CHAPTER 6

EXISTING ENVIRONMENT

6.1 INTRODUCTION

This chapter is mainly explained about the condition of the existing environment including:

- Zone of study
- Physico-chemical
- Biological
- Socio economic

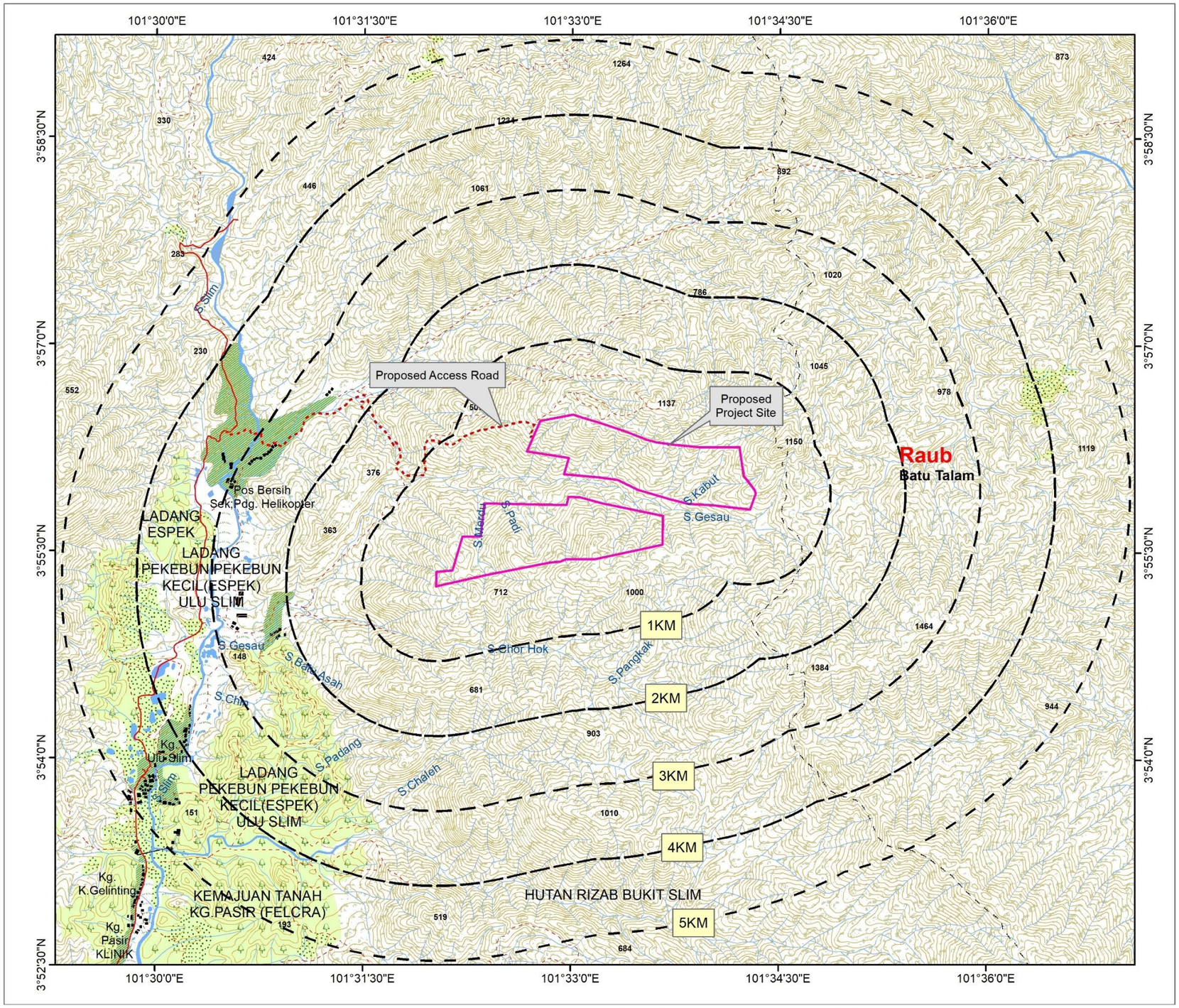
The information and data used in every aspects been studied classified as primary and also secondary data. The source of data will be stated in the phrases.

6.2 ZONE OF STUDY

As for the project site, zone of study is within 5 km radius had been done (**Figure 6.2.1**). There are a few Sensitive Receptor had been identified in the project site which are:

a) Orang Asli Settlements Area (approximately 3 km)
b) Water Intake (approximately 4 km)

Further discussed on the impacts and mitigation measures are in **Chapter 7** and **Chapter 8** respectively.



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Mukim Slim
Hutan Rizab Bukit Slim

Legend

- Project Site
- Mukim
- Access Road
- Paved Road
- River
- Contour Line
- Settlement Area
- Main River
- Lake
- Grass
- Secondary Forest, Belukar, Riung, Jerami
- Sundry Tree Cultivation
- .1137 Spot Height
- Rubber Plantation
- Oil Palm Plantation
- Forest

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Figure 6.2.1: Zone of Study within 5-km radius of the Project site

6.3 PHYSICO-CHEMICAL STUDY

Under this subchapter, mainly described on the following physico-chemical studies:

- Land use
- Topography
- Geology
- Soil
- Meteorological Conditions
- Air and Noise
- Water Quality
- Hydrology

6.3.1 Land Use

The following paragraphs describe the land use types found in the study area. **Figure 6.3.1** and **Table 6.3.1** show the land use activities within 5km radius from the project site.

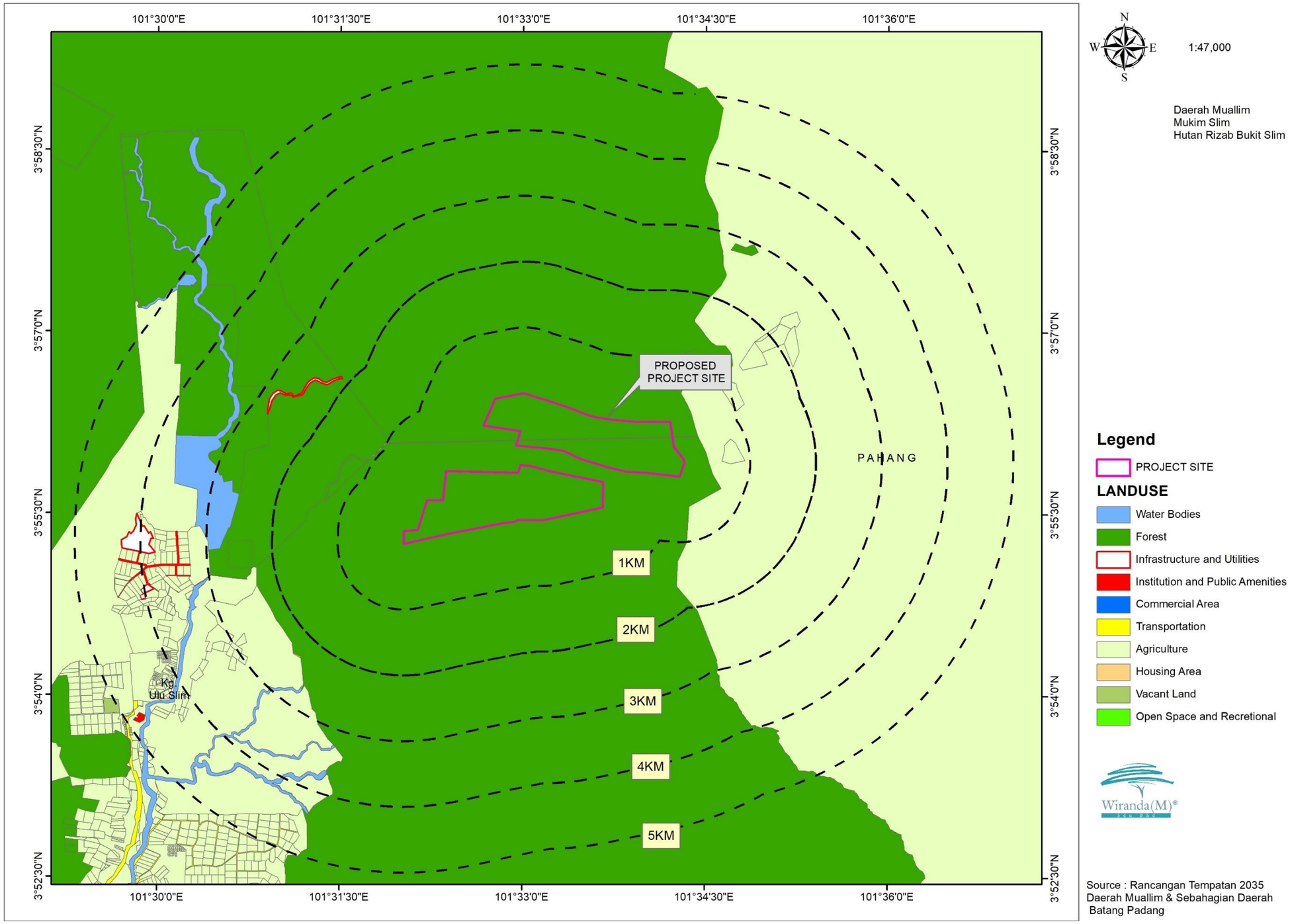


Figure 6.3.1: Existing Land Use of the Project Site

Table 6.3.1: Land Use of the Project Site

NO	DESCRIPTION	
1	Existing condition of the project site	
2	Kampung Orang Asli Sg Gesau (3 km radius from Project site)	
3	Kampung Orang Asli Pos Bersih (3 km radius from Project site)	
4	Kampung Ulu Slim (4 km radius from Project site)	

5	Water Treatment Plant Sg Geliting (4 km radius from Project site)	

a) Forest

The existing condition of the project site is a Forest Reserve; Bukit Slim Forest Reserve. This land has been approved for forest plantation and timber harvesting by the Department of Forestry, Perak Darul Ridzuan to be developed by Liput Raya Sdn Bhd for about 400 hectares of this forest.

b) Agriculture

Other than forest, the main land use activity that found surrounds the project site is agriculture, which is oil palm and rubber plantation. The plantations area mostly located at the western and southwest part of the project site.

c) Settlements

Settlements around the project site are further described in **Subchapter 6.5 – Socio-Economic**. The project site is in Mukim Slim and all settlements area is well facilitated with school, kindergarten, medical clinic and hall. **Table 6.3.2** shows the settlement areas within 5 km radius from the project site.

Table 6.3.2: The Settlement Areas with the Approximate Distance at the Project Site

HUMAN SETTLEMENT	APPROXIMATE DISTANCE AND LOCATION FROM THE PROJECT SITE
Kampung Orang Asli Sg Gesau	Western, 3 km radius
Kampung Orang Asli Pos Bersih	Western, 3 km radius
Kampung Ulu Slim	Southwest, 4 km radius

Clean tap water for this village is supplied by two sources namely Lembaga Air Perak (LAP) and *air bukit* whiles the electricity has been provided by Tenaga Nasional Berhad (TNB).

6.3.2 Topography

The topography of the Project site is described based on the range of elevation and slope terrain. The topographical view is illustrated in **Figure 6.3.2**.

Generally, this project site is lies within an elevation of 445 m to 980 m from the above of Mean Sea Level (MSL). The highest point about 980 m above MSL is spotted within the project site (northeast and southeast part). The hilly area is located at the northeast side and sloping down to the western part of the project site. The lowest point is sited at the west part of the site. The elevation mapping is presented in **Figure 6.3.3**.

