouldered Kite		LC	LC	TP	NRIP	2
3		<i>Haliastur</i>	<i>H. indus</i>	Brahminy Kite		LC	LC	TP	RIP	3
4		<i>Haliaeetus</i>	<i>H. leucogaster</i>	White-bellied Sea-eagle		LC	LC	TP	RIP	4
5		<i>Ichthyophaga</i>	<i>I. ichthyaetus</i>	Grey-headed Fish-eagle		NT	NE	TP	NRIP	1
6	Aegithinidae	<i>Aegithina</i>	<i>A. viridissima</i>	Green Iora		NT	NT	TP	NRIP	2
7			<i>A. tiphia</i>	Common Iora		LC	LC	TP	RIP	2
8	Alcedinidae	<i>Halcyon</i>	<i>H. smyrnensis</i>	White-throated Kingfisher		LC	LC	TP	RIP	6
9		<i>Alcedo</i>	<i>A. atthis</i>	Common Kingfisher	OBS&MN	LC	LC	TP	RIP	2
10		<i>Todiramphus</i>	<i>T. chloris</i>	Collared Kingfisher	OBS	LC	LC	TP	RIP	8
11	Apodidae	<i>Apus</i>	<i>A. nipalensis</i>	House Swift		LC	LC	TP	NRIP	5
12	Ardeidae	<i>Egretta</i>	<i>E. garzetta</i>	Little Egret		LC	LC	TP	RIP	4
13		<i>Butorides</i>	<i>B. striata</i>	Little Heron		LC	LC	TP	RIP	3
14		<i>Nycticorax</i>	<i>N. nycticorax</i>	Black-crown Night Heron		LC	LC	TP	NRIP	1
15		<i>Ardea</i>	<i>A. purpurea</i>	Purple Heron		LC	LC	TP	RIP	1
16		<i>Ardeola</i>	<i>A. speciosa</i>	Javan Pond Heron		LC	LC	TP	NRIP	1
1	Bucerotidae	<i>Anthracoceros</i>	<i>A. albirostris</i>	Oriental pied Hornbill		LC	LC	TP	RIP	6
18	Caprimulgidae	<i>Caprimulgus</i>	<i>C. macrurus</i>	Large-tailed Nightjar		LC	LC	TP	NRIP	4
19	Cisticolidae	<i>Orthotomus</i>	<i>O. ruficeps</i>	Ashy Tailorbird		LC	LC	TP	RIP	3
20			<i>O. sutorius</i>	Common Tailorbird		LC	LC	TP	RIP	1
21			<i>O. atrogularis</i>	Dark-necked Tailorbird		LC	LC	TP	NRIP	1

No.	Family	Genus	Scientific Name	Local Name	Methods	IUCN Status	Conservation Status			No. of individuals
							MyBIS	WCA 2010	GBIF	
22		<i>Prinia</i>	<i>P. flaviventris</i>	Yellow-bellied Prinia		LC	LC	TP	RIP	3
23	Columbidae	<i>Chalcophaps</i>	<i>C. indica</i>	Asian Emerald Dove		LC	LC	P	NRIP	2
24		<i>Ducula</i>	<i>D. aenea</i>	Green Imperial-pigeon		LC	LC	TP	NRIP	3
25		<i>Treron</i>	<i>T. vernans</i>	Pink-necked Green-pigeon		LC	LC	P	RIP	31
26		<i>Columba</i>	<i>C. livia</i>	Rock Pigeon		LC	LC	P	NRIP	12
27		<i>Spilopelia</i>	<i>S. chinensis</i>	Spotted Dove		LC	NE	NE	RIP	14
28		<i>Geopelia</i>	<i>G. striata</i>	Zebra Dove		LC	LC	NE	RIP	19
29	Coraciidae	<i>Eurystomus</i>	<i>E. orientalis</i>	Oriental Dollarbird		LC	LC	TP	RIP	8
30	Corvidae	<i>Corvus</i>	<i>C. splendens</i>	House Crow		LC	LC	NE	RIP	8
31			<i>C. macrorhynchos</i>	Large-billed Crow		LC	LC	NE	RIP	4
32	Cuculidae	<i>Centropus</i>	<i>C. sinensis</i>	Greater Coucal		LC	LC	TP	RIP	1
33		<i>Phaenicophaeus</i>	<i>P. diardi</i>	Black-bellied Malkoha		LC	NT	TP	NRIP	1
34			<i>P. sumatranus</i>	Chesnut-bellied Malkoha		NT	NT	TP	NRIP	6
35	Dicaeidae	<i>Dicaeum</i>	<i>D. cruentatum</i>	Scarlet-backed Flowerpecker		LC	LC	TP	RIP	1
36			<i>D. trigonostigma</i>	Orange-bellied Flowerpecker		LC	LC	TP	NRIP	2
37	Estrildidae	<i>Lonchura</i>	<i>L. atricapilla</i>	Chestnut Munia		LC	LC	NE	NRIP	2
38	Hirundinidae	<i>Hirundo</i>	<i>H. tahitica</i>	Pacific Swallow		LC	LC	TP	RIP	23
39	Motacillidae	<i>Anthus</i>	<i>A. rufulus</i>	Paddy filed Pipit		LC	LC	TP	RIP	1
40	Muscicapidae	<i>Copsychus</i>	<i>C. saularis</i>	Oriental Magpie-robin		LC	LC	P	NRIP	4
41	Nectariniidae	<i>Anthreptes</i>	<i>A. malacensis</i>	Brown-throated Sunbird	OBS&MN	LC	LC	TP	RIP	16
42		<i>Leptocoma</i>	<i>L. sperata</i>	Purple-throated Sunbird	OBS	LC	LC	TP	NRIP	2
43	Oriolidae	<i>Oriolus</i>	<i>O. chinensis</i>	Black-naped Oriole		LC	LC	TP	RIP	1

No.	Family	Genus	Scientific Name	Local Name	Methods	IUCN Status	Conservation Status			No. of individuals
							MyBIS	WCA 2010	GBIF	
44	Passeridae	<i>Passer</i>	<i>P. montanus</i>	Eurasian Tree Sparrow		LC	LC	NE	RIP	7
45	Phasianidae	<i>Gallus</i>	<i>G. gallus</i>	Red Junglefowl	OBS&CT	LC	LC	P	RIP	1
46	Picidae	<i>Dinopium</i>	<i>D. javanense</i>	Common Flameback	OBS	LC	LC	TP	NRIP	1
47		<i>Picus</i>	<i>P. vittatus</i>	Laced Woodpecker		LC	LC	TP	NRIP	1
48	Pycnonotidae	<i>Pycnonotus</i>	<i>P. goiavier</i>	Yellow-vented Bulbul		LC	LC	NE	RIP	6
49			<i>P. plumosus</i>	Olive-winged Bulbul	MN	LC	LC	TP	NRIP	3
50	Rallidae	<i>Amaurornis</i>	<i>A. phoenicurus</i>	White-breasted Waterhen	OBS	LC	LC	P	RIP	3
51	Rhipiduridae	<i>Rhipidura</i>	<i>R. javanica</i>	Malaysian Pied Fantail		LC	LC	TP	RIP	1
52	Scolopacidae	<i>Actitis</i>	<i>A. hypoleucos</i>	Common Sandpiper		LC	LC	TP	RIP	4
53	Sturnidae	<i>Aplonis</i>	<i>A. panayensis</i>	Asian Glossy Starling		LC	LC	NE	RIP	81
54		<i>Acridotheres</i>	<i>A. javanicus</i>	Javan Myna		VU	VU	NE	RIP	25
55			<i>A. tristis</i>	Common Myna		LC	LC	NE	RIP	16
Total										375

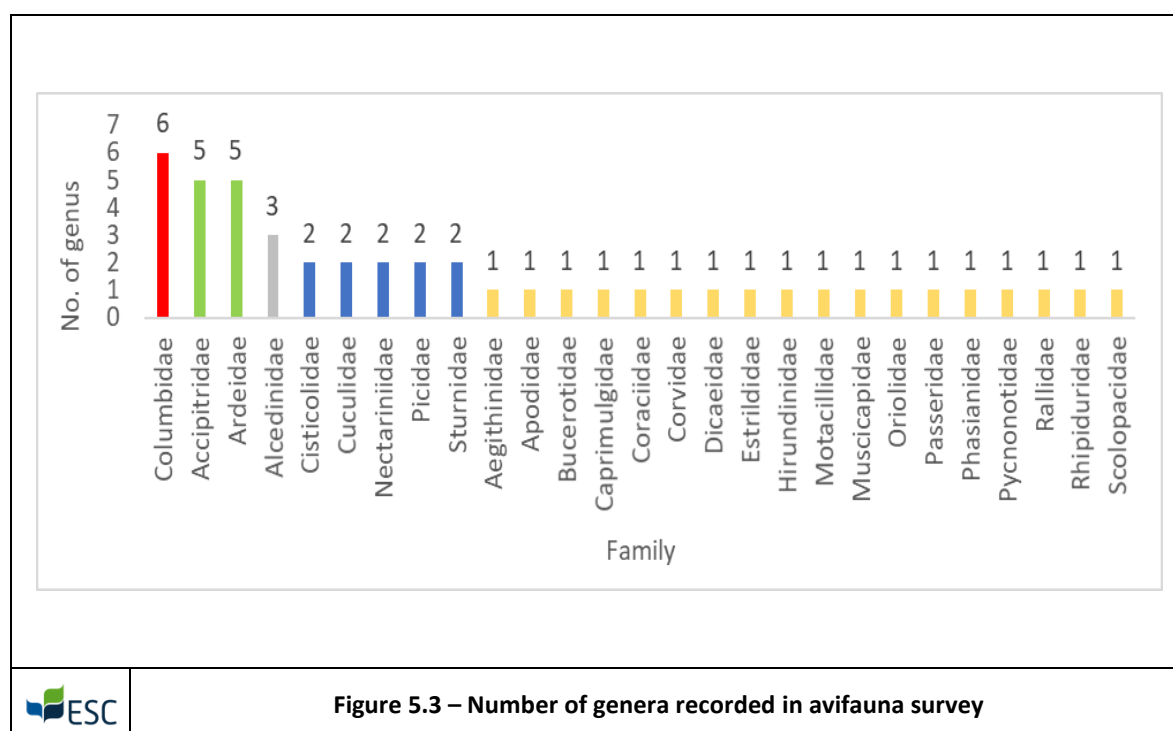
## Note:

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- NRIP : Not Recorded in Pengerang
- EN : Endangered
- VU : Vulnerable
- NT : Near Threatened
- LC : Least Concern
- NA : Not Available
- TP : Totally Protected

A total of 55 bird species from 27 families and 47 genera were reported in this survey (**Table 5.8**). Family Columbidae showed the highest number of genera recorded with six (6) genera (12.8%) followed by family Accipitridae and Ardeidae with five (5) genera (10.6%) each while other family only had 1-3 genus (**Figure 5.3**).

Family Columbidae is a bird family consisting of pigeons and doves. This family are widely distributed worldwide and have high ability to adapt different environments and habitats. Rock Dove (*Columba livia*) had the highest genera recorded for this family.

Meanwhile the least family spotted in survey sites was family Scolopacidae with 15 genera. There was no issue in food competition among different species which inhabit similar habitat because different beak features require different food source. Common Sandpiper is a migratory bird, the only species (4 individuals) observed in Scolopacidae family. It has been reported that southward migration will only occur during non-breeding seasons starting end of July and its peak time in September to October. Since the survey was conducted in the middle of September, this bird species should be sighted regularly during the sampling period but otherwise happened. This might be caused by the habitat condition. Based on our observation, the Sandpiper was only sighted at Sg Lepau where the area has more clay soil which is suitable for the bird to forage compared to other areas where the soil condition had already submerged. Food competition will rise due to limited forage space eventually affect food resources. Since this species is a migratory bird, there is a high possibility that the majority of these birds have already imprinted in their memory that Pengerang is not a suitable feeding ground for them and is not yet in its optimal state. Pengerang is located at southernmost of Peninsular Malaysia, majority of the birds that migrate from Northern of Malaysia might have not come to Pengerang since the peak migratory season is still ongoing and will only end in October. There is a possibility to get a high number of these birds during the peak migratory season in October.



### 5.2.3 Herpetofauna

A total of 17 species which belong to 10 families and 14 genera were successfully recorded during the survey (**Table 5.9**)



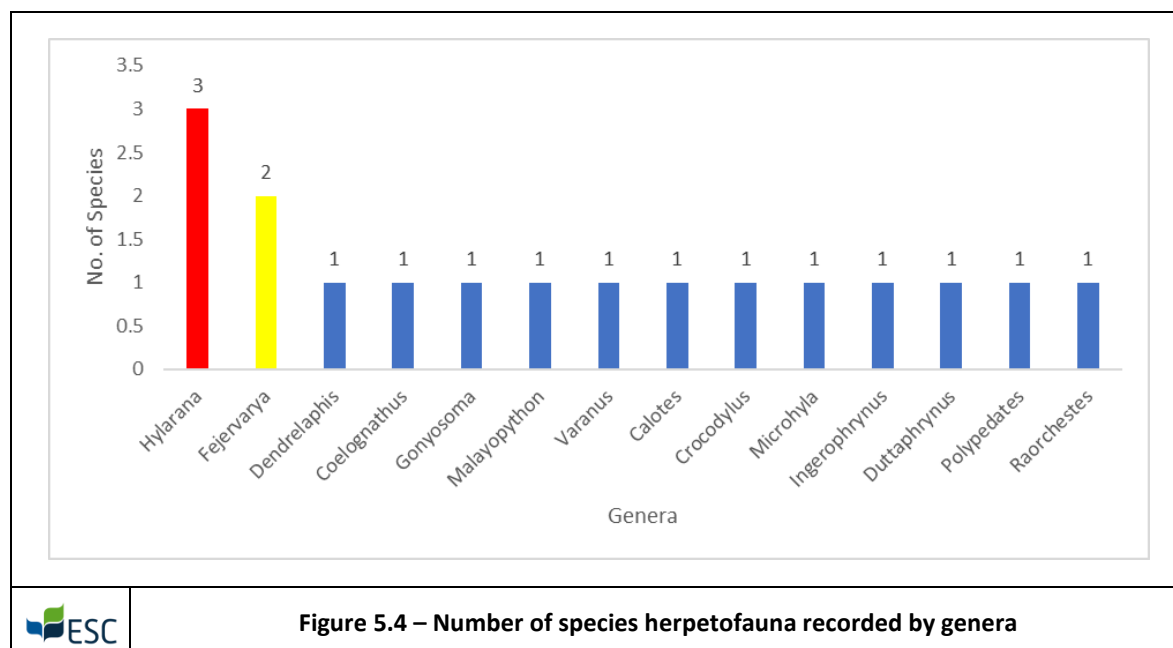
Table 5.9: Herpetofauna Species Observed in Pengerang

No	Family	Genus	Species	Common name	Local name	Methods	Conservation status			No. of individual
							MyBIS	IUCN	GBIF	
1	Colubridae	<i>Dendrelaphis</i>	<i>D. pictus</i>	Common Bronze-back	NA	CH	LC	LC	NRIP	1
2		<i>Coelognathus</i>	<i>C. flavolineatus</i>	Yellow-striped Rat Snake	Selingsing Batu, Laju Ekor Hitam, Laju Biasa	OBS	LC	LC	NRIP	1
3		<i>Gonyosoma</i>	<i>G. oxycephalum</i>	Red-tailed Racer	Selingsing, Laju Ekor Merah	OBS	LC	LC	NRIP	1
4	Pythonidae	<i>Malayopython</i>	<i>M. reticulatus</i>	Reticulated Python	Sawa Batik	INT	LC	LC	NRIP	1
5	Varanidae	<i>Varanus</i>	<i>V. salvator</i>	Asian Water Monitor	Biawak Air	OBS	LC	LC	NRIP	2
6	Agamidae	<i>Calotes</i>	<i>C. versicolor</i>	Common Garden Lizard	Sesumpah Kuning	CH	LC	NE	NRIP	3
7	Crocodylidae	<i>Crocodylus</i>	<i>C. porosus</i>	Saltwater Crocodile	Buaya Tembaga	INT	LC	LC	NRIP	-
8	Dicroglossidae	<i>Fejervarya</i>	<i>F. limnocharis</i>	Asian Grass Frog	Katak Padi	CH	LC	LC	NRIP	4
9			<i>F. cancrivora</i>	Asian Brackish Frog	Katak Bakau, Katak Pemakan Ketam	CH	LC	LC	NRIP	1
10	Ranidae	<i>Hylarana</i>	<i>H. baramica</i>	Golden-eared Rough-sided Frog	Katak Baram	CH	LC	LC	NRIP	1
11			<i>H. labialis</i>	White-lipped Frog	Katak Bibir Putih	OBS	NE	NE	NRIP	1
12			<i>H. nicobariensis</i>	Nicobar Island Frog	Katak Cengkerik	OBS (Sound)	LC	LC	NRIP	-

No	Family	Genus	Species	Common name	Local name	Methods	Conservation status			No. of individual
							MyBIS	IUCN	GBIF	
13	Microhylidae	<i>Microhyla</i>	<i>M. heymonsi</i>	Dark Sided Chorus Frog, Arcuate-spotted Pygmy Frog	Katak Bermulut Sempit Heymon, Mulut Sempit, Padi Bersisi Gelap	CH	LC	LC	NRIP	1
14	Bufonidae	<i>Ingerophrynus</i>	<i>I. parvus</i>	Dwarf Toad, Lesser Malacca Toad	Katak Puru Kerdil, Kodok Kecil, Kodok Sg Kecil	CH	LC	LC	NRIP	1
15		<i>Duttaphrynus</i>	<i>D. melanostictus</i>	Southeast Asian Toad, Asian Common Toad, Spectacled Toad, Asian Black-spined Toad	Katak Puru Biasa, Kodok Biasa	CH	LC	LC	NRIP	1
16	Rachophoridae	<i>Polypedates</i>	<i>P. leucomystax</i>	Four-lined Tree Frog	Katak Pokok Jalur Empat	OBS	LC	LC	NRIP	1
17		<i>Raorchestes</i>	<i>R. parvulus</i>	Dwarf Bush Frog, Karin Bubble-net Frog	Katak Belukar Kecil	OBS (Eggs)	LC	LC	NRIP	2
Total										22

## Note:

- OBS : Observation
- INT : Interview
- MN : Mist Netting
- CH : Catch by Hand
- RIP : Recorded in Pengerang
- NRIP : Not Recorded in Pengerang
- NT : Near Threatened
- LC : Least Concern
- NA : Not Available



Genus with the highest number of species recorded was from genus *Hylarana* spp. with three (3) species followed by genus *Fejervarya* spp. with two (2) species recorded. The remaining 12 genera only record one species each (**Figure 5.4**). Both *Hylarana* spp. and *Fejervarya* spp. were genera that belongs to frog's group. Three species identified in *Hylarana* spp. were *Hylarana baramica*, *Hylarana labialis* and *Hylarana nicobariensis*. *Hylarana baramica* also known as *Pulchrana baramica* is a frog species that is widely distributed in tropical moist lowland forests and swamps in Southeast Asian region. *Hylarana labialis* also known as *Chalcorana labialis*, is endemic species in Malaysia where it is commonly found on vegetation located nearby forest streams and swamps. *Hylarana nicobariensis* is a frog species that commonly inhabits lowland secondary forest, swamps and even disturbed areas. Their habitat preferences were in accordance with the environment conditions in this survey sampling sites where several swamps can be found within the site vicinity which likely becomes their breeding sites. *Hylarana* spp. can be easily found as they can live in various type of habitat.