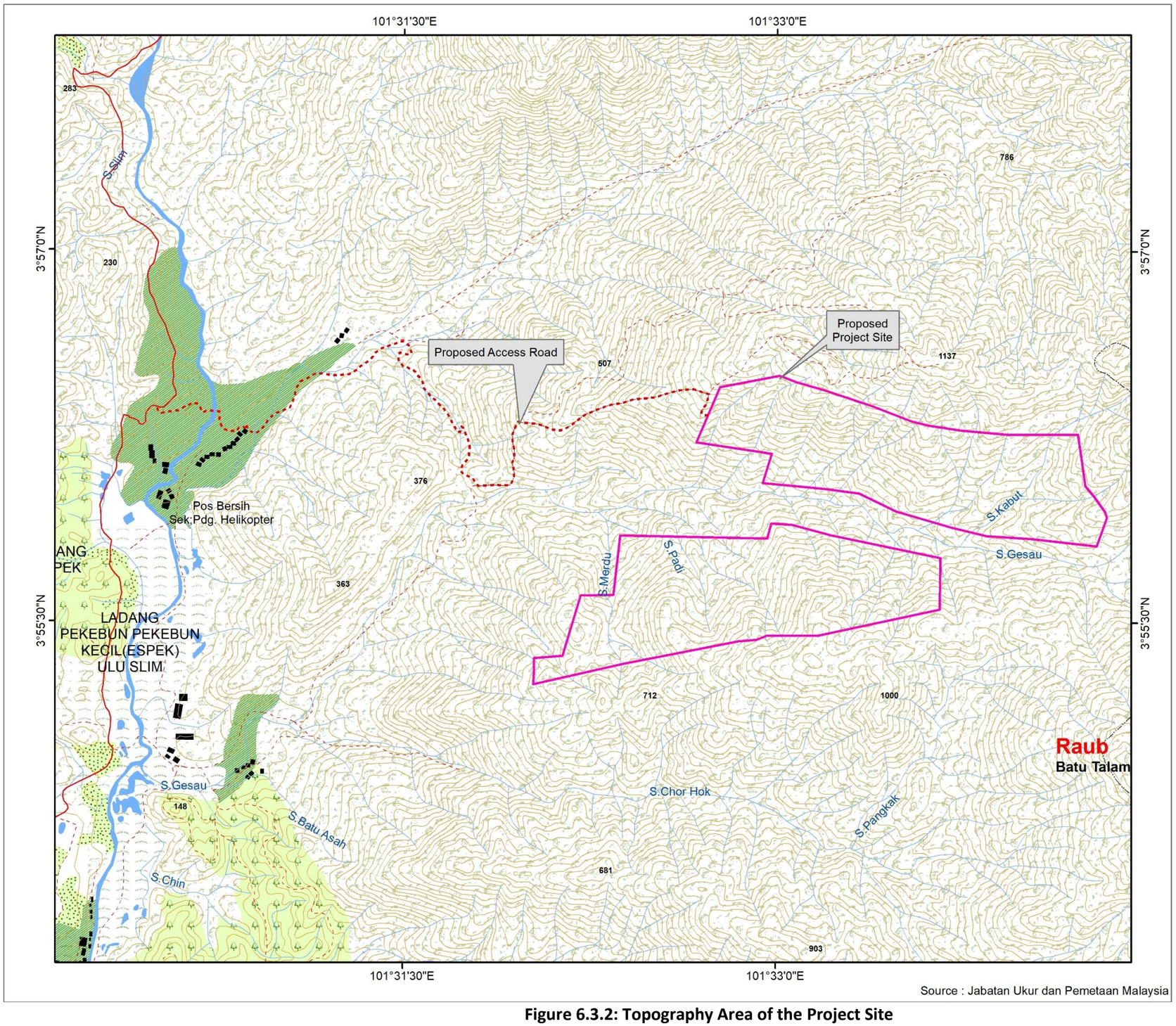


Figure 6.3.2: Topography Area of the Project Site

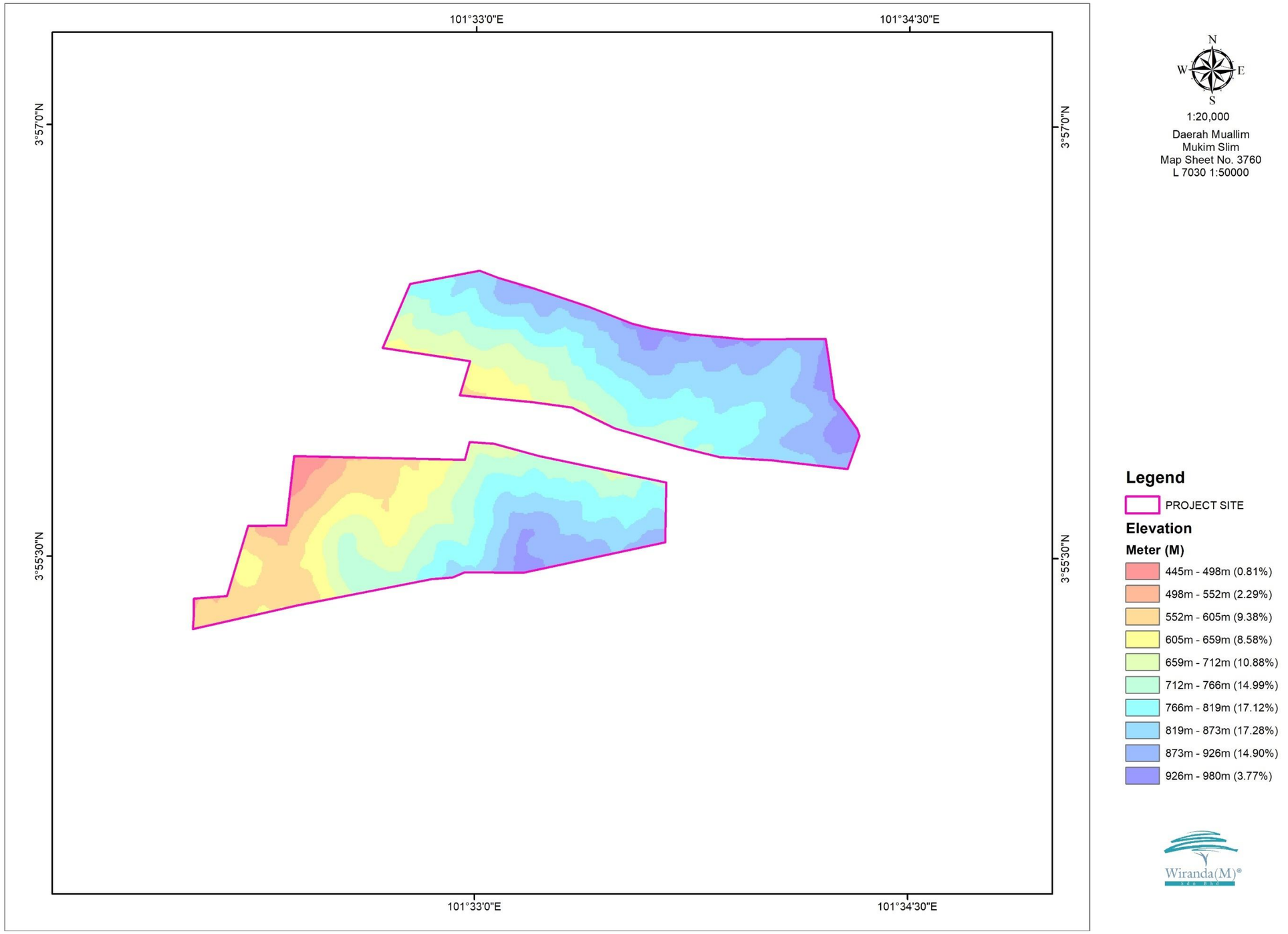


Figure 6.3.3: Elevation Range of the Project Site

i. Slope Gradient Analysis

The slope within the Project site has been analysed based on contour data acquired from Department of Survey and Mapping Malaysia (JUPEM). The slope analysis map is shown in **Figure 6.3.4**.

Table 6.3.3: Percentage of Slope within the Project Site

	SLOPE	CLASS	PERCENTAGE %	AREA (Ha)
	0˚ - 15˚	I	15.26%	61.04
	16˚ - 25˚	II	52.68%	210.72
	26˚ - 35˚	III	30.94%	123.76
	>35˚	IV	1.12%	4.48

Source: Consultant's estimation
**Note: Terrain classification according to Department of Agriculture*

Table 6.3.3 shows that the Project site is dominated by slope 16˚ - 25˚ that make up about 52.68% (210.72 ha) of the total area. Slope 26˚- 35˚ and 0˚- 15˚ make up 30.94% (123.76 ha) and 15.26% (61.04 ha) of the total area respectively. The remaining areas are slope above 35˚ that covering 1.12% (4.48 ha) of the total area respectively.

According to *Manual Perhutanan Jilid III*, harvesting of forest trees will not be performed in the area above 40˚ and while referring to slope class III (25˚ - 35˚), only 123.76 hectares is occupied which are less than 50% of the total area (400 hectares) of the project site. For area above 40˚ are strictly prohibited from any land development to protect the sloping structure and minimize the erosion.

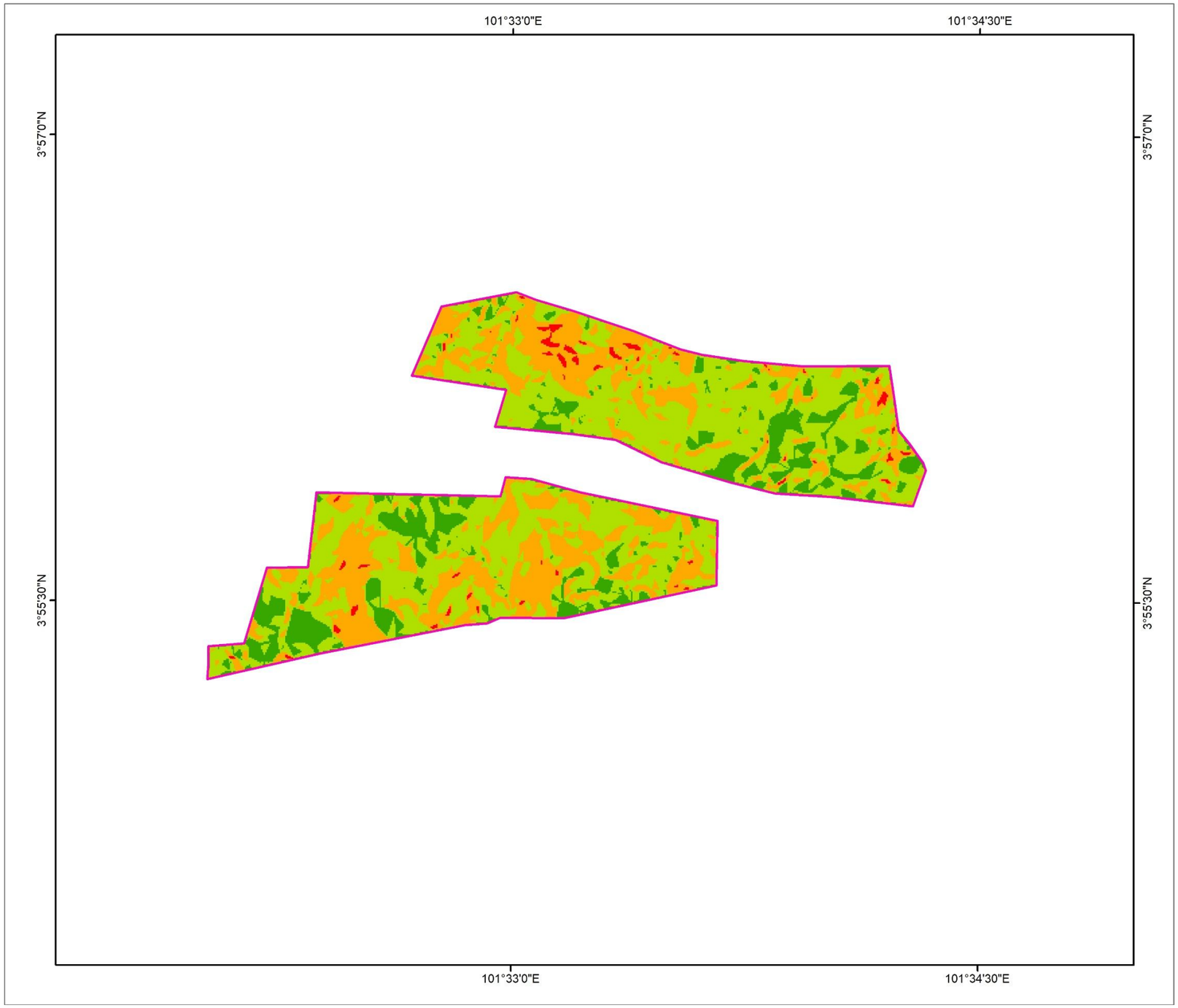


Figure 6.3.4: Slope Analysis of the Project Site

6.3.3 Geology & Mineral

Information about the geological set up in the project area was obtained from the Geological Map of Peninsular Malaysia, 1985, published by the Malaysian Geological Survey Department and "Geology of Peninsular Malaysia" jointly published by University of Malaya and The Geological Society of Malaysia.

While, minerals information for project site were describes from minerals map which is produced by Department of Minerals and Geosciences Malaysia (First Time Edition, 2010).