#### 5.2.4 Ichthyofauna

The collection of fish species in this study was not fully optimized due to the occurrence of high tide throughout the sampling period. High tide influenced by moon gravitational force makes the ocean water to flows into the intertidal zones. The ocean's water overflows not only affect the wildlife but also increase the depth of the rivers thus changing the surrounding conditions. Since the depth of the rivers (sampling sites) had increased, the length of Gill Nets cannot reach the river bottom eventually give a higher chance for the fish to escape the Gill Nets.

As shown in **Table 5.10**, the highest fish catches were 122 individuals (83%) belongs to *Toxotes jaculatrix* also known as Banded Archer Fish. This species is known to produce water jet from its mouth to shoot down its prey which usually resting on vegetation near water surface. During day time, this fish will swim near low overhanging vegetation to find its prey near the Gill Nets. Although it is a brackish fish water, yet it has the ability to adapt in freshwater.

Table 5.10: Ichthyofauna Species Observed in Pengerang

No	Family	Genus	Species	Common name	Local name	Methods	Conservation status			No. of individuals
							MyBIS	IUCN	GBIF	
1	Toxotidae	<i>Toxotes</i>	<i>T. jaculatrix</i>	Banded Archer Fish	Sumpit-sumpit,	GN	LC	LC	NRIP	122
2	Clupeidae	<i>Nematalosa</i>	<i>N. nasus</i>	Bloch's gizzard shad	Selangat		LC	LC	NA	8
3	Lutjanidae	<i>Lutjanus</i>	<i>L. monostigma</i>	Russell's One-spot snapper	Tanda-tanda		LC	LC	NRIP	1
4	Plotosidae	<i>Plotosus</i>	<i>P. canius</i>	Canine Eel Catfish	Sembilang, Unsat-unsat		NE	NE	NRIP	1
5	Ariidae	<i>Nemaptryx</i>	<i>N. caelata</i>	Engraved Catfish	Duri		NE	NE	NA	1
6	Serranidae	<i>Epinephelus</i>	<i>E. tauvina</i>	Greasy Grouper	Kerapu Pertang		DD	DD	NRIP	1
7	Latidae	<i>Lates</i>	<i>L. calcarifer</i>	Barramundi	Siakap Putih		LC	LC	NRIP	1
8	Eleotridae	<i>Ophiocara</i>	<i>O. porocephala</i>	Northern Mud Gudgeon	Belontok Pasir, Belukor		LC	LC	NRIP	3
9	Synanceiidae	<i>Synanceia</i>	<i>S. verrucose</i>	Stonefish	Depu		NE	LC	NRIP	2
10	Belonidae	<i>Tylosurus</i>	<i>Tylosurus sp.</i>	Needlefish	Todak		CC	CC	NA	1
11	Scatophagidae	<i>Scatophagus</i>	<i>S. argus</i>	Spotted Scat	Kitang		LC	LC	NRIP	1
12	Megalopidae	<i>Megalops</i>	<i>M. cyprinoides</i> (Broussnet, 1782)	Tarpon	Bulan-bulan		DD	DD	NA	3
13	Carangidae	<i>Scomberoides</i>	<i>S. commersonnianus</i>	Talang Queen-fish	Talang		LC	LC	NRIP	2
14	Gerreidae	<i>Gerres</i>	<i>G. oyena</i>	Silver-biddy	Kapas-kapas		LC	LC	NRIP	1
Total										147

Note:

OBS : Observation  
DD : Data Deficient  
NT : Near Threatened

LC : Least Concern  
RIP : Recorded in Pengerang  
NRIP : Not Recorded in Pengerang

NA : Not Available

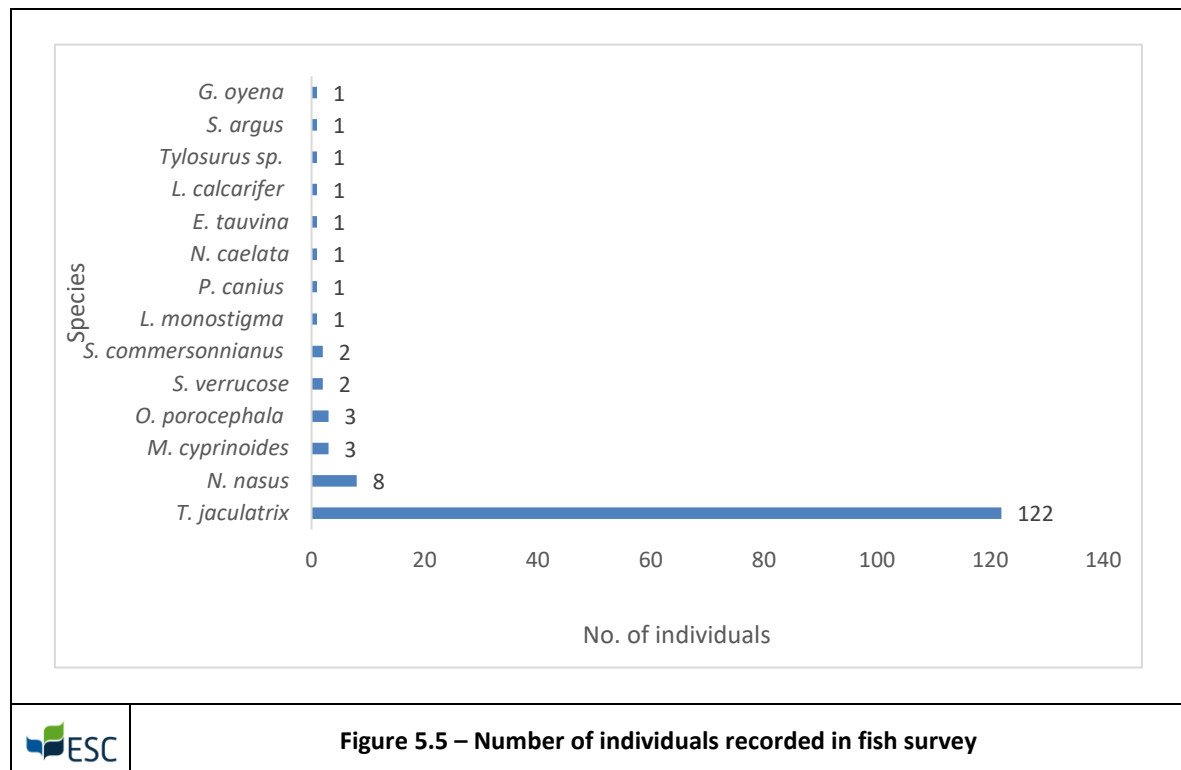


Table 5.11: Morphometric Measurements of Fish Caught During Survey

Species	Measurements	
	Weight (g)	Total length (cm)
<i>Toxotes jaculatrix</i>	92.2 (47.31-221.86)	16.7 (14-21.8) Common length:20 Max: 30
<i>Nematalosa nasus</i>	48.41 (33.48-67.8)	16.28 (14.2-18.5) Common: 15 Max: 25.5
<i>Lutjanus monostigma</i>	100.3 (79.6-121)	19.75 (17.3-22.2) Common: 50 Max:60
<i>Plotosus canius</i>	26.5	114 Common: 80 Max:150
<i>Nemapteryx caelata</i>	103	22.2 Common: 24 Max:47
<i>Epinephelus tauvina</i>	163	23.2 Common: 61 Max: 100
<i>Lates calcarifer</i>	267	27 (29-60)
<i>Ophiocara porocephala</i>	110.86 (81-126.13)	19.8 (18.1-21.1) Max: 34
<i>Synanceia verrucosa</i>	268 (254-282)	25.25 (24.5-26) (24-40)
<i>Tylosurus sp.</i>	52.4	240.53
<i>Scatophagus argus</i>	75.39	3.2



Species	Measurements	
	Weight (g)	Total length (cm)
		(14-38)
<i>Megalops cyprinoides</i>	480.12 (339.76-620.48) Max: 18kg	39.4 (35.8-43) (25-150)
<i>Scomberoides commersonnianus</i>	582.4 (195.4-969.35) Max: 16kg	40 (29-51) (63.5-120)
<i>Gerres oyena</i>	51.46 NA	14.5 (22-30)

Fish caught in this sampling is smaller in size while some of it can be considered as immature fish when compared with fish weight reported in FishBase (2021). As for fish length, mature fish recorded a normal measurement except for immature fish.

### 5.3 Conservation Status

Conservation status for flora and fauna species observed in this survey were compared against International Union for Conservation of Nature (IUCN), Malaysia Biodiversity Information System (MyBIS) and Global Biodiversity Information Facility (GBIF) data. In terms of GBIF status, ESC had state whether the species observed in the survey has already been reported in Pengerang or otherwise. The conservation status used in GBIF is totally similar with IUCN status. Summary of flora and fauna conservation status are shown in **Table 5.12** and **Table 5.13**.

#### 5.3.1 Flora

As shown in **Table 5.12**, one (1) species, known as *Intsia bijuga* (Ipil) was considered as Vulnerable (VU) while majority of them (155 species) were evaluated as Near Threatened (NT). Four (4) species falls under Least Concern (LC) category and they are *Excoecaria agallocha* (Buta-Buta), *Euthemis leuocarpa* (Pelawan Beruk), *Ochanostachys amentacea* (Petaling) and *Podocarpus polystachyus* (Podo Laut). The remaining three (3) species were classified as Not Available (NA) category.