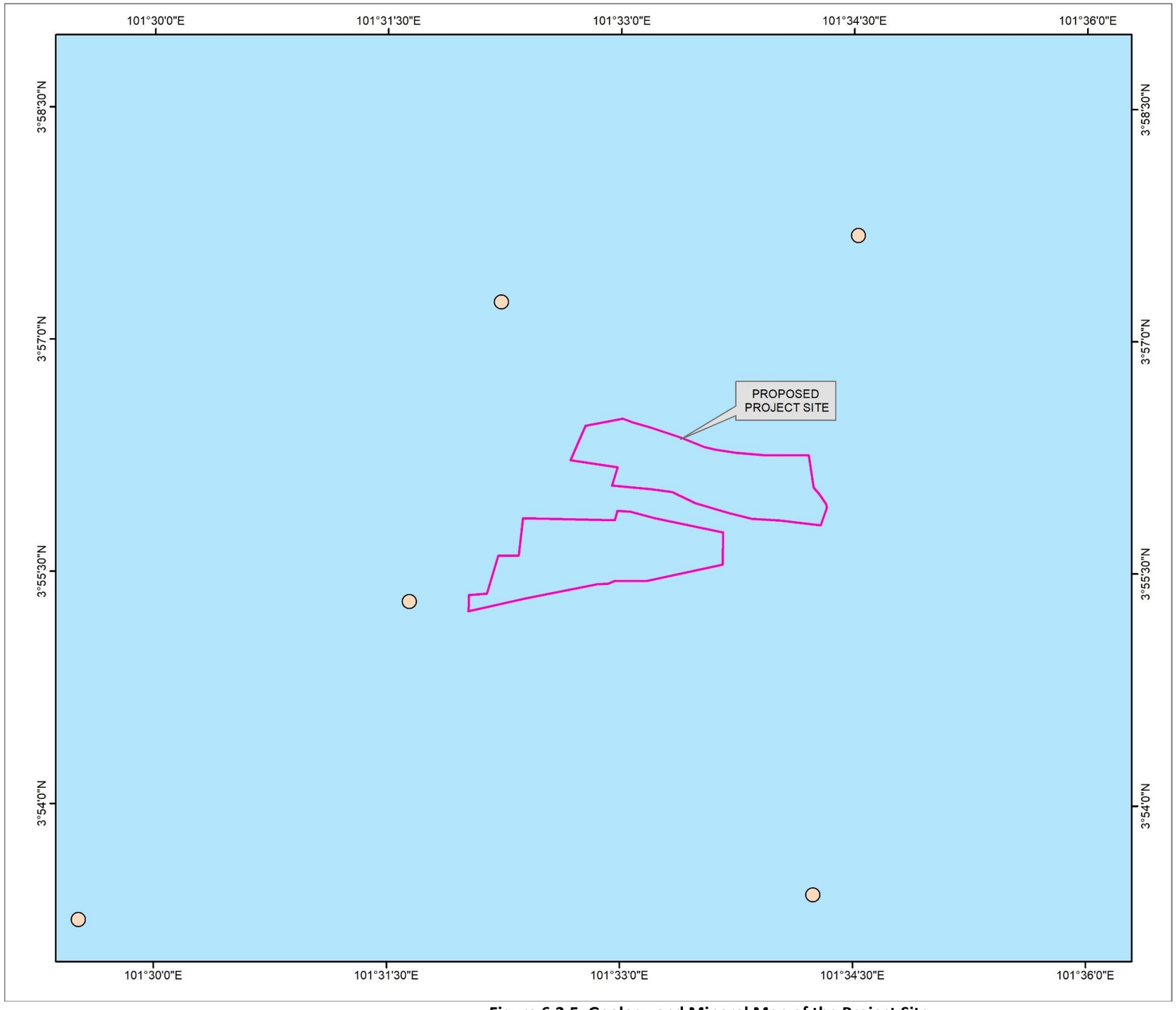
ii. Geology

The geology of the project site is categorized under Acid Intrusives (**Figure 6.3.5**) which consists of intrusive rocks mainly granite with minor granodiorite.

iii. Mineral

The information contained is obtained mainly from the Geological Survey of Malaysia including both published and unpublished reports.

Figure 6.3.5 shows the minerals map of the project site. Minerals study has been described within 5 km radius of the Project site. Tin (Sn) was found within 5 km radius of the Project boundary.



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Legend

PROJECT SITE

Mineral

Tin

Lithology

Acid intrusives (undifferentiated).

Discription
Intrusive rocks, mainly granite with minor granodiorite.

Source : Rancangan Tempatan 2035
Daerah Muallim & Sebahagian Daerah Batang Padang

Figure 6.3.5: Geology and Mineral Map of the Project Site

6.3.4 Soil

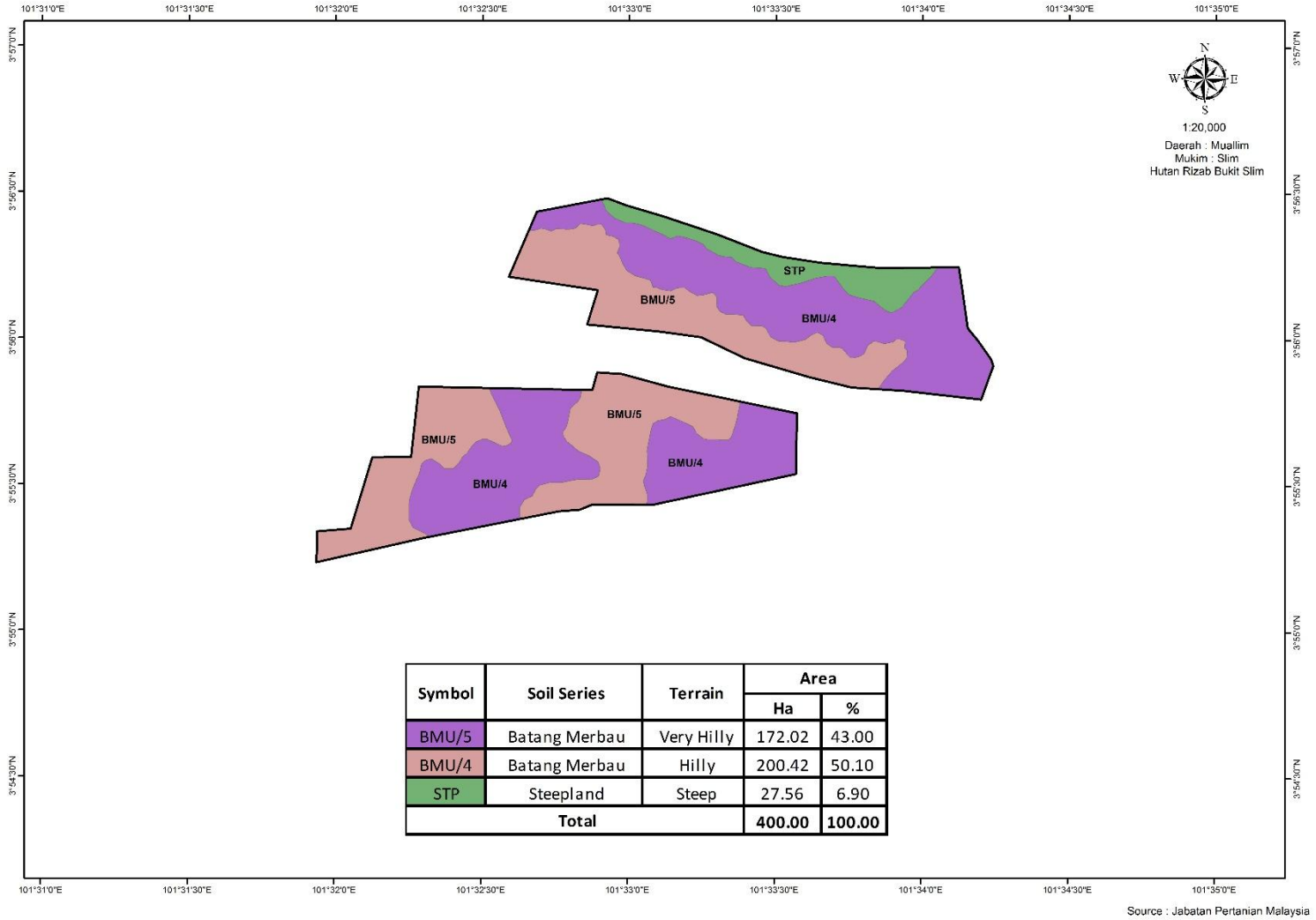
The assessment of the soil types in the study area is based on physical inspections and the Soils Map issued by the Deparment of Agriculture (**Appendix 6**). The soil type is shown in **Table 6.3.4**. While **Figure 6.3.6** shows the soil map of the project site.

Table 6.3.4: The Soil Types and their Extent

Symbols (Mapping Units)	Terrain Classes	Soil Series	Extent	
			Ha	%
Bmu/5	Very hilly	Batang Merbau Series	172.02	43.00
Bmu/4	Hilly	Batang Merbau Series	200.42	50.10
Stp	Steepland	Steepland	27.56	6.90
Total			**400.00**	**100.00**

Table 6.3.5: Soil Series Morphology Properties

Symbol	Soil Series	Terrain	Area Ha (%)
Bmu/5	Batang Merbau Series	Very Hilly (20° –25°)	172.02 (43.00%)
Bmu/4	Batang Merbau Series	Hilly (12°-20°)	200.42 (50.10%)
MORPHOLOGICAL PROPERTIES			
Soils of Batang Merbau Series are brownish yellow (10YR 5/4, 5/6, 5/8) to brown (10YR 5/2, 5/4): textured medium sandy clay; square block structure; fine to medium size; weak to medium grade; deep soil; cation exchange capacity <5 CMOL(+) perkilogram, low base saturation; harizon diagnosis argillic			
Symbol	**Soil Series**	**Terrain**	**Area Ha (%)**
STP/6	Steepland	Steep (25° –30°)	27.56 (6.90)
MORPHOLOGICAL PROPERTIES			
Steep topography soil.			



Symbol	Soil Series	Terrain	Area	
			Ha	%
BMU/5	Batang Merbau	Very Hilly	172.02	43.00
BMU/4	Batang Merbau	Hilly	200.42	50.10
STP	Steepland	Steep	27.56	6.90
Total			**400.00**	**100.00**

Figure 6.3.6: Soil Map of the Project Site

a. Estimation of the Soil Erosion Potential for Existing Conditions

The purpose of the soil loss equation is to predict soil loss due to soil erosion processes and to provide a guide in conservation planning on a farm basis. The equation enables the planner to predict the average rate of soil erosion for each of the various combinations of crop system, management techniques and conservation practices on any particular area.

The Revised Universal Soil Loss Equation (RUSLE) was developed from erosion plot and rainfall simulator experiments. The RUSLE is composed of six factors to predict the long-term average annual soil loss (A). The equation takes the simple product form:

$$A = R \times K \times LS \times C \times P$$

Where;

A = average annual soil loss in the Project area

R = rainfall erosivity index

K = soil erodibility factor

LS = topographic factor which represent the slope length and slope steepness

C = a cropping-management factor

P = conservation practice factor

Therefore, RUSLE equation which follows the Urban Storm Water Management (MSMA) and Department of Agriculture Malaysia (DOA) guideline are used to estimate the value of an average annual soil loss of the Project area. The unit of the average annual soil loss (A) is ton/hectare/year. The Department of Agriculture Malaysia classified the soil loss into 5 categories as shown in **Table 6.3.6**.

Table 6.3.6: Classification of Soil Loss

SOIL LOSS (ton/ha/yr)	CLASSIFICATION
<10	Low
10 – 50	Moderate
50 – 100	Moderate High
100 – 150	High
>150	Very High

Source: Erosion Risk Map Peninsular Malaysia, Department of Agriculture

For the Project, the potential soil loss calculations have been calculated using the Department of Irrigation and Drainage Malaysia (DID) method. **Table 6.3.7** shows the estimation of the soil erosion potential for existing conditions in a phased development. The details of soil suitability report and soil calculation can be referred in **Appendix 6** and **Appendix 7** respectively.

Generally, soil loss occurs even under natural conditions without human interference. The Project site is covered with forest vegetation. Therefore, the expected soil loss can be small under existing undisturbed conditions as opposed to the potential soil loss after intervention by development activities in the particular area.

Table 6.3.7: Estimation of Soil Loss by Phase Development

(Existing Condition)

STAGE	PETAK	AMOUNT OF SOIL LOSS (TONNE)
		DID METHOD
1	1	1.16
	2	0.68
2	3	1.47
	4	1.39

Source: Consultant's Calculation

Note: For DID method, the R value was taken from the Guideline for Erosion and Sediment Control in Malaysia, (DID Malaysia).

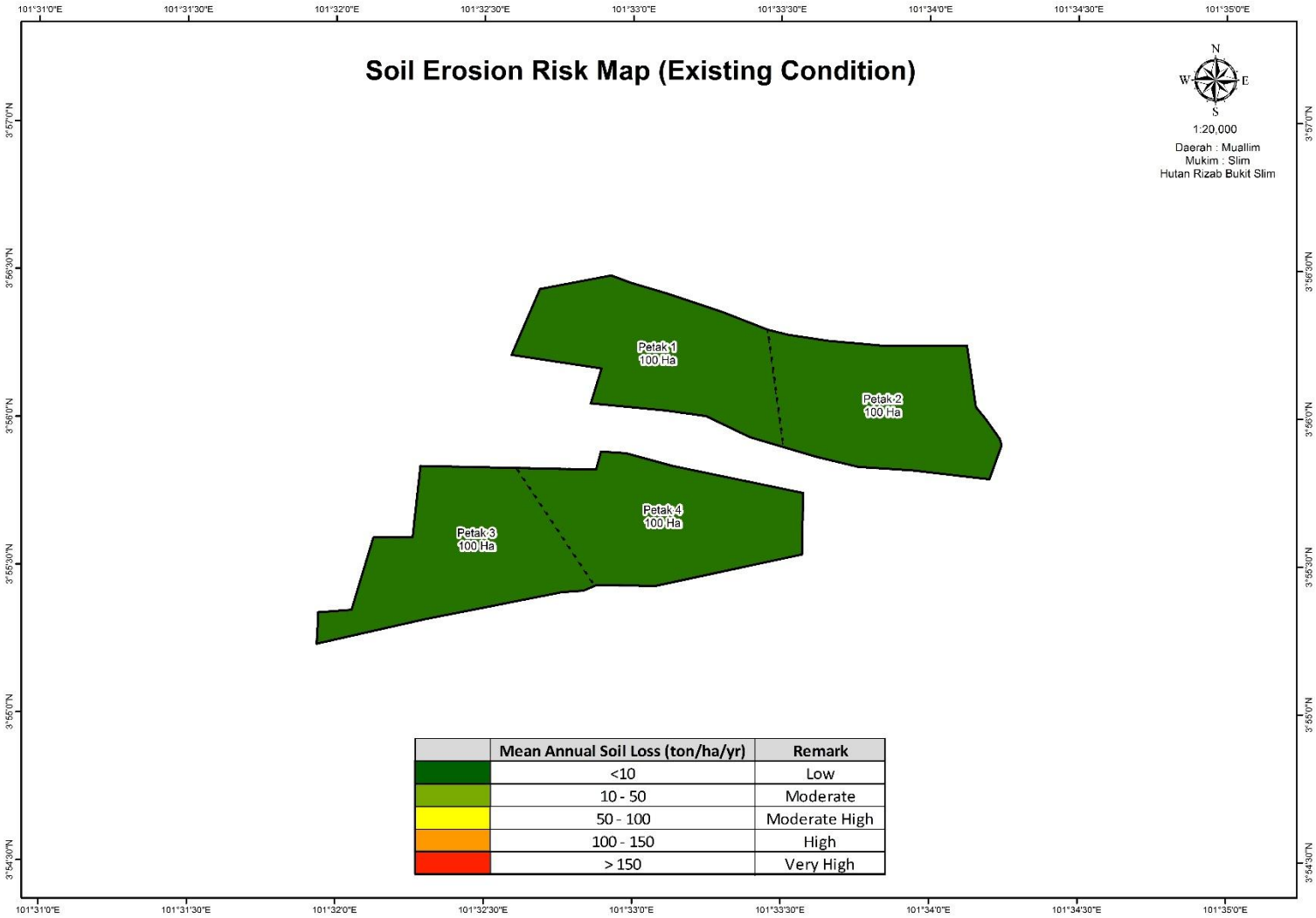


Figure 6.3.7: Soil Erosion Risk Map (Existing Condition)

b. Estimation of Sediment Yield

The Modified Universal Soil Loss Equation (MUSLE) is used for the sediment yield estimation. It was developed by Williams (1975) to calculate the sediment yield of a catchment as a result of a specific storm event. The empirical relationship is expressed by the following equation for individual storm events:

$$Y = 89.6(VQp)^{0.56} (K\ LS\ C\ P)$$

Where;