Based on the IUCN database, majority of flora species (129 species) were categorized under Not Evaluated (NE) while 30 species were categorized under Least Concern (LC). There were two (2) species were classified under Vulnerable (VU) category and they were *Podocarpus polystachyus* (Podo Laut) and *Intsia bijuga* (Ipil). Meanwhile, one (1) species was classified as Critically Endangered (CR) namely *Bruguiera hainesii* (Berus Mata Buaya) and one (1) species was falls under Data Deficient (DD) category (**Table 5.12**).

According to GBIF database, 147 species were categorized as Not Recorded in Pengerang (NRIP) which means that data for these 147 species already exist in their database however, they were not identified/registered specifically in Pengerang. Sixteen (16) were classified as Not Available (NA) due to limited info available for these species (**Table 5.12**).

**Table 5.12: Conservation Status based on MyBIS, IUCN and GBIF Data of Fauna Observed in Pengerang**

Data Category	MyBIS								IUCN							**GBIF		
	No. of species																	
	NA	NE	LC	NT	VU	EN	CR	DD	NE	LC	NT	VU	EN	CR	DD	RIP	NRIP	NA
No. of species	3	155	4		1				129	30		2		1	1	0	147	16

### 5.3.2 Fauna

There were 95 species recorded during the fauna survey for this study. Seven (7) species of concern are found under MyBIS data set which falls under Near Threatened (3 species), Vulnerable (3 species), and Endangered (1 species). Based on IUCN database, there were 2 species under Vulnerable (VU) status and 5 species under Near Threatened (NT) status. The majority of the recorded species in this study falls under NRIP status in the GBIF register.

**Table 5.13: Conservation Status based on MyBIS, IUCN and GBIF Data of Fauna Observed in Pengerang**

Data Category	MyBIS							IUCN							GBIF		
	No. of species																
	NE	LC	NT	VU	EN	CR	DD	NE	LC	NT	VU	EN	CR	DD	RIP	NRIP	NA
Mammals	1	5	-	2	1	-	-	-	6	2	1	-	-	-	-	9	-
Avifauna	2	49	3	1	-	-	-	-	51	3	1	-	-	-	34	21	-
Herpetofauna	1	16	-	-	-	-	-	2	15	-	-	-	-	-	-	17	-
Ichthyofauna	4	8	-	-	-	-	2	3	9	-	-	-	-	2	-	10	4

Note:

- OBS : Observation
- INT : Interview
- MN : Mist Netting
- CT : Camera Trapping
- RIP : Recorded in Pengerang
- NRIP : Not Recorded in Pengerang
- EN : Endangered
- VU : Vulnerable
- NT : Near Threatened
- LC : Least Concern
- NA : Not Available
- DD : Data Deficient

The description of the findings is provided in the following sections below.

### 5.3.3 Mammal

According to MyBIS database, one (1) mammal species was categorized under Endangered (EN) category which is *Trachypithecus obscurus* (Dusky Leaf Monkey) and two (2) species were reported as Vulnerable (VU) and they were *Macaca fascicularis* (Long-tailed Macaque) and *Lutrogale perspicillata* (Smooth-coated Otter) while five (5) species were categorized under Least Concern (LC) and one (1) species falls under Not Evaluated (NE) category (**Table 5.13**).

By referring to IUCN database, six (6) mammal species were categorized under Least Concern (LC), single species namely *Lutrogale perspicillata* (Smooth-coated Otter) falls under Vulnerable (VU) category while two (2) species reported as Near Threatened (NT) and they were *Trachypithecus obscurus* and *Macaca fascicularis* (**Table 5.13**).

GBIF data shows that nine (9) mammal species reported as NRIP (Not Recorded in Pengerang) which means that data for these nine (9) species already exist in their database however, no data of those mammals specifically in Pengerang was found or mapped. This survey can be considered as the first mammals survey conducted in Pengerang (**Table 5.13**).

### 5.3.4 Avifauna

Majority of avifauna species, 49 species in total were reported as Least Concern (LC) in MyBIS database. Only two (2) species were considered as Not Evaluated (NE) while three (3) species namely *Aegithina viridissima* (Green iora), *Phaenicophaeus diardi* (Black-bellied Malkoha) and *Phaenicophaeus sumatranus* (Chesnut-bellied Malkoha) falls under Near Threatened (NT) category. Only one (1) species, *Acridotheres javanicus* (Javan myna) falls under Vulnerable (VU) category (**Table 5.13**).

According to IUCN checklist, 51 species out of 55 species recorded in Pengerang were categorized under Least Concerned (LC) category. Three (3) species for instance *Phaenicophaeus sumatranus* (Chesnut-bellied Malkoha) and *Aegithina viridissima* (Green iora) and *Ichthyophaga ichthyaetus* (Grey-headed Fish-eagle) were recorded under Near Threatened (NT) while one (1) species *Acridotheres javanicus* (Javan myna) classified under Vulnerable (VU) category (**Table 5.13**).

Based on the GBIF data, 34 species observed in Pengerang had been recorded and mapped in GBIF database. Even that so, this survey result can be considered as significant as it will give additional information on the species distribution in Pengerang. The remaining 21 species were classified as Not Recorded in Pengerang (NRIP) since none of these species were mapped in Pengerang (**Table 5.13**).

### 5.3.5 Herpetofauna

Almost all herpetofauna species observed on site (16 species out of 17 species) were classified under Least Concern (LC) while one (1) species was identified as Not Evaluated (NE) based on MyBIS database (**Table 5.13**).

As for IUCN status, fifteen (15) species were categorized under Least Concern (LC) category while the remaining two (2) species falls under Not Evaluated (NE) category (**Table 5.13**).

All seventeen (17) herpetofauna species have not been mapped out in GBIF database thus they are considered as Not Recorded in Pengerang (NRIP) (**Table 5.13**).

### 5.3.6 Ichthyofauna

Majority of ichthyofauna species observed (8 species) fall under Least Concern (LC) category, 4 species categorized under Not Evaluated (NE) and 2 species under Data Deficient (DD) based on MyBIS database (**Table 5.13**).

IUCN status reported that nine (9) fish species were evaluated as Least Concern (LC), three (3) species as Not Evaluated (NE) and two (2) species in Data Deficient (DD) category (**Table 5.13**).

Ten (10) out of fourteen (14) fish species were classified as Not Recorded in Pengerang (NRIP) while the remaining 4 fish species were categorized as Not Available (NA) in GBIF database. The 4 fish species that were under NA are *Nematalosa nasus* (Bloch's Gizzard Shad), *Nemaptryx caelata* (Engraved Catfish), *Tylosurus sp.* (Needlefish-type fish) and *Megalops cyprinoides* (Tarpon) (**Table 5.13**).

## 6 BIODIVERSITY MANAGEMENT PLAN

The survey result shows that there are no fauna species that are considered endangered in the project area except for one (1) mangrove species classified under Critically Endangered (CR) category. The flora species identified are consistent with secondary and peat swamp forests species. However, due to its location, the field assessments revealed a number of important fauna species classified as Critically Endangered (CR) and Vulnerable (VU) 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

### 6.1 Potential Threats

#### 6.1.1 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 PEC construction activities will result in loss of vegetation, it is important to ensure that the land is rehabilitated by re-planting and landscaping programmes.

At present, Sg Santi Forest Reserve is the only area with vast mangrove forest. This is an important place for some wildlife either with or without conservation value such as *M. fascicularis*, *T. obscurus*, *L. perspicillata*, migratory birds, ichthyofauna and others to forage, rearing their babies and take refuge from the elements. Moreover, mangrove is the main area for fish breeding sites. Destruction of the mangrove areas will only lead to the depletion of Malaysian fish stock and in the long run will overthrow Malaysia into food security problem.

In addition, two (2) mangrove species namely *Rhizophora x annamalayana* and *Bruguiera heinesii* that were identified as rare and endangered species were observed at Sg Lepau, Sg Santi and Sg Jelutong. Based on IUCN database, *Bruguiera heinesii* is categorized under Critically Endangered (CR) category. This finding shows that Sg Santi Forest Reserve must be protected and preserved at all cost to ensure rare and endangered mangrove species will not extinct. Mangroves, after coral reefs, are the most effective natural protection against tropical storms acting as wave and wind breaker. Mangroves are amongst the richest biodiverse ecosystems.

#### 6.1.2 Human-Wildlife Conflicts

Fauna associated with forest will be chased out when the trees are chopped except for certain species that can tolerate human existence. The occurrence of these species will definitely create a conflict among human and wildlife for shelter and food resources. Small and sparse forest areas will increase competition among wildlife in terms of food availability, nesting ground, roaming area and mating partner. Only the stronger one will prevail while the loser will be wiped out. This phenomenon is called survival of the fittest and is common in a natural environment.

#### 6.1.3 Wildlife Hunting

Wildlife hunting has become one of the main factors to wildlife extinction (Loki *et al.*, 2019). Not only in Malaysia, but globally. In Pengerang, this issue was brought up by locals who live in Kg. Bukit Gelugor. Even though Kg Bukit Gelugor is within agricultural zone, there is some area that is quite dense of forest cover with small portion of swampy area. According to the locals, foreigner workers went hunting in the forest to catch wildlife such as wild boar as source of food. In addition, there is sighting of a very large phyton crossing the road goes into another forest. Besides that, unidentified peafowl species that resembles the pheasant family is said to live in the forest. All these claims should not be taken lightly and if possible, must be highlighted either to prevent human-wildlife conflicts or the extinction of valuable species.

#### 6.1.4 Pollution

Since Pengerang Energy Complex (PEC) is developed within the proposed Pengerang Industrial Park (PIP) within heavy industrial zone, the environmental issue associated with this project would be industrial pollution. Industrial pollution is the pollution that can be directly linked with industry. This form of pollution is one of the leading causes of pollution worldwide. Globally, 70 percent of industrial waste is dumped directly into water. Even greater than the dumping of toxic industrial chemicals is the contribution of domestic garbage and sewage, accounting for 80 percent of water pollution globally. Asia has the highest number of polluted rivers in the world, mostly due to its dumping of raw sewage and the resulting bacteria.

Industrial pollution can also impact air quality, and it can enter the soil, causing widespread environmental problems. Industrial activities are a major source of air, water and land pollution, leading to illness and loss of life all over the world. Abundant discharge of industrial toxins making the natural environment harmful, unstable, and uncomfortable for physical and also for biological environment. Physical and biological environment can also be damaged by the heat and pollutants in the air. These pollutants including vapours, aerosols, solid particles, toxic gases and smoke drive from industrial processes.

Source of industrial pollution may come from various sources namely burning of fossil fuels, used of chemical solvents, untreated gas, liquid and chemical waste being released into the environment and improper disposal of waste materials. On top of that, used of heavy machinery for transportation and burning lands may also contribute to air pollution. Besides that, oil spills from the machines/ trucks that run down to the nearby streams and riparian areas will affect the fauna associated with water.

Industrial pollution continues to cause significant damage to the earth and all of its inhabitants due to chemical wastes, pesticides, radioactive materials etc. It affects wildlife and ecosystems and disrupts natural habitats. Animals are becoming extinct, and habitats are being destroyed. The increasing liquid, solid and hazardous wastes undermine ecosystem health and impact on food, water and health security. Industrial pollution disasters, including oil spills and radioactive leakage, take years to decades to clean up.

#### 6.1.5 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.

## 6.2 Mitigation Measures

The following describes the proposed mitigation by PEC and any other stakeholders in PIPC based on potential threats above.

### 6.2.1 Habitat Degradation and Pollution

Proposed projects need to be consistent with existing development plan, master plan or land use plan to avoid any habitat degradation and pollution to the habitat. Careful measures of the following are required to be conducted by PEC.

#### Control of Earthworks

Earthworks during the construction of PEC facilities will contribute the highest impact if not carried out with proper environmental control. There is a tendency for contractors to conduct earthworks without giving due consideration to the environmental impact.

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.

#### 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 contractors. Techniques for the prevention and control of soil erosion are also highlighted in the guidelines.

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/waterbody. In other cases, sediment traps/ponds are not maintained hence causing a build-up of silt.

#### Control of Water Quality

Other than sediment that can cause deterioration of water quality, the discharge of untreated industrial effluent, sewage and sullage especially from daily activities can be another source of pollutants. The proper industrial effluent treatment facility, silt control during the construction phase as planned in the EIA/ESHIA stage, and provisions of sanitary system/facilities complying with the requirements of the Department Sewerage Services should be provided.

#### Waste Management

During construction, overburden or earth spoil shall be disposed of within the project area or in designated spoil tips. Open burning of any waste construction materials such as formworks and biomass removed is strictly prohibited. These materials should be chipped and carted away. Any scheduled waste during constructions, operations and post operations is to be managed as per Environmental Quality (Scheduled Wastes) Regulations 2005 and related guidelines e.g., Guidelines on Storage of Hazardous Chemicals, 2006.

### 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 shall be used to clean the transport and access roads with drainage shall be prepared before any construction starts and water trucks is provided to wet roads especially during dry periods. Any air pollution during constructions, operations and post operations is to be managed as per Environmental Quality (Clean Air) Regulation, 2014.

### 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. Any air pollution during constructions, operations and post operations is to be managed as per Occupational Safety & Health Regulation (Noise Exposure), 2019 and related guidelines e.g., Guidelines for Environmental Noise Limits and Control.

### Monitoring

The need for environmental monitoring and audit, as per EIA approval conditions is mandatory. 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 should be developed and internally archived/submitted as necessary to the Department of Environment and Department of Occupational Safety and Health (DOSH) on a regular basis.

## **6.2.2 Habitat Enrichment**

Under these measures, PEC can show further commitment by supporting any NGOS's, government agencies or private companies to accomplish the following preservation works namely:

- Preservation of Sg Santi Forest Reserve

It is highly recommended that Sg Santi Forest Reserve to be preserved and treated as Permanent Forest Reserve so that uncontrolled development within this area can be stopped. Establishment of Buffer Zone is very important to control harmful anthropogenic activities not only in the forest, but near or around the forest (Götmark *et al.*, 2000). This goal can be achieved with preserving current buffer zone to maintain forest conditions.

- Preservation of Seagrass Area

Seagrass is essential to the biodiversity of an ecosystem and is highly sensitive to any environmental changes. During the survey, a seagrass area was spotted outside of Project boundary (>5 km radius). The type of seagrass observed is *Enhalus acoroides*. This seagrass area is important for the *Dugong* or sea manatee (dugong) habitat. No Dugong were spotted during the site survey. However, according to the local, Dugong were reported often seen in the seagrass bed area especially for food consumption. With rising sea levels, many coastlines are under threat from erosion. Seagrass meadows reduce the power of waves hitting the coast and as some seagrass species have leaf blades up to 1m long, this can really help dampen wave action. Through reducing wave action this also protects coastlines from flooding and storms.

Seagrass plays a role in chemical processes such as water purification. As marine plants, seagrasses photosynthesise, which helps oxygenate the water column. Seagrass meadows also stabilize sediment which improves water clarity, which also improves local water quality. By filtering the water column,

seagrass removes seawater pollution. This includes removing fish pathogens, which helps keep local fish populations healthier, reduce contamination in seafood and reduce coral disease.



*Enhalus acoroides* seagrass observed during the survey

### 6.2.3 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 any waterbody related to PEC effluent. If any, 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 during constructions to post operations are as below:

- Health Education: Health education activities are to be carried out to create awareness among the workers 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 workers 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; and
- 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.

#### 6.2.4 Monitoring Programme

Under PEC jurisdiction, PEC must ensure that release of industrial effluents/ chemicals/ wastes from PEC facilities into the waterway especially Sg Santi is strictly prohibited. Industrial waste may be toxic, ignitable, corrosive or reactive and if improperly managed, this waste can pose dangerous health and environmental consequences. Polluted water is unsuitable for drinking, recreation, agriculture, and industry. It diminishes the aesthetic quality of rivers. More seriously, contaminated water destroys aquatic life and reduces its reproductive ability.

Besides that, anthropogenic thermal differences caused by the discharge of hot water from power plants and factories directly into an open water source can also caused water pollution as it decreases oxygen levels and alters the species that can survive there, often inviting non-native species invasion, altering the food chain and typically reducing species biodiversity.

On top of that, air and water quality must be monitored regularly following DOE recommendation as stated in the EIA Approval Conditions for this Project. Specific monitoring programmes already established to support the conservation of Sg. Santi in the effort to control any potential pollution into Sg. Santi include:

**Table 6.1: Water Quality Monitoring Programme as per EIA Approval Conditions dated 28<sup>th</sup> November 2019  
With DOE Letter Reference No (JAS.600-2/9/5 Jilid 3)**

No.	Control and Monitoring	Sampling Frequency	Standard	Monitoring Phase
1.	Control of surface run-off discharge	Once every three (3) months	i. Total Suspended Solids (TSS) less than 50 mg/L: or ii. Turbidity less than 250 Nephelometric Turbidity Unit (NTU)	Starting from land disturbing until project completion
2.	Control of Effluent Discharge	Once every three (3) months	Standard A of Environmental Quality (Industrial Effluent) Regulations 2009	During operational phase
3.	River water quality monitoring	Once every three (3) months	National Water Quality Standards (NWQS) for Malaysia	Starting from land disturbing/ operational phase/ until project completion/ end of operation
5.	Groundwater Monitoring	Once every three (3) months	Groundwater Quality Standards for Conventional Raw	During operational phase

No.	Control and Monitoring	Sampling Frequency	Standard	Monitoring Phase
			Water Treatment (Drinking Water)	
5.	Marine Water Quality Monitoring	Once every three (3) months	National Marine Water Quality Standards (NMWQS) for Malaysia	During operational phase

**Table 6.2: Air Quality Control and Monitoring Programme as per EIA Approval Conditions dated 28<sup>th</sup> November 2019 With DOE Letter Reference No (JAS.600-2/9/5 Jilid 3)**

No.	Control and Monitoring	Ambient air emission limit	Frequency	Standard
1.	PM <sub>10</sub>	Refer to the application limit for year 2020 40 µg/m <sup>3</sup> (1 year averaging time) 100 µg/m <sup>3</sup> (24 hours averaging time)	Monthly	Malaysian Ambient Air Quality Guidelines Malaysian Ambient Air Quality Standard (at 25 Celsius and 101.13 kPa)
2.	PM <sub>2.5</sub>	15 µg/m <sup>3</sup> (1 year averaging time) 35 µg/m <sup>3</sup> (24 hours averaging time)	Monthly	Malaysian Ambient Air Quality Standard
3.	Sulphur Dioxide (SO <sub>2</sub> )	250 µg/m <sup>3</sup> (1 hour averaging time) 80 µg/m <sup>3</sup> (24 hours averaging time)	Monthly	Malaysian Ambient Air Quality Standard
4.	Nitrogen Dioxide (NO <sub>2</sub> )	280 µg/m <sup>3</sup> (1 hour averaging time) 70 µg/m <sup>3</sup> (24 hours averaging time)	Monthly	Malaysian Ambient Air Quality Standard
5.	Ground-Level Ozone (O <sub>3</sub> )	180 µg/m <sup>3</sup> (1 hour averaging time) 100 µg/m <sup>3</sup> (24 hours averaging time)	Monthly	Malaysian Ambient Air Quality Standard
6.	Carbon Dioxide (CO)	30 µg/m <sup>3</sup> (1 hour averaging time) 10 µg/m <sup>3</sup> (8 hours averaging time)	Monthly	Malaysian Ambient Air Quality Standard