Y	=	Sediment yield per storm event (tons)
V	=	Runoff volume in cubic meter
Qp	=	Peak discharge in m3/s

Table 6.3.8 shows the estimation of sediment yield under existing conditions within the Project site. The estimated value is t/event. The detailed calculations are shown in **Appendix 7**.

Table 6.3.8: Estimation of Potential Sediment Yield for Existing Conditions

PETAK	TOTAL (tonne/event)
	Existing Condition
1	12.2
2	7.2
3	15.5
4	14.6

Source: Consultant's Calculation.

6.3.5 Hydrology

a. River System and Drainage Patern

River System

The river that contributed in this project site is tributaries of Sg Gesau. Tributaries of Sg Gesau flow to the west of the Project site and discharge into Sg. Slim. All the contributed river will finally discharge into the main river of Sungai Bernam. Distance of project site from Sungai Slim is approximately 5 km.

b. Hydrology Pattern

Catchment

There is one (1) catchment of this particular river at the project site with total area of 12.07 km^2.

Flood Estimation

The flood frequency estimates of the main rivers catchments were carried out using the MSMA 2nd Edition by Drainage and Irrigation Department (DID). The calculation of Peak Discharge, Q_{peak} for the study area was based on Modified Rational Method (D.I.D 1975) as shown below.

$$Qy = \frac{C\ yIt\ A}{360}$$

Where,

Qy : y year ARI peak flow (m3/s)

A : drainage area (ha)

C : dimensionless runoff coefficient

yIt : y year ARI average rainfall intensity over time of concentration , tc(mm/hr)

Table 6.3.9 below shows the estimated peak flow for main river catchment within the Project site for recurrent interval of 2-years, 5-years, 10-years, 20-years, 50-years and 100-years.

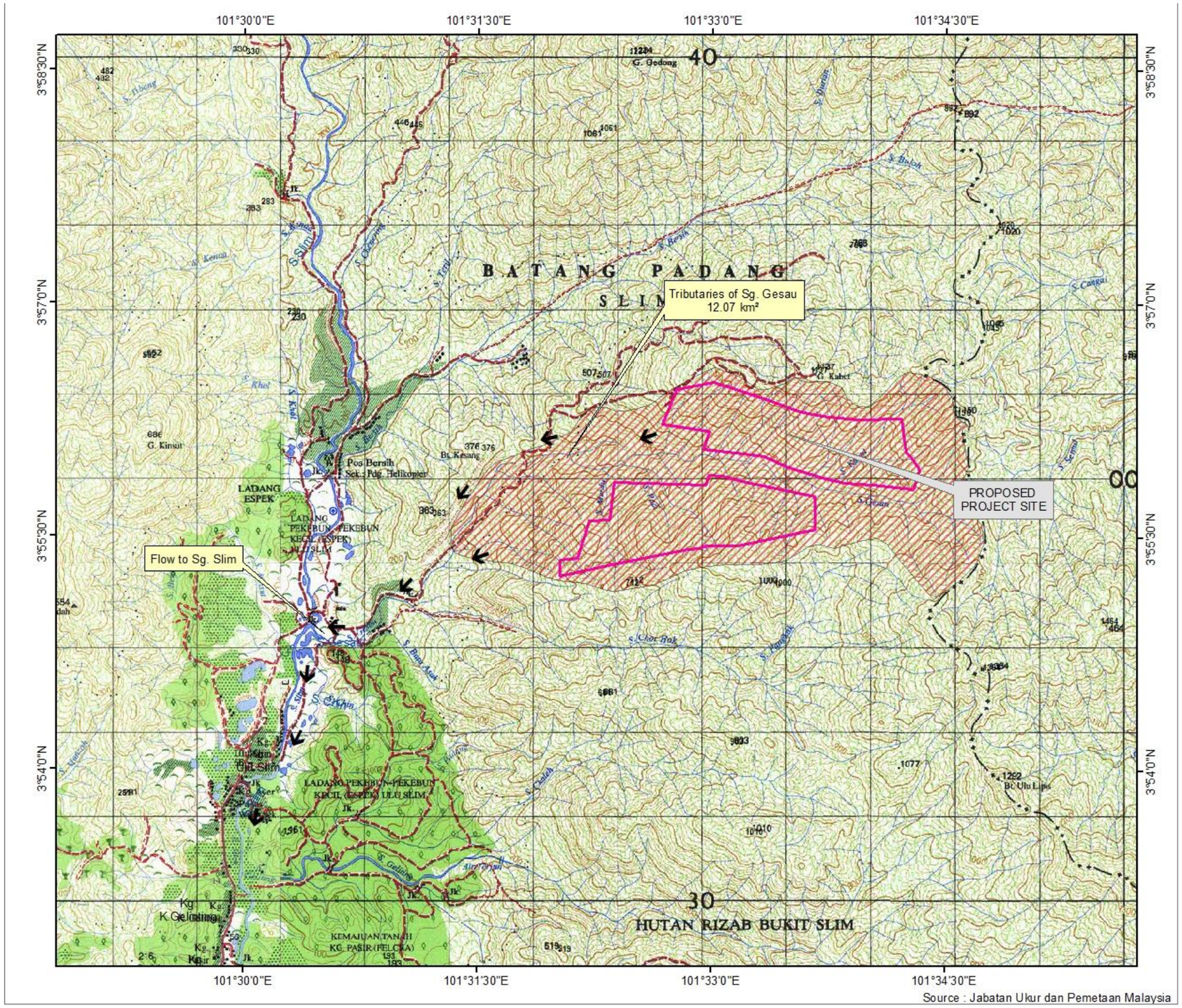
Table 6.3.9: The Peak Flow for the Tributaries of Sungai Gesau

Location	Rec. Interval Years/Event	Peak Flow, Q pre (existing) (m^3/s)	Peak Flow, Q during timber harvesting (m^3/s)	Q post (m^3/s)		
				Peak Flow, Q after 6 months development (m^3/s)	Peak Flow, Q after 2 years development (m^3/s)	Peak Flow, Q after 5 years development (m^3/s)
Tributaries of Sungai Gesau (12.07 km^2)	2	19.88	23.85	22.86	20.87	19.88
	5	30.47	36.57	35.04	32.00	30.47
	10	38.67	46.40	44.47	40.60	38.67
	20	48.45	58.14	55.71	50.87	48.45
	50	62.33	74.80	71.68	65.45	62.33
	100	73.52	88.23	84.55	79.91	73.52

****Consultant's Estimation*

The time concentration, tc were influenced by the topography, geology, shape and size of shape catchment and land use within the watershed. The peak flow, Q value above shows for Q existing, Q during timber harvesting, Q after 6 months planted with cover crops, Q after 2 years forest development and Q after 5 years forest development for the catchment of tributaries of Sg Gesau.

During timber harvesting, there may be slight increase in the peak flow which inevitably will affect the erosion and sedimentation. It is expected and unlikely flood may occur due to over flowing of surrounding river systems into the project site. The best management practices or Land Disturbing, Pollution Prevention and Mitigation Measure (LD-P2M2) (Sediment Trap, Sediment Basin, Check dam) shall be installed first at site before field establishment started to minimize erosion and sediment enter to water courses. Refer **Appendix 8** where it shows that the value of peak flow, Q after 5 years forest development equal to peak flow, Q existing at project site.



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Legend

- water flow
- Catchment
- Project site

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Figure 6.3.8: Catchment Map at the Project Site

6.3.6 Meteorological Conditions

Description of the climate in the Project site and its surrounding is based on data obtained from the nearest meteorological stations such as rainfall, temperature, relative humidity, wind speed and wind rose. The nearest meteorological station located at Felda Sungai Behrang (Coordinate point: 03° 47’ N and 101° 28' E; and Elevation: 48 m).

a) Rainfall

Figure 6.3.9 shows the annual rainfall for ten years (2010-2019). The average annual rainfall for the ten years ranges from 105.9 mm to 403.5 mm. The maximum annual rainfalls were recorded higher in the Year 2012 (403.5 mm)

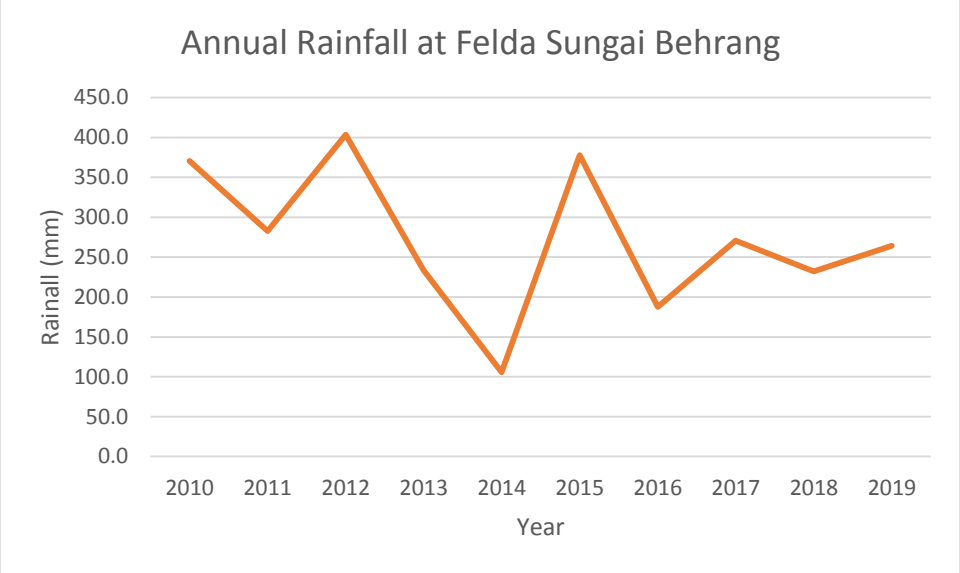


Figure 6.3.9: Annual Rainfall at Felda Sungai Behrang Station (2010-2019)

b) Temperature

The annual mean temperature for ten years (2010-2019) the temperature ranges from 26.5 °C - 27.7 °C. From the following figure, it shows that Year of 2016 recorded the highest annual mean temperature (27.7 °C) while Year of 2010 recorded the lowest annual mean temperature (26.5 °C).