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## APPENDIX A - Comparison of Flora Observed in Current Survey and Previous Studies

No.	Species	Current Survey (16-20 <sup>th</sup> September 2021)	Previous Studies
1	<i>Artocarpus heterophyllus</i>		x
2	<i>Artocarpus integer</i>		x
3	<i>Citrus sp.</i>		x
4	<i>Cocos nucifera</i>		x
5	<i>Coffee sp.</i>		x
6	<i>Durio sp.</i>		x
7	<i>Mangifera indica</i>		x
8	<i>Musa sp.</i>		x
9	<i>Imperata cylindrica</i>	x	x
10	<i>Urena lobate</i>		x
11	<i>Chrysopogon aciculatus</i>		x
12	<i>Eupatorium odoratum</i>		x
13	<i>Melastoma malabatricum</i>	x	x
14	<i>Sterea palmifolia</i>		x
15	<i>Panicum brevifolium</i>		x
16	<i>Paspalum conjugatum</i>		x
17	<i>Ischaemum muticum</i>	x	x
18	<i>Mallotus paniculatus</i>		x
19	<i>Cyperus javanicus (Cyperus sp.)**</i>	x	x
20	<i>Pyrrosia longifolia</i>		x
21	<i>Decranopteris linearis</i>		x
22	<i>Lygodium circinnatum</i>		x
23	<i>Stenochlaena palustris</i>		x
24	<i>Diplazium esculentum</i>		x
25	<i>Acanthus sp.</i>		x
26	<i>Acrostichum sp.</i>		x
27	<i>Avicennia alba</i>	x	x
28	<i>Avicennia officinalis</i>	x	x
29	<i>Calamus erinaceus</i>	x	x
30	<i>Ceriops decandra</i>		x
31	<i>Derris trifoliata</i>	x	x
32	<i>Dolichandrone spathacea (Dolichandrone sp.)**</i>	x	x
33	<i>Excoecaria agallocha</i>	x	x
34	<i>Nypa fruticans</i>	x	x
35	<i>Bruguiera cylindrica</i>	x	x
36	<i>Bruguiera exaristata</i>		x
37	<i>Bruguiera gymnorhiza</i>	x	x
38	<i>Bruguiera parviflora</i>	x	x
39	<i>Bruguiera sexangula</i>	x	x
40	<i>Bruguiera hainesii</i>	x	x
41	<i>Rhizophora mucronata</i>	x	x
42	<i>Rhizophora apiculata</i>	x	x
43	<i>Ceriops tagal</i>	x	x
44	<i>Sonneratia alba</i>	x	x
45	<i>Sonneratia gigantea</i>		x
46	<i>Macaranga gigantea</i>		x
47	<i>Ardisia caripa</i>		x
48	<i>Tetracera indica</i>		x
49	<i>Grewia tomentosa</i>		x
50	<i>Vitex pubescens</i>		x

No.	Species	Current Survey (16-20 <sup>th</sup> September 2021)	*Previous Studies
51	<i>Dendrobium crumenatum</i>		x
52	<i>Terminalia catappa</i>	x	x
53	<i>Acalypha wilkesiana</i>		x
54	<i>Dillenia sufruticosa</i>	x	x
55	<i>Ficus grossularioides</i> , <i>F. fistulosa</i> , <i>F. microcarpa</i>	x	x
56	<i>Avicennia rumphiana</i>	x	
57	<i>Buchanania arborescens</i>	x	
58	<i>Camptosperma coriaceum</i>	x	
59	<i>Swintonia schwenkii</i>	x	
60	<i>Drepananthus carinatus</i>	x	
61	<i>Xylopia ferruginea</i>	x	
62	<i>Anisophyllea disticha</i>	x	
63	<i>Alstonia angustifolia</i>	x	
64	<i>Finlaysonia obovata</i>	x	
65	<i>Tylophora flexuosa</i>	x	
66	<i>Willughbeia coriacea</i>	x	
67	<i>Melanthera biflora</i>	x	
68	<i>Pluchea indica</i>	x	
69	<i>Ilex cymosa</i> Blume	x	
70	<i>Eleiodoxa conferta</i>	x	
71	<i>Korthalsia flagellaris</i>	x	
72	<i>Oncosperma tigillarium</i>	x	
73	<i>Sesuvium portulacastrum</i>	x	
74	<i>Stenochlaena palustris</i>	x	
75	<i>Telmatoblechnum indicum</i>	x	
76	<i>Ploiarium alternifolium</i>	x	
77	<i>Dacryodes rostrata</i>	x	
78	<i>Calophyllum rupicola</i>	x	
79	<i>Calophyllum rufigemmatum</i>	x	
80	<i>Calophyllum sclerophyllum</i>	x	
81	<i>Calophyllum soulattri</i>	x	
82	<i>Calophyllum tetrapterum</i>	x	
83	<i>Calophyllum teysmannii</i>	x	
84	<i>Calophyllum wallichianum</i> var. <i>incrassatum</i>	x	
85	<i>Trema tomentosa</i>	x	
86	<i>Rourea fulgens</i>	x	
87	<i>Bhesa paniculata</i>	x	
88	<i>Parastemon urophyllus</i>	x	
89	<i>Lumnitzera littorea</i>	x	
90	<i>Garcinia nigrolineata</i>	x	
91	<i>Eleocharis ochrostachys</i>	x	
92	<i>Fimbristylis cymosa</i>	x	
93	<i>Lepironia articulata</i>	x	
94	<i>Scleria ciliaris</i>	x	
95	<i>Scleria sumatrensis</i>	x	
96	<i>Pteridium esculentum</i>	x	
97	<i>Diospyros lanceifolia</i>	x	
98	<i>Macaranga heynei</i>	x	
99	<i>Macaranga pruinosa</i>	x	
100	<i>Macaranga recurvata</i>	x	
101	<i>Pimelodendron griffithianum</i>	x	

No.	Species	Current Survey (16-20 <sup>th</sup> September 2021)	*Previous Studies
102	<i>Acacia auriculiformis</i>	x	
103	<i>Acacia mangium</i>	x	
104	<i>Aganope heptaphylla</i>	x	
105	<i>Dalbergia candenatensis</i>	x	
106	<i>Intsia bijuga</i>	x	
107	<i>Leucaena leucocephala</i>	x	
108	<i>Ormosia bancana</i>	x	
109	<i>Castanopsis lucida</i>	x	
110	<i>Castanopsis megacarpa</i>	x	
111	<i>Lithocarpus conocarpus</i>	x	
112	<i>Lithocarpus ewyckii</i>	x	
113	<i>Flagellaria indica</i>	x	
114	<i>Fagraea racemosa</i>	x	
115	<i>Dicranopteris linearis</i>	x	
116	<i>Scaevola taccada</i>	x	
117	<i>Enhalus acoroides</i>	x	
118	<i>Cratoxylum arborescens</i>	x	
119	<i>Cratoxylum glaucum</i>	x	
120	<i>Ixonanthes icosandra</i>	x	
121	<i>Clerodendron inerme</i>	x	
122	<i>Premna serratifolia</i>	x	
123	<i>Vitex pinnata</i>	x	
124	<i>Cassytha filiformis</i>	x	
125	<i>Lindera lucida</i>	x	
126	<i>Nothaphoebe coriacea</i>	x	
127	<i>Norrisia malaccensis</i>	x	
128	<i>Lycopodiella cernua</i>	x	
129	<i>Tristellateia australasiae</i>	x	
130	<i>Commersonia bartramia</i>	x	
131	<i>Heritiera littoralis</i>	x	
132	<i>Heritiera simplicifolia</i>	x	
133	<i>Talipariti tiliaceum</i>	x	
134	<i>Memecylon amplexicaule</i>	x	
135	<i>Memecylon edule</i>	x	
136	<i>Xylocarpus moluccensis</i>	x	
137	<i>Xylocarpus granatum</i>	x	
138	<i>Artocarpus lakoocha</i>	x	
139	<i>Artocarpus scortechinii</i>	x	
140	<i>Myrica esculenta</i>	x	
141	<i>Rhodamnia cineria</i>	x	
142	<i>Syzygium antisepticum</i>	x	
143	<i>Syzygium caudatum</i>	x	
144	<i>Syzygium glabratum</i>	x	
145	<i>Syzygium grande</i>	x	
146	<i>Syzygium oblatum</i>	x	
147	<i>Syzygium muelleri</i>	x	
148	<i>Syzygium pustulatum</i>	x	
149	<i>Syzygium zeylanicum</i>	x	
150	<i>Horsfieldia wallichii</i>	x	
151	<i>Nepenthes gracilis</i>	x	
152	<i>Nepenthes rafflesiana</i>	x	



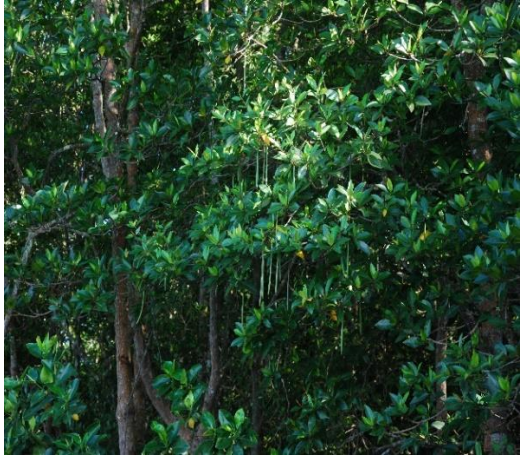





No.	Species	Current Survey (16-20 <sup>th</sup> September 2021)	*Previous Studies
153	<i>Brackenridgea hookeri</i>	x	
154	<i>Euthemis leucocarpa</i>	x	
155	<i>Ochanostachys amentacea</i>	x	
156	<i>Nephrolepis auriculata</i>	x	
157	<i>Pandanus artocarpus</i>	x	
158	<i>Pandanus tectorius</i>	x	
159	<i>Adinandra dumosa</i>	x	
160	<i>Eurya acuminata</i>	x	
161	<i>Xanthophyllum eurhynchum</i>	x	
162	<i>Breynia racemosa</i>	x	
163	<i>Glochidion littorale</i>	x	
164	<i>Glochidion superbum</i>	x	
165	<i>Pennisetum polystachion</i>	x	
166	<i>Themeda villosa</i>	x	
167	<i>Acrostichum aureum</i>	x	
168	<i>Acrostichum speciosum</i>	x	
169	<i>Ceriops zippeliana</i>	x	
170	<i>Gynotroches axillaris</i>	x	
171	<i>Pellacalyx axillaris</i>	x	
172	<i>Rhizophora</i> × <i>annamalayana</i>	x	
173	<i>Diplospora malaccensis</i>	x	
174	<i>Gynochthodes sublanceolata</i>	x	
175	<i>Mussaendopsis beccariana</i>	x	
176	<i>Morinda citrifolia</i>	x	
177	<i>Morinda elliptica</i>	x	
178	<i>Morinda umbellata</i>	x	
179	<i>Oxyceros longiflorus</i>	x	
180	<i>Porterandia anisophyllea</i>	x	
181	<i>Psychotria sarmentosa</i>	x	
182	<i>Scyphiphora hydrophyllacea</i>	x	
183	<i>Timonius wallichianus</i>	x	
184	<i>Allophylus cobbe</i>	x	
185	<i>Guioa bijuga</i>	x	
186	<i>Scolopia macrophylla</i>	x	
187	<i>Planchonella obovata</i>	x	
188	<i>Lygodium microphyllum</i>	x	
189	<i>Eurycoma longifolia</i>	x	
190	<i>Smilax setosa</i>	x	
191	<i>Stachytarpheta jamaicensis</i>	x	
192	<i>Cayratia trifolia</i>	x	
193	<i>Podocarpus polystachyus</i>	x	







Source of Previous Studies:

- Chemsain Konsultant Sd. Bhd. 2012. Preliminary Environmental Impact Assessment and Quantitative Risk Assessment for Regasification Terminal 2 (RGT2) Pipeline Project. Pp. 47;
- Faridah-Hanum, I., Latiff, A., Khalid Rehman, H. and Munir, O. 2014. Mangrove ecosystems of Asia: Status, Challenges and Management Strategies. Springer, New York. Pp. 455; and
- Nordatul Akmar, Z., Wan Juliana, W.A., Muhamad Razali, S. & Maimon, A. 2011. Community Structure and Biomass of Three Mangrove Forests at South Johor. Paper presented at the Proceedings of the University Malaysia Terengganu 10th International Annual Symposium. 11-13 July 2011, Kuala Terengganu, Malaysia.


**APPENDIX B – Photographs of Flora Species Observed During Survey Conducted on 16-20th September 2021 in Pengerang**

Flora Species Observed	
 <p><i>Rhizophora Mucronata</i></p>	 <p><i>Bruguiera Gymnorhizza</i></p>
 <p><i>Rhizophora Apiculata</i></p>	 <p><i>Rhizophora x Annamalayana</i></p>
 <p><i>Sonneratia Alba</i></p>	 <p><i>Sonneratia Alba</i></p>



Flora Species Observed	
	
<i>Ceriops Zippeliana</i>	<i>Xylocarpus Granatum</i>
	
<i>Bruguiera Gymnorhizza</i>	<i>Bruguiera Parviflora</i>
	
<i>Scyphipjora Hydrophyllacea</i>	<i>Scyphipjora Hydrophyllacea</i>









Flora Species Observed	
 <p><i>Lumnitzera Littorea</i></p>	 <p><i>Lumnitzera Littorea</i></p>
 <p><i>Acrostichum Aureum</i></p>	 <p><i>Bruguiera Hainesii</i></p>
 <p><i>Bruguiera Hainesii</i> stem</p>	 <p><i>Bruguiera Hainesii</i> calyx</p>



Flora Species Observed	
 <p><i>Horsefieldia Wallichii</i></p>	 <p><i>Acrostichum Speciosum</i></p>
 <p><i>Ceriops Tagal</i></p>	 <p><i>Nepenthes Gracilis</i></p>
 <p><i>Rhizophora x Annamalayana</i></p>	 <p><i>Avicennia Rumphiana</i></p>



Flora Species Observed	
 <p><i>Nypa Fructicans</i></p>	 <p><i>Intsia Bijuga</i></p>
 <p><i>Podocarpus Polystachyus</i></p>	 <p><i>Bruguiera Cylindrica</i></p>
 <p><i>Excoecaria agallocha</i></p>	 <p><i>Avicennia Officinalis</i></p>



## Flora Species Observed

*Avicennia Rumphiana**Bruguiera Sexangula**Euthemis Leucocarpa**Brackenridgea Hookeri**Nepenthes rafflesiana & Nepenthes gracilis**Lindera Lucida*




## Flora Species Observed

*Ochanostachys Amentacea**Nepenthes Rafflesiana*






### APPENDIX C – Photographs of Mammals, Avifauna, Herpetofauna and Ichnofauna Observed on 16-20th September 2021 in Pengerang




#### Mammals

Mammals Observed	Description
	<p>Family : Suidae</p> <p>Scientific Name : <i>Sus scrofa</i></p> <p>English Name : Wild Boar</p> <p>Local Name : Babi Hutan</p> <p>Date Observed : 17 Sept 2021</p> <p>Location : S12 (1°25'44.1"N 104°09'32.6"E)</p>
	<p>Family : Mustelidae</p> <p>Scientific Name : <i>Lutrogale perspicillata</i></p> <p>English Name : Smooth-coated Otter</p> <p>Local Name : Memerang Licin</p> <p>Date Observed : 17 Sept 2021</p> <p>Location : S12 (1°25'44.1"N 104°09'32.6"E)</p>
	<p>Family : Cercopithecidae</p> <p>Scientific Name : <i>Macaca fascicularis</i></p> <p>English Name : Long-tailed Macaque</p> <p>Local Name : Kera</p> <p>Date Observed : 17 Sept 2021</p> <p>Location : Sg. Sebina – S6 (1°25'16.8"N 104°10'45.7"E)</p>




Mammals Observed	Description
	<p>Family : Pteropodidae  Scientific Name : <i>Macroglossus sobrinus</i>  English Name : Greater Long-nosed Fruit Bat  Local Name : Cecadu Madu Besar</p>
	<p>Family : Pteropodidae  Scientific Name : <i>Cynopterus brachyotis</i>  English Name : Lesser Short-nose Fruit Bat  Local Name : Cecadu Pisang</p>
	<p>Family : Pteropodidae  Scientific Name : <i>Eonycteris spelaea</i>  English Name : Lesser Dawn Bat  Local Name : Cecadu Gua</p>




Avifauna




Avifauna Observed	Description
	<p>Family : Bucerotidae</p> <p>Scientific Name : <i>Anthracoceros albirostris</i></p> <p>English Name : Oriental Pied Hornbill</p> <p>Local Name : Enggang Kelingking</p> <p>Date Observed : 16 Sept 2021</p> <p>Location : Sg. Santi - S1 (1°26'55.9"N 104°08'35.5"E)</p>
	<p>Family : Sturnidae</p> <p>Scientific Name : <i>Acridotheres javanicus</i></p> <p>English Name : Javan Myna</p> <p>Local Name : Tiong Jawa</p> <p>Date Observed : 16 Sept 2021</p> <p>Location : Sg. Sebina –S6 (1°25'16.8"N 104°10'45.7"E)</p>
	<p>Family : Corvidae</p> <p>Scientific Name : <i>Corvus macrorhynchos</i></p> <p>English Name : Large-billed Crow</p> <p>Local Name : Gagak Paruh Besar</p> <p>Date Observed : 17 Sept 2021</p> <p>Location : Sg. Sebina –S6 (1°25'16.8"N 104°10'45.7"E)</p>

Avifauna Observed	Description
	<p> Family : Hirundinidae  Scientific Name : <i>Hirundo tahitica</i>  English Name : Pacific Swallow  Local Name : Sualo Batu  Date Observed : 17 Sept 2021  Location : Sg. Sebina –S6  (1°25'16.8"N 104°10'45.7"E) </p>
	<p> Family : Accipitridae  Scientific Name : <i>Haliastur indus</i>  English Name : Brahminy Kite  Local Name : Lang Merah  Date Observed : 17 Sept 2021  Location : Sg. Sebina –S6  (1°25'16.8"N 104°10'45.7"E) </p>
	<p> Family : Ardeidae  Scientific Name : <i>Butorides striata</i>  English Name : Little Heron  Local Name : Pucung Keladi  Date Observed : 17 Sept 2021  Location : Survey Area - Sg. Kapal  (1°21'13.0"N 104°12'58.4"E) </p>