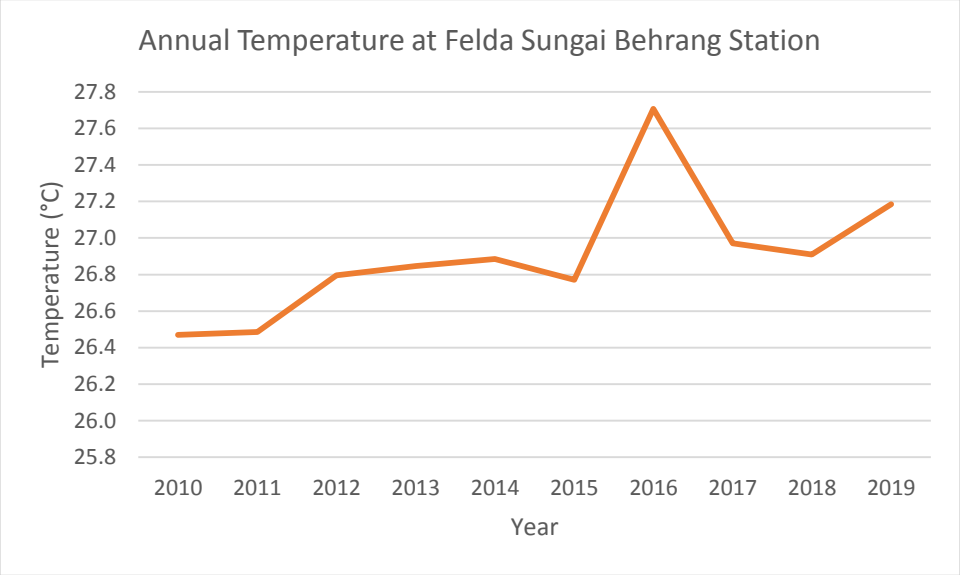


Figure 6.3.10: Annual Mean Temperature at Felda Sungai Behrang Station for Ten Years (2010-2019)

c) Relative Humidity

Figure 6.3.11 shows the average annual of relative humidity. Annual relative humidity for the year 2010 - 2019 ranged from 78.2% to 86.6%

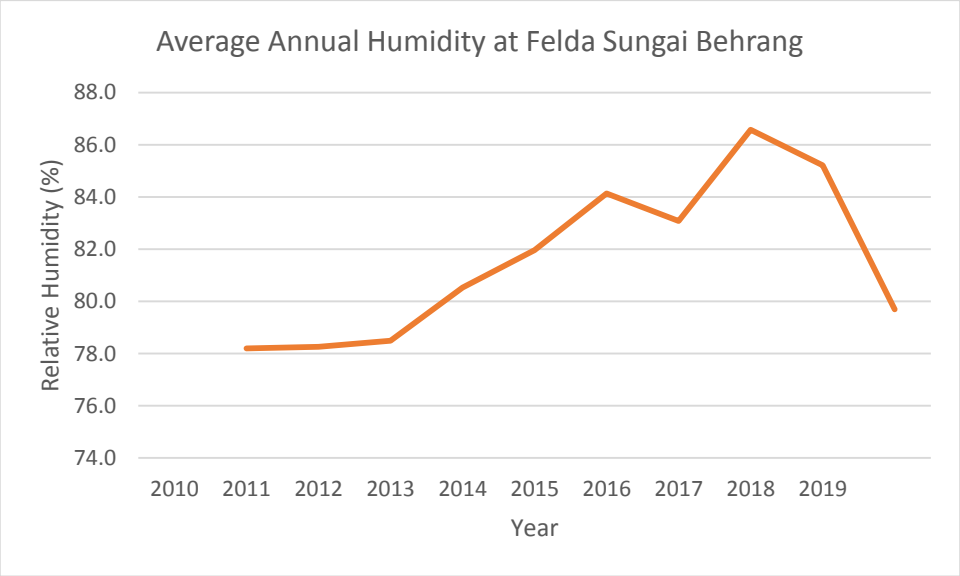


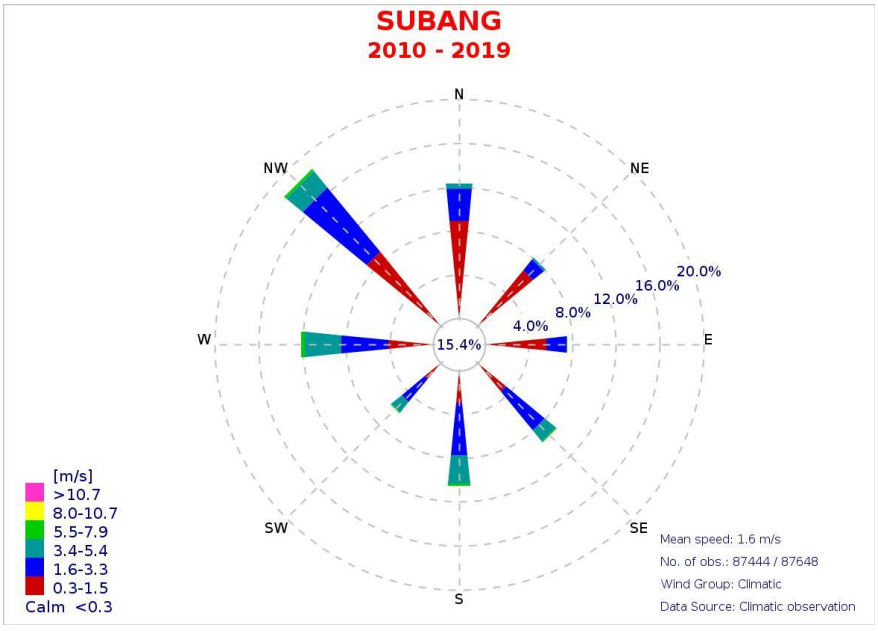
Figure 6.3.11: Ten Years Monthly Average Relative Humidity at Felda Sungai Behrang Station

d) Surface Wind

The data used to describe the wind characteristic was based on the summary data of 2010 to 2019 at Subang Meteorological Station which is the nearest station with availability data. The summary of wind rose is shown in **Table 6.3.10** and **Figure 6.3.12**. Higher wind speeds ranged between 2.1 to 2.5 m/s which come from the south and west directions while lower wind speeds ranged between 1.1 to 1.3 m/s blows from the north and east.

Table 6.3.10: Percentage Frequency and Mean Velocity of Winds from Various Directions

Percentage frequencies of occurrence for concurrent wind direction (degrees) and speed (m/s) within specified ranges [%]								
	Wind speed range							
Direction	**0.3-1.5**	**1.6-3.3**	**3.4-5.4**	**5.5-7.9**	**8.0-10.7**	**>10.7**	**Total**	**Mean Speed**
Calm							**15.4**	
Variable	0	0	0	0	0	0	**0**	
N	8.9	3	0.5	0	0	0	**12.4**	1.3
NE	6.5	1.4	0.2	0	0	0	**8.1**	1.1
E	5.7	1.8	0.1	0	0	0	**7.6**	1.2
SE	3.4	4.6	1.3	0.1	0	0	**9.3**	2.1
S	3	4.8	2.6	0.2	0	0	**10.5**	2.5
SW	1.9	2.7	1.3	0.1	0	0	**5.9**	2.4
W	4.2	4.3	3.3	0.3	0	0	**12.1**	2.5
NW	8.7	7.6	2	0.2	0	0	**18.5**	1.9



Source: Malaysian Meteorological Department, 2020

Figure 6.3.12: Wind Rose Summary of Subang Station (2010-2019)

6.3.7 Ambient Air Quality

The project site is located in a forest reserve. The ambient air quality study was carried out on 2nd to 4th December 2020. The parameter measured was Portable Air Volume Sampler. This monitoring was conducted for 24 hours at all sampling stations. The details of the sampling stations and the results of analysis are shown in **Figure 6.3.13** and **Table 6.3.11**.

The result of the analysis (**Table 6.3.11**) shows baseline values for Particulate Matter (PM10) ranging between 13.6 µg/m^3 to 21.3 µg/m^3. There are no industrial activities or significant air pollution sources in the vicinity that may adversely contribute to air pollutants in the study area. Only vehicular movements that produce exhaust emissions can contribute to temporary air pollution in the area.

The certificates of analysis for the air quality are attached in **Appendix 9**.

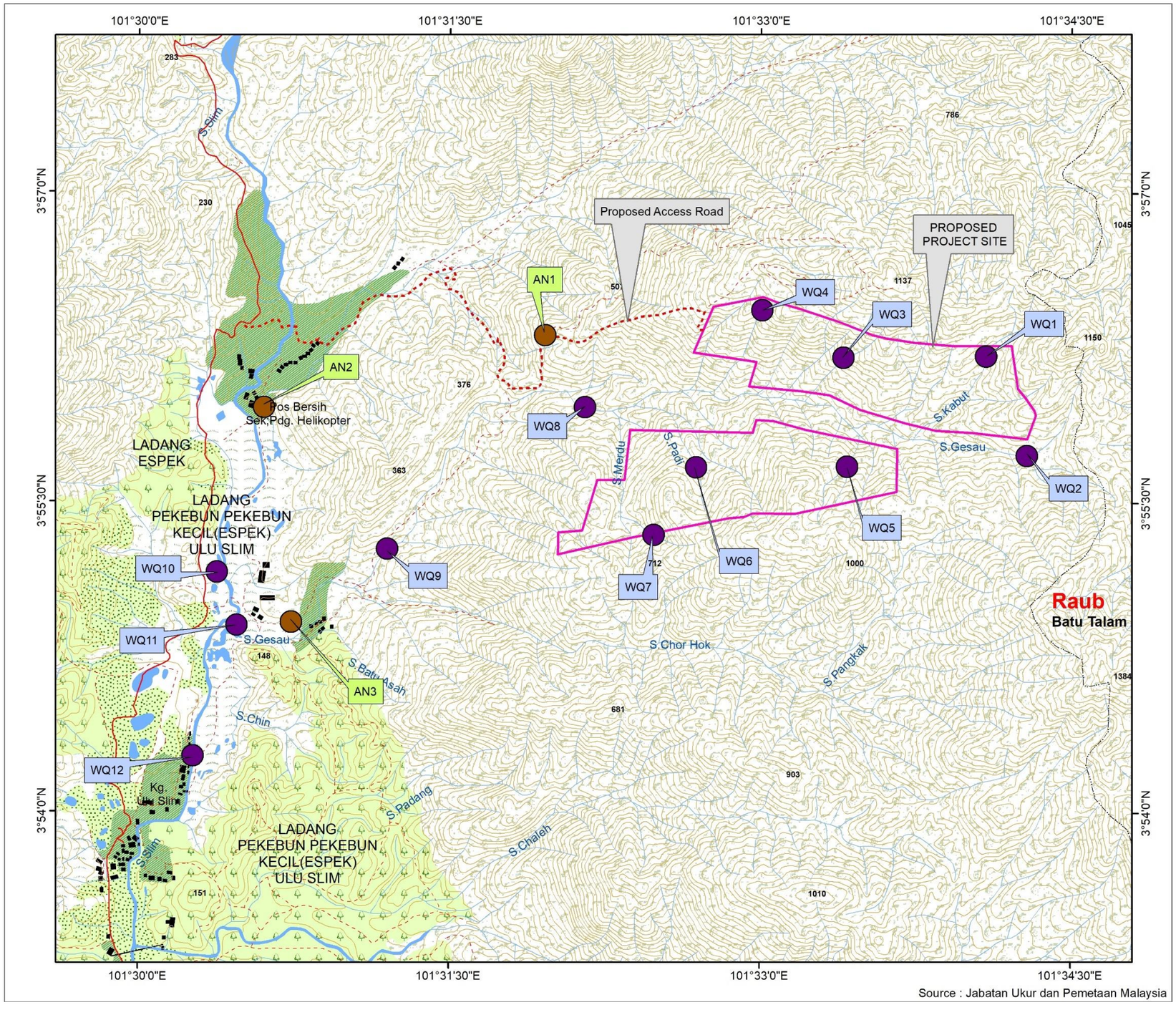
Table 6.3.11: Ambient Air Quality Results for All Sampling Stations

A1			
	**Location**	Access Road	
	Coordinate	101° 31' 57.616" E 3° 56' 18.476" N	
	Sampling Date	2/12/2020	
	ANALYSIS DATA		
	Test Parameter	**Result**	**Recommended Limit****
	PM_{10} (µg/m^3)	13.6	100
A2			
	**Location**	Nearest settlement, Pos Bersih	
	Coordinate	101° 30' 36.330" E 3° 55' 57.425" N	
	Sampling Date	4/12/2020	
	ANALYSIS DATA		
	Test Parameter	**Result**	**Recommended Limit****
	PM_{10} (µg/m^3)	21.3	100

A3

Location	Nearest settlement, Kg Sg Gesau	
Coordinate	101° 30' 44.199" E 3° 54' 55.048" N	
Sampling Date	3/12/2020	
ANALYSIS DATA		
Test Parameter	**Result**	**Recommended Limit****
PM_{10} (µg/m^3)	18.5	100

**Malaysia Ambient Air Quality Standard (2020)*
Source: EHSANLAB



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Hutan Rizab Bukit Slim

Legend

- Project Site
- Mukim
- Unpaved Road
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- Lake
- Grass
- Secondary Forest, Belukar, Riung, Jerami
- Sundry Tree Cultivation
- .1137 Spot Height
- Rubber Plantation
- Oil Palm Plantation
- Forest
- Swamp
- Air and Noise Sampilng Point
- Water Quality Sampling Point

Source : Jabatan Ukur dan Pemetaan Malaysia

Figure 6.3.13: Locations of Air Quality, Noise Level & Water Quality Monitoring Stations

6.3.8 Ambient Noise

Noise level monitoring was carried out in the vicinity of the project site to delineate the existing condition of noise levels and also to obtain baseline data for the EIA report. Noise level monitoring was carried out on 2nd to 5th December 2020. Three ambient noise level stations were selected as shown in **Figure 6.3.13**.

Ambient noise level was conducted for 24 hours at all sampling stations. The details of the sampling stations and the results of analysis are shown in **Table 6.3.12**. The Certificate of Laboratory Analysis is attached **in Appendix 9**.

The results of the analysis show that the baseline L_{Aeq} ranged between 48.6 dBA to 54.5 dBA for day time. For night time, the L_{Aeq} ranged between 35.8 dBA to 43.8 dBA. All sampling points comply with the recommended limit of Schedule 1 in the Planning Guidelines for Environmental Noise Limits and Control, 2019.

Table 6.3.12: Ambient Noise Levels for All Sampling Stations

N1

Location	Access Road		
Coordinate	101° 31' 57.616" E 3° 56' 18.476" N		
Sampling Date	2/12/2020 – 3/12/2020		
Result	**Day Time**	**Night Time**	***Recommended Limit**
L_{Aeq}	48.6	35.8	Day Time: 55 dBA Night Time: 50 dBA

N2

Location	Nearest settlement, Pos Bersih		
Coordinate	101° 30' 36.330" E 3° 55' 57.425" N		
Sampling Date	4/12/2020 – 5/12/2020		
Result	**Day Time**	**Night Time**	***Recommended Limit**
L_{Aeq}	53.1	42.6	Day Time: 55 dBA Night Time: 50 dBA

N3

Location	Nearest settlement, Kg Sg Gesau		
Coordinate	101° 30' 44.199" E 3° 54' 55.048" N		
Sampling Date	3/12/2020 – 4/12/2020		
Result	**Day Time**	**Night Time**	***Recommended Limit**
L_{Aeq}	54.5	43.8	Day Time: 55 dBA Night Time: 50 dBA

** Suburban Residential (Medium Density) Areas, Public Spaces, Parks, Recreational Areas. (Source: Annex A, Schedule 1: Maximum Permissible Sound Level (LAeq) by Receiving Land Use for Planning and New Development. The Planning Guidelines for Environmental Noise Limits and Control, 2019)*

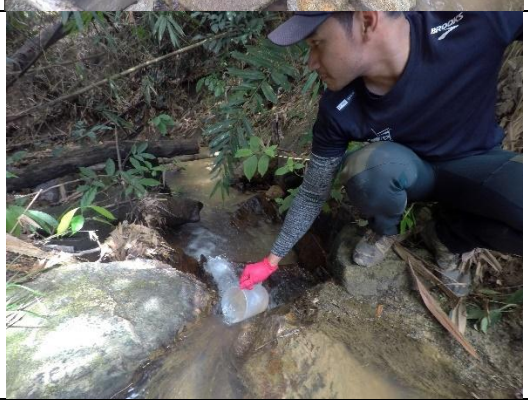
Source: ERALab Sdn Bhd

6.3.9 Water Quality

Water quality sampling was conducted on 2 until 3 December 2020. For the purpose of documenting the existing water quality, twelve (12) location of sampling stations were selected as shown in **Table 6.3.13**. All the water samples were collected within and outside the project site to obtain the existing conditions of water quality before any timber harvesting activities and Forest Plantation development take place. Therefore, all the results of the water quality will be referred as the baseline data in the EIA report. The grab sampling technique was used to collect the water samples. The samples were kept in ice and sent to ERALab Sdn Bhd to be analyzed. The water quality sampling locations is shown in **Figure 6.3.13**.

Table 6.3.13: Location of Water Quality Sampling Stations

SAMPLING STATION	COORDINATE	PICTURE
WQ1	101° 34' 5.373" E 3° 56' 12.659" N (Sg. Kabut (Tributary of Sg Gesau) – Within project boundary)	
WQ 2	101° 34' 17.166" E 3° 55' 43.715" N (Sg. Gesau – Upstream)	

WQ 3	101° 33' 24.075" E 3° 56' 12.171" N (Tributary of Sg. Gesau – Within project boundary)		
WQ 4	101° 33' 0.546" E 3° 56' 25.972" N (Tributary of Sg. Gesau – Within project boundary)		
WQ 5	101° 33' 25.163" E 3° 55' 40.535" N (Tributary of Sg. Gesau – Within project boundary)		
WQ 6	101° 32' 41.528" E 3° 55' 40.229" N (Sg. Padi (Tributary of Sg Gesau) – Within project boundary)		

WQ 7	101° 32' 29.218" E 3° 55' 20.555" N (Sg. Merdu (Tributary of Sg Gesau) – Within project boundary)	
WQ 8	101° 32' 9.234" E 3° 55' 57.623" N (Sg. Gesau – Downstream)	
WQ 9	101° 31' 11.980" E 3° 55' 16.347" N (Sg. Gesau – Downstream)	
WQ 10	101° 30' 22.776" E 3° 55' 9.567" N (Sg. Slim – Upstream)	

WQ 11	101° 30' 28.477" E 3° 54' 54.150" N (Sg. Gesau – Downstream)	
WQ 12	101° 30' 15.875" E 3° 54' 16.092" N (Sg. Slim – Downstream)	

i) Existing Water Quality

In-situ measurements for selected parameters were carried out using pre-calibrated portable meters for temperature, pH, dissolved oxygen (DO) and turbidity. **Table 6.3.14** shows the water quality parameter at the respective water quality stations. The water quality in the river near the Project site should follow the Class IIB of the National Water Quality Standard (NWQS). The certificate is attached in **Appendix 9**.

Table 6.3.14: Water Quality Within and Outside the Project Site

SAMPLING STATION	Temperature (°C)	pH	DO (mg/L)	Turbidity (NTU)	BOD_5 (mg/L)	COD (mg/L)	TSS (mg/L)	Oil & Grease (mg/L)	NH_3N (mg/L)	Total Coliform (cfu/100 mL)
WQ1	25.4	7.12	9.05	7.30	1	<4	2	ND(<1)	ND(<0.2)	1800
WQ2	25.3	6.45	9.12	5.11	3	6	2	ND(<1)	ND(<0.2)	1100
WQ3	24.9	7.00	8.78	8.26	3	8	40	ND(<1)	ND(<0.2)	2100
WQ4	24.8	6.84	8.97	6.60	3	10	7	ND(<1)	ND(<0.2)	920
WQ5	24.8	5.20	6.74	7.40	2	7	19	ND(<1)	ND(<0.2)	670
WQ6	24.9	6.63	6.95	9.24	3	10	3	ND(<1)	ND(<0.2)	230
WQ7	25.1	6.32	6.88	8.33	2	5	2	ND(<1)	ND(<0.2)	310
WQ8	24.5	6.68	8.09	6.44	1	4	12	ND(<1)	ND(<0.2)	360
WQ9	25.5	5.13	7.25	28.2	2	5	11	ND(<1)	ND(<0.2)	2500
WQ10	25.6	6.90	6.98	24.2	1	<4	5	ND(<1)	ND(<0.2)	780
WQ11	25.3	6.80	7.43	16.2	1	4	16	ND(<1)	ND(<0.2)	1100
WQ12	25.7	6.20	7.15	28.1	2	5	13	ND(<1)	ND(<0.2)	1400
Class IIB of NWQS	**-**	**6-9**	**5-7**	**50**	**3**	**25**	**50**	**40;N**	**0.3**	**5000**

Source: ERALab Sdn Bhd

Temperature

Variations of temperature at the river water quality stations ranged from 24.5 °C to 25.7 °C. The variation of temperature basically is influenced by the size of the respective water bodies, soil type and cover, wind, cloud cover, water vapor, and moisture on the ground.

pH

The pH values for all water quality stations recorded in the ranged pH 5.20 to 7.12. Based on this in-situ analysis, all the sampling stations comply with the acceptable range except for WQ1 and WQ3 with 7.12 and 7.00 respectively.

Dissolved Oxygen (DO)

The DO concentration ranged from 6.74 to 9.12 mg/L. Due to the natural condition, oxygen enters the water mostly via diffusion at the water-air interface. DO is an important water quality parameter that influences the living conditions of all aquatic organisms that require oxygen. Only WQ5, WQ6, WQ7 and WQ10 comply with the acceptable range.

Turbidity

This physical characteristic of water is a measurement of the water clarity. The turbidity values at all of the water quality stations ranged from 5.11 NTU to 28.2 NTU. Basically, the turbidity component consists of suspended solids in the form of clay, silt, and sand from soils, phytoplankton (suspended algae) and bits of decaying vegetation. All water sampling stations recorded turbidity value within the acceptable range.

Biochemical Oxygen Demand (BOD_5) and Chemical Oxygen Demand (COD)

The organic loading of the water bodies can be measured by its Biochemical Oxygen Demand (BOD5) and Chemical Oxygen Demand (COD) values. The lowest and highest levels for BOD are 1 mg/L and 3 mg/L respectively. While for COD parameter, the lowest and highest levels for this parameter are 4 mg/L and 10 mg/L respectively.

BOD is the total dissolved oxygen required by bacteria for the decaying process under aerobic conditions. It also the best indicator in determine oxygen pressure in consequence

of organic pollution of aquatic organisms living. All sampling stations recorded BOD and COD value within the acceptable range.

Total Suspended Solid (TSS)

TSS is a measure of the mass of suspended material in a given volume of water. It acts as an indicator to soil erosion and is linked to transport in rivers; it includes nutrients, metals and chemicals associated with agricultural activities (Un GEMS/Water, 2005). The TSS values for all water quality stations in the ranged of 2 mg/L to 40 mg/L. All sampling stations recorded TSS value within the acceptable range.

Oil & Grease, Ammoniacal Nitrogen & Total Coliform

All the recorded values for these parameters in all sampling stations are within acceptable range.

NPK

Some water quality stations were selected for NPK (total nitrogen, Phosphate and Potassium as K) analysis. The selected water stations and the results are shown in **Table 6.3.15**.

Table 6.3.15: NPK Content in the Water Sampling Stations

Metals	Total Nitrogen as N (mg/L)	Phosphorus as P (mg/L)	Potassium as K (mg/L)
WQ9	1	0.11	1.24
WQ12	2	0.09	1.36

ii) Water Quality Index

The study utilized a system of classifying water quality based on the water quality Index (WQI). The WQI relates a group of water quality parameters to a common scale and combines them into a single number. WQI is a method of combining numerous water quality parameters into one concise and objective value representing the state of the water quality trend. In this study, the WQI value of the water sample was calculated using a method developed by Norhayati (1981) that has been adopted by DOE.

Six parameters used for the evaluation of the WQI are Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO), Suspended Solids (SS), pH and Ammoniacal Nitrogen (NH_3-N). The sub-indices for the chosen parameters are named SICOD, SIBOD, SIDO, SISS, SIpH and SIAN, and the formula used to calculate the WQI is shown below:

$$WQI = 0.16 * SICOD + 0.19 * SIBOD + 0.22 * SIDO + 0.16 * SISS + 0.12 * SIpH + 0.15 * SIAN$$

Where, SI is the sub index of each parameter. The sub index for each parameter is derived from a system of best-fit equations as shown in **Table 6.3.16**.

The data were then compared to the National Water Quality Standard for Class IIB, recreational use with body contact. **Table 6.3.17** and **Table 6.3.18** show the water quality classification based on the WQI.

Table 6.3.16: Best-Fit Equations for the Estimation of the Sub-Indices Values

PARAMETER	SUB-INDEX FORMULA	CONDITION
DO	SIDO = 0 SIDO = -0.395 + 0.030x^2 – 0.00020x^3 SIDO = 100	For x ≤ 8 For 8 < x < 92 For x ≥ 92
BOD	SIBOD = 100.4 – 4.23x SIBOD = 108* $e^{-0.055x}$ – 0.1x	For x ≤ 5 For x > 5
COD	SICOD = -1.33x + 99.1 SICOD = 103$e^{-0.0157x}$ – 0.04x	For x ≤ 20 For x > 20
N-NH_3	SIAN = 100.5 – 105x SIAN = 94* $e^{-0.573x}$ – 5*x - 2 SIAN = 0	For x ≤ 0.3 For 0.3 < x < 4 For x ≥ 4
SS	SISS = 97.5 * $e^{-0.00676x}$ + 0.05x SISS = 71* $e^{-0.0016x}$ – 0.015x SIDO = 0	For x ≤ 100 For 100 < x < 1000 For x ≥ 1000
pH	SIpH = 17.2 – 17.2x + 5.02x^2 SIpH = -242 + 95.5x – 6.67x^2 SIpH = -181 + 82.4x – 6.05x^2 SIpH = 536 – 77.0x + 2.76x^2	For x < 5.5 For 5.5 ≤ x < 7 For 7 ≤ x < 8.75 For x ≥ 8.75

NOTE: x - concentration in mg/L for all parameters except for pH and DO

Table 6.3.17: Water Quality Classification Based on Water Quality Index

RANGE	*CLASS*	*USES*
> 92.7	Class I	Conservation of natural environment Water Supply 1 – Practically no treatment necessary Fishery 1 – Very sensitive aquatic
76.5 – 92.7	Class II	Water Supply II – Conventional treatment required Fishery II – Sensitive aquatic species
51.9 – 76.5	Class III	Recreational use with body contact
31.0 – 51.9	Class IV	Water Supply III – Extensive treatment required Fishery III – Common, of economic value and tolerant species; livestock drinking
< 31	Class V	None of the above

Source: National Water Quality Standard (NWQS)

Table 6.3.18: Water Quality Index and its Status

WQI	STATUS
Clean	81 – 100
Slightly Polluted	60 – 80
Polluted	0 - 59

Source: DOE Water Quality Classification based on WQI

The results of the WQI calculated by the consultant are as shown in **Table 6.3.19**.

Table 6.3.19: Water Quality Index

STATION	WQI	CLASS	STATUS
WQ1	94.49	I	Clean
WQ2	92.15	II	Clean
WQ3	88.89	II	Clean
WQ4	91.15	II	Clean
WQ5	85.88	II	Clean
WQ6	90.42	II	Clean
WQ7	91.92	II	Clean
WQ8	93.48	I	Clean
WQ9	87.57	II	Clean
WQ10	93.34	I	Clean
WQ11	93.21	I	Clean
WQ12	91.18	II	Clean

Source: Consultant's Calculation

A water body with a high WQI value indicates a cleaner water body. Water quality refers to the characteristics of a water body that will influence its suitability for a specific use, i.e. how well the water quality meets the need of the user. Water quality status indicates the level of pollutant composition and thus can be related to human activities (Anhar *et al.,* 1998).

Based on the calculations of the WQI in **Table 6.3.19**, it shows the range of WQI is ranged from 85.88 to 94.49. All sampling stations are categorized as 'clean' and fall under Class I (WQ1, WQ8, WQ10 and WQ11) and the rest of the sampling stations fall under Class II.

iii) Water Intake

Table 6.3.20 shows the locations of the water intake point around the project site.

Table 6.3.20: Location of Water Intake Point

No.	Name of Water Plant	Water Intake	Coordinate of Water Intake	Photo
1	Water Treatment Plant Sg Geliting	Sg Geliting	N 03° 53' 24.4" E 101° 31' 13.9"	
		Sg Slim	N 03° 54' 07.2" E 101° 30' 10.9"	

Based on **Figure 6.3.14**, it shows the source of the water treatment plant surrounding the Project site. Water Treatment Plant Sg. Geliting have two water intake which is Water Intake Sg Geliting and Water Intake Sg Slim. Currently, only water intake Sg Geliting is in use and water intake Sg Slim will start operations once the water demand in the supply area exceeded the current supply (**Appendix 13**). According to the letter from LAP, the water treatment process is in accordance with the guidelines set by SPAN and MOH under National Drinking Water Quality Surveillance Program. From the guideline, the recommended Turbidity value for raw water quality is 1000 NTU. The water intake (Sg Geliting) will not be affected by the project due to the different catchment meanwhile water intake (Sg Slim) located approximately 5 km downstream from the project site.

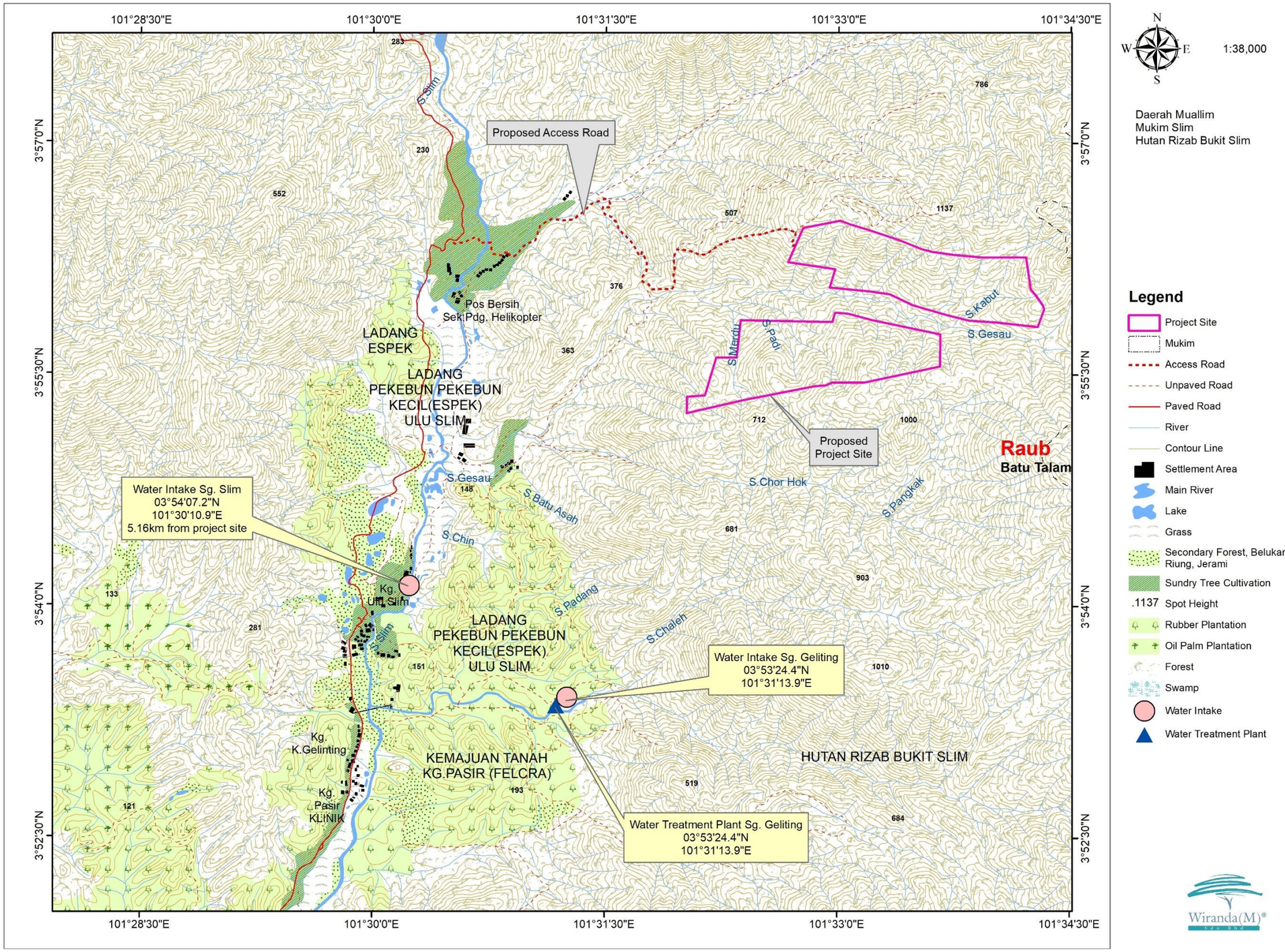


Figure 6.3.14 Location of Water Intake Point

6.4 BIOLOGICAL STUDY

This section describes the existing environment in the project site in terms of the biological environment. The description is based on field studies and review of existing literature related to the study area sourced from published reports. The elements that will describe consist of flora, fauna and avifauna. Both, primary and secondary data are used to describe the existing biological environment.

6.4.1 Fauna

6.4.1.1 Existing Habitat

The proposed project site has several types of landscape level features from lowland to hilly areas. It is still well forested however; it was developed with an urbanized area to the west which indirectly influenced the fauna communities. The in-situ habitat attribute is still well forested; influence by the existing river and tributaries which naturally flow through the proposed project site varies the species assemblages. (**Figure 6.4.1**).

Figure 6.4.1: The view of existing vegetated primary forest areas in the proposed project site A) emergence tree, and B) secondary vegetation.

6.4.1.2 Methodology

The acquisition data of faunas were collected by the mean of point count sampling method which been selected random systematically in the proposed project site; based on direct observation technique by combining both visually and aurally (Buckland et al., 1993; 2001). Fauna sampling point of the Project site is shown in **Figure 6.4.2**. This method is suitable for

any areas with less accessible landscape or naturally have high density of vegetation thus, helps observer to concentrate on any movements besides, promises of less disturbance, cost-effectives and time efficient. These methods are based upon directly observing samples by means of 10 x 42 mm binocular made by Bushnell and a digital single-lens reflex camera - DSLR, mounted with wide angle, macro, general or tele-lenses covering 55 - 300 mm made by Nikon to photograph faunas' species and its habitat (**Figure 6.4.3**).

Figure 6.4.3: Direct observation method via binocular and digital single-lens reflex camera.

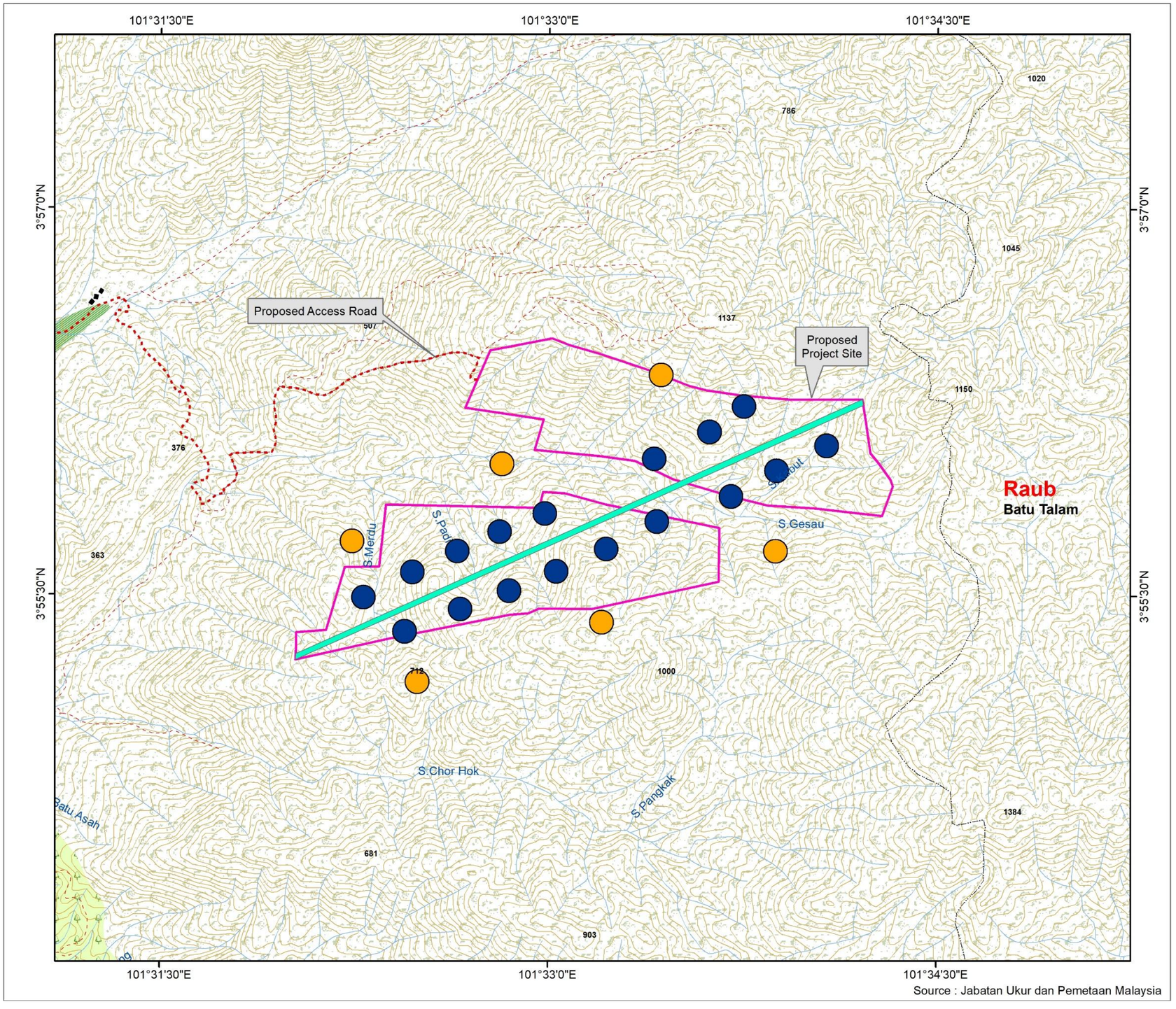
Meanwhile, the acquisition data of herpetofauna were collected via visual encounter survey (Crump & Scott, 1994) also known as 'time constrained search' (Campbell & Christman, 1982; Corn & Bury, 1990) based on randomized walk design. This method involves such protocols i.e., choosing random directions and walking set distances (500 meters), recording sample within a set distance of path (2 meters), and a search pattern i.e., examine all rocks along a stream and vegetation along the edge of a water body. The survey conducted by daytime for some diurnal species (active during day time) but most species are nocturnal (active during night time) and more readily detected with the aid of a torch or spotlight.

Furthermore, a passive method of camera trap technology (**Figure 6.4.4**) been applied in the vicinity areas as a supplementary, in order to record presence of cryptic, elusive or endangered species (Janecka et al., 2011; Burton et al 2015; Tan et al., 2017) that are otherwise rarely detected in the wild by human observer (Silveira et al., 2003) and are difficult to determine by identification of footprint or any others sign. The digital cameras allow of capturing sighting data via infrared technology - SunTek HC-800A 16 megapixel 120°

1080P Video Record IR Night Vision Trail Hunting Camera Trap with 5 second trigger speed which automatically activated by movement from any object. This camera equipped with 18 gigabytes secure digital (SD) card capacity and 8 double AA batteries to make sure the camera work for two months in the field. The camera was mounted to a tree with an iron wire cable and marked using a Global Positioning System (GPS) receiver with built-in barometric altimeter (Garmin GPS Map 62cs, Garmin International Inc., Kansas City, USA).

Figure 6.4.4: The application of passive camera trapping method focally to detect the presence of terrestrial vertebrae at the proposed project site.

In particular, indirect survey techniques involves such identification of signs (i.e., footprints, feces, food leftovers, marks on tree, feathers, and etc.), interviewing with local communities and secondary data obtained from related agencies e.g., Department of Wildlife and National Park (DWNP) and Department of Forestry were also been carried. Each recorded species was compared based on illustrated guide books - A field Guide to the to the regional species - Birds of West Malaysia and Singapore (Jeyarajasingam & Pearson, 2012), Mammals of South-East Asia (Francis, 2008), Reptiles of South-East Asia (Das, 2010) and commercial recordings guide for regional birds from a CD-ROM of Birds of Tropical Asia 3: Sound and Sights (Scharringa, 2005).



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Daerah Muallim
Mukim Slim
Hutan Rizab Bukit Slim

Legend

- Project Site
- Mukim
- Access Road
- Unpaved Road
- Paved Road
- River
- Contour Line
- Settlement Area
- Main River
- .1137 Spot Height
- Rubber Plantation
- Oil Palm Plantation
- Forest
- Transect Line
- Sampling Point Fauna (500m)
- Sampling Point Flora (100m)

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Figure 6.4.2 The Flora and Fauna Point in the Project Site

6.4.1.3 Wildlife Local Protection and Global IUCN's Red List Status

The wildlife status in Peninsula Malaysia and Federal Territory of Labuan is categorized based on the Wildlife Conservation Act 2010 [amendment of schedule] Order 2012 (Act 716); which basically replaced the 38-year-old Wildlife Protection Act 1972 (Act 76). The WCA 2010 covers more species including those that were not listed in the previous act and imposes stricter penalties involving wildlife crime. The act formerly listed wildlife species under Schedule 1 Protected and Schedule 2 Totally Protected.

In term of global conservation status, the Red List by the International Union for Conservation of Nature (IUCN) is the most widely used. Floras' and faunas' species are classified into 9 groups, specified through several criteria such as population size, rate of decline, degree of population, geographic distribution, and distribution fragmentation which was:

1) **Extinct** (**EX**) - No known individuals remaining;
2) **Extinct in the wild** (**EW**) - Known only to survive in captivity, or as a naturalized population outside its historic range;
3) **Critically endangered** (**CR**) - Extremely high risk of extinction in the wild;
4) **Endangered** (**EN**) - High risk of extinction in the wild;
5) **Vulnerable** (**VU**) - High risk of endangerment in the wild;
6) **Near threatened** (**NT**) - Likely to become endangered in the near future;
7) **Least concern** (**LC**) - Lowest risk (Does not qualify for a more at-risk category; widespread and abundant taxa are included in this category);
8) **Data deficient** (**DD**) - Not enough data to make an assessment of its risk of extinction;
9) **Not evaluated** (**NE**) - Has not yet been evaluated against the criteria.

In the context of the IUCN Red List, "threatened" embraces the three categories of Critically Endangered, Endangered, and Vulnerable. The diagram (Figure 1.4) below shows the hierarchy of the categories:

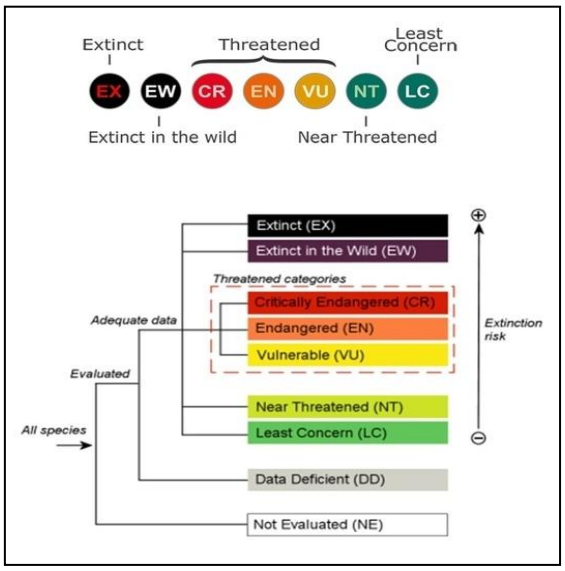

Figure 6.4.5: The hierarchy of IUCN Red List Categories.

6.4.1.4 Results

Totals of point counts were established in the proposed project site in a period from 1st until 9th December 2020. Meanwhile, the camera trapping program were conducted for a period estimated of 3 months (November 2020 to January 2021). The species listed below are based on primary data of field survey with secondary supporting information, to ensure that the list of species recorded in the proposed project site is at an optimum level - included highly expected species. Further below are the following reasons:

- Some species are elusive, cryptic, seasonally occurrence (migratory species) and very low in number that much longer time is needed up to a week or even months to record;
- Specific methodology is required for some species such as cage trapping, harp trap, mist netting etc. which require longer time, larger cost, and greater workforce.

Avian

Total of 113 avian species from 42 families were recorded during the survey period, include 28 species which was highly expected to present at the proposed project site. Out of that number, 9 and 96 species were listed as protected and totally protected under the WCA 2010 respectively, while another 8 species were not listed under the act. As on the IUCN status, 4 species were listed as vulnerable, 16 species as near threatened while another 93 species were listed as least concern (**Table 6.4.1**). Cuculidae and Pycnonotidae represent as the largest family with 8 species recorded each.

There are 4 hornbills' species was recorded during the survey period. Hornbills are a group of diurnal birds, big size ranging from 30 - 1200 cm and weight from 102 - 6200 g, and generally observed travelling in pairs or small family groups on top of canopy level (arboreal). There are territorial species and their territories usually are much related to its diet (Alan, 1991). The vulnerable black hornbill has a yellowish bill for the male while the female has a dark grey bill. This species threatened by its selectiveness towards the environment and resources when it comes to reproduction. They will only start breeding and nesting when there is a large supply of fruits available and large tree size for nesting otherwise, it may curtail nesting for years (O'Gara, 2004). Meanwhile, rhinoceros hornbill could be recorded at the proposed project site via its loud call. It can be distinguished by its orange and red huge bill and casque. The color coming from preen oil rubbed on from the preen gland above the tail. Species of hornbills formerly found inhabits prime lowland and hill tropical forest where it usually focusses at certain part of forested area, searching for fruiting trees, insect's communities and small animals (omnivorous); and indirectly could serve as an indicator to a healthy and balance ecosystem.

The vulnerable greater green leafbird is very similar in appearance to the lesser green leafbird, but note that the greater green leafbird is distinguished by its powerful beak, yellow throat and eye ring of the female; and lack of a yellow border along the black throat patch found in the male. Meanwhile, the lesser green leafbird are bright green in color; male has a black-and-blue throat while the female sometimes shows a slight yellow tinge to

the throat. These species inhabit subtropical or tropical moist lowland forest and subtropical or tropical mangrove forest, old-growth forest but also secondary forest, adjacent plantation, large parks and edges. It moves quite conspicuously at the canopy level, jumping between branches and flying from tree to tree. It often visits fruiting fig trees, but also takes insects and small invertebrates. It is found in Brunei, Indonesia, Malaysia, Myanmar, Singapore, and Thailand.

Others species need to be highlighted in term of vulnerable species is the Javan myna and long-tailed parakeet. The Javan myna is a member of starling family. It can also be found in habitat include urban forest and cultivated areas. It is omnivorous and consume wide variety of food source such as seeds, fruit, nectar, insects, and human wastes. It is often found scavenge in groups, bold and not very afraid of human existence (Adrian & Chris, 2010). Populations of the species within its natural range of Java and Bali (Craig & Feare, 2016) found to declined rapidly as a result of trapping for the bird trade and effect of pesticide use (Eaton et al., 2015). However, it is found possible that birds from the introduced (and flourishing) population in Peninsular Malaysia are actually now being used to supply this species for the trade back to Java. The long-tailed parakeet is a mainly green with a long blue tail species. The male has a black cape and red face meanwhile the female lacks black cap and has less red. This species is able to live in wide variety of habitats such as in swamp forests, lowland evergreen forest, oil palm plantations, coconut plantations, gardens, public parks, and is a frequent visitor to agricultural areas (especially those who yield tropical fruits and seeds. Its diet consists of a variety of berries, papaya, areca nuts, wild fruit, seeds, and cultivated grains such as corn. It is an extremely social bird, small size of groups to flocks of thousands individual during breeding season. This species natural habitat is threatened by unsustainable deforestation, unmanaged logging and illegal pet trade.

Green iora is a small 12 to 14 cm long bird (Myers, 2016). It inhabits canopy of lowland forest up to 820 m a.s.l., tall secondary forest, peat swamp forest, and mangrove forest (Wells, 2010). This iora often occurs in pairs or small group, feeds on invertebrates, regularly joining mixed-species foraging flocks. The population is probably declining because of habitat loss caused by unsustainable logging and uncontrolled land conversion.

Black-bellied malkoha is a species of malkoha in the family Cuculidae. Its natural habitats are lowland and foothill forests and forest edges, where it clambers about rather clumsily in trees and dense tangles. It also can be found at secondary habitats and occurs at higher elevations. This forest-associated species is listed as Near Threatened because it is suspected to be undergoing a moderately rapid decline owing to the extensive loss of lowland forests.

Black-and-yellow broadbill formerly inhabits subtropical or tropical moist lowland forest, and subtropical and tropical moist montane forest. It feeds primarily on insects especially orthopterans (grasshoppers, cicadas, etc.) mantises, and beetles. This species is threatened by habitat destruction by uncontrolled human activity mainly for the purpose of harvesting natural resources for industrial production and urbanization. An unmanaged clearing habitat for agriculture is another principal cause of their habitat destruction.

The grey-bellied bulbul is a species of songbird in the Pycnonotidae family. It has a unique bicolored patterning; ashy gray with golden-wings. This species inhabits subtropical or tropical moist lowland forests, hill forests, usually in mature or near-mature growth, and regularly moves through upper strata of forests where they sometimes moving with mixed flocks. Both species is threatened primarily by habitat loss.

Great argus can be observed by its loud calls which intentionally produce to attract females for mating reasons. This species of pheasant is native to Malay Peninsula, Borneo and Sumatra. It inhibited concentrated in tall, dry lowland primary, secondary and logged forests, up to 1,300 m (BirdLife International, 2013). It feeds on forest floor in early morning and evening primarily consuming for berries, seeds, flowers, leaf buds, and invertebrates (Winarni et al., 2009). Great argus is amongst the largest of all pheasants (up to 6.5 feet in length) and believes to be the only living largest pheasant in its natural habitat besides others living pheasant i.e. green peafowl which reared in captivates.

Chesnut-naped forktail is a species of bird in the flycatcher family. This species usually found along stream and clear river in lowland and hill forest. Besides that, it can also be found in secondary scrub, dry ridges and abandoned logging road up to 1,300 m a.s.l. This species

forage near water consumes range of insects and snakes. It is threatened by habitat loss, as lowland forest is rapidly being cleared across its range. It is expected to remain in hill habitat and classed as near threatened (Collar, 2017).

There is also terrestrial specialist species were recorded i.e., fluffy-backed tit-babbler. This is birds of tropical areas belong in group of which have a greatest variety in Southeast Asia and the Indian subcontinent. Species belong to this group has small to medium body size and spend mostly of its day on the forest floor, wooded areas or scrubland environment. Babbler is primarily insectivorous although, may also take berries and sometimes will consume small lizard and others vertebrates (Perrins, 1991) which mainly found at forest floor.

Others 93 species were evaluated as least concern - those species populations' and distributions' status been evaluated worldwide as not being focus of species conservation. They do not qualify as threatened or near threatened (conservation dependent). However, bear in mind, neither the importance of species nor the level of conservation category, as with other native organism, every species plays an importance ecosystem services. Avian are importance to maintain sustainable populations' levels of their prey and predator species and, after death, provide food for scavenger and decomposer. Besides that, avian are also important in plant reproduction through their services as pollinators or seed dispersers.

Table 6.4.1: List of avian recorded at the proposed project sites based on family.

NO	FAMILY	SPECIES			CONSERVATION PROTECTION STATUS		OBSERVATION METHOD
		SCIENTIFIC NAME	COMMON NAME	LOCAL NAME	LOCAL	GLOBAL	
1	Acanthizidae	*Gerygone sulphurea*	Golden-bellied Gerygone	Cekup Perepat	TP	LC	Call
2	Accipitridae	*Accipiter trivirgatus*	Crested Goshawk	Lang Sika	TP	LC	Sighting
		Aviceda leuphotes	Black Baza	Lang Baza Berjambul	TP	LC	Sighting
		Nisaetus alboniger	Blyth's Hawk-eagle	Lang Hantu	TP	LC	Sighting
		Nisaetus cirrhatus	Changeable Hawk-eagle	Lang Hindek	TP	LC	Call
		Pernis ptilorhynchus	Oriental Honey-buzzard	Lang Lebah	TP	LC	Sighting
		Spilornis cheela	Crested Serpent-eagle	Helang Berjambul	TP	LC	Sighting
3	Aegithinidae	*Aegithina viridissima*	Green Iora	Kunyit Bakau	TP	NT	Call
		Aegithina tiphia	Common Iora	Kunyit Pacat	TP	LC	Call
4	Alcedinidae	*Alcedo meninting*	Blue-eared Kingfisher	Pekaka Bintek-bintek	TP	LC	Call
		Ceyx erithaca	Black-backed Dwarf-Kingfisher	Pekaka Rimba	TP	LC	Expected
		Ceyx rufidorsa	Rufous-backed Dwarf Kingfisher	-	TP	LC	Expected
5	Apodidae	*Aerodramus fuciphagus*	Edible-nest Swiftlet	Layang-layang Gua	-	LC	Sighting
		Aerodramus maximus	Black-nest Swiftlet	Layang-layang Padi	-	LC	Sighting
6	Bucerotidae	*Anorrhinus galeritus*	Bushy-crested Hornbill	Enggang Belukar	TP	NT	Expected
		Anthracoceros albirostris	Oriental