Avifauna Observed	Description
	<p>           Family : Columbidae            Scientific Name : <i>Geopelia striata</i>            English Name : Zebra Dove            Local Name : Merbok            Date Observed : 17 Sept 2021              Location : Survey Area - Sg. Kapal            (1°21'13.0"N 104°12'58.4"E)         </p>
	<p>           Family : Sturnidae            Scientific Name : <i>Acridotheres tristis</i>            English Name : Common Myna            Local Name : Tiong Rumah            Date Observed : 18 Sept 2021              Location : Survey Area – Jalan Gelugur            (1°23'14.2"N 104°13'25.5"E)         </p>
	<p>           Family : Cuculidae            Scientific Name : <i>Phaenicophaeus sumatranus</i>            English Name : Chestnut-bellied Malkoha            Local Name : Cenok Kecil            Date Observed : 18 Sept 2021              Location : Sg. Jelutong - S11            (1°26'18.4"N 104°09'57.6"E)         </p>

Avifauna Observed	Description
	<p> Family : Accipitridae  Scientific Name : <i>Spilornis cheela</i>  English Name : Crested Serpent-eagle  Local Name : Lang Berjambul  Date Observed : 18 Sept 2021  Location : Sg. Jelutong - S11  (1°26'18.4"N 104°09'57.6"E) </p>
	<p> Family : Picidae  Scientific Name : <i>Picus vittatus</i>  English Name : Laced Woodpecker  Local Name : Belatok Hijau  Date Observed : 18 Sept 2021  Location : S12  (1°25'44.1"N 104°09'32.6"E) </p>
	<p> Family : Accipitridae  Scientific Name : <i>Haliaeetus leucogaster</i>  English Name : White-bellied Sea-eagle  Local Name : Lang Siput  Date Observed : 18 Sept 2021  Location : Survey Area - Kg. Bukit Raja  (1°22'50.7"N 104°14'24.0"E) </p>

Avifauna Observed	Description
	<p> Family : Columbidae  Scientific Name : <i>Streptopelia chinensis</i>  English Name : Spotted Dove  Local Name : Tekukur  Date Observed : 18 Sept 2021  Location : Survey Area - Kg. Bukit Raja  (1°22'50.7"N 104°14'24.0"E) </p>
	<p> Family : Accipitridae  Scientific Name : <i>Ichthyophaga ichthyaetus</i>  English Name : Grey-headed Fish-eagle  Local Name : Lang Kepala Kelabu  Date Observed : 18 Sept 2021  Location : Sevana Cove Fire and Rescue Station  (1°24'33.1"N 104°12'35.7"E) </p>
	<p> Family : Motacillidae  Scientific Name : <i>Anthus rufulus</i>  English Name : Paddyfield Pipit  Local Name : Pipit Padi  Date Observed : 18 Sept 2021  Location : Sevana Cove Fire and Rescue Station  (1°24'33.1"N 104°12'35.7"E) </p>







Avifauna Observed	Description
	<p> Family : Alcedinidae  Scientific Name : <i>Todiramphus chloris</i>  English Name : Collared Kingfisher  Local Name : Burung Pekaka Bakau  Date Observed : 19 Sept 2021  Survey Area – Southern of Sg.  Location : Lepau  (1°23'54.0"N 104°08'34.9"E) </p>
	<p> Family : Nectariniidae  Scientific Name : <i>Anthreptes malacensis</i>  English Name : Brown-throated Sunbird  Local Name : Kelicap Mayang Kelapa  Date Observed : 19 Sept 2021  Survey Area – Southern of Sg.  Location : Lepau  (1°23'54.0"N 104°08'34.9"E) </p>
	<p> Family : Aegithinidae  Scientific Name : <i>Aegithina tiphia</i>  English Name : Common Iora  Local Name : Burung Kunyit Kecil  Date Observed : 19 Sept 2021  Survey Area – Southern of Sg.  Location : Lepau  (1°23'54.0"N 104°08'34.9"E) </p>

Avifauna Observed	Description
	<p>           Family : Alcedinidae            Scientific Name : <i>Alcedo atthis</i>            English Name : Common Kingfisher            Local Name : Pekaka Cit-cit Kecil            Date Observed : 19 Sept 2021            Location : Desa Selatan         </p>
	<p>           Family : Sturnidae            Scientific Name : <i>Aplonis panayensis</i>            English Name : Asian Glossy Starling            Local Name : Perling Mata Merah            Date Observed : 20 Sept 2021            Location : Survey Area - Kg. Lepau            (1°23'29.2"N 104°09'05.6"E)         </p>
	<p>           Family : Dicaeidae            Scientific Name : <i>Dicaeum cruentatum</i>            English Name : Scarlet-backed Flowerpecker            Local Name : Sepah Puteri Merah            Date Observed : 20 Sept 2021            Location : Survey Area - Kg. Lepau            (1°23'29.2"N 104°09'05.6"E)         </p>





Avifauna Observed	Description
	<p>Family : Accipitridae  Scientific Name : <i>Elanus axillaris</i>  English Name : Black-shouldered Kite  Local Name : Lang Tikus  Date Observed : 20 Sept 2021  Location : Survey Area - Kg. Lepau  (1°23'29.2"N 104°09'05.6"E)</p>
	<p>Common Kingfisher (<i>Alcedo atthis</i>) was caught in mist net at Desa Selatan or Southern Village.</p>
	<p>Brown Throated Sunbird (<i>Anthreptes malacensis</i>) was caught in mist net at Kg Lepau.</p>




Ichthyofauna




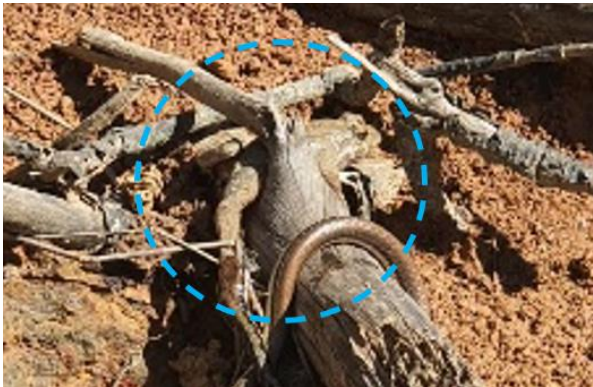
Fish Observed	Description
	<p>Family : Latidae</p> <p>Scientific Name : <i>Lates calcarifer</i></p> <p>English Name : Barramundi</p> <p>Local Name : Siakap Putih</p>
	<p>Family : Toxotidae</p> <p>Scientific Name : <i>Toxotes jaculatrix</i></p> <p>English Name : Banded Archer Fish</p> <p>Local Name : Sumpit-sumpit</p>
	<p>Family : Belonidae</p> <p>Scientific Name : <i>Tylosurus sp.</i></p> <p>English Name : Needlefish</p> <p>Local Name : Todak</p>
	<p>Family : Eleotridae</p> <p>Scientific Name : <i>Ophiocara porocephala</i></p> <p>English Name : Northern Mud Gudgeon</p> <p>Local Name : Belontok Pasir, Belukor</p>

Herpetofauna

Herpetofauna Observed	Description
	<p>Family : Colubridae</p> <p>Scientific Name : <i>Dendrelaphis pictus</i></p> <p>English Name : Common Bronze-back</p> <p>Local Name : Not Available (NA)</p>
	<p>Family : Colubridae</p> <p>Scientific Name : <i>Coelognathus flavolineatus</i></p> <p>English Name : Yellow-striped Rat Snake</p> <p>Local Name : Selingsing Batu, Laju</p> <p>Local Name : Ekor Hitam, Laju Biasa</p>
	<p>Family : Agamidae</p> <p>Scientific Name : <i>Calotes versicolor</i></p> <p>English Name : Common Garden Lizard</p> <p>Local Name : Sesumpah Kuning</p>
	<p>Family : Varanidae</p> <p>Scientific Name : <i>Varanus salvator</i></p> <p>English Name : Asian Water Monitor</p> <p>Local Name : Biawak Air</p>

Herpetofauna Observed	Description
	<p>Family : Dicroglossidae</p> <p>Scientific Name : <i>Fejervarya limnocharis</i></p> <p>English Name : Asian Grass Frog</p> <p>Local Name : Katak Padi</p>
	<p>Family : Ranidae</p> <p>Scientific Name : <i>Hylarana baramica</i></p> <p>English Name : Golden-eared Rough-sided Frog</p> <p>Local Name : Katak Baram</p>
	<p>Family : Microhylidae</p> <p>Scientific Name : <i>Microhyla heymonsi</i></p> <p>English Name : Frog, Arcuate-spotted Pygmy Frog</p> <p>Local Name : Katak Bermulut Sempit Heymon</p>
	<p>Family : Bufonidae</p> <p>Scientific Name : <i>Ingerophrynus parvus</i></p> <p>English Name : Dwarf Toad</p> <p>Local Name : Katak Puru Kerdil</p>



Herpetofauna Observed	Description
	<p>Family : Bufonidae</p> <p>Scientific Name : <i>Duttaphrynus melanostictus</i></p> <p>English Name : Southeast Asian Toad</p> <p>Local Name : Kodok Biasa</p>
	<p>Family : Rachophoridae</p> <p>Scientific Name : <i>Polypedates leucomystax</i></p> <p>English Name : Four-lined Tree Frog</p> <p>Local Name : Katak Pokok Jalur Empat</p>
	<p>Family : Rhacophoridae</p> <p>Scientific Name : <i>Philautus parvulus</i></p> <p>English Name : Dwarf Bush Frog (Eggs)</p> <p>Local Name : Katak Belukar Kecil</p>
	<p>Family : Dicroglossidae</p> <p>Scientific Name : <i>Fejervarya cancrivora</i></p> <p>English Name : Asian Brackish Frog</p> <p>Local Name : Katak Bakau, Katak Pemakan Ketam</p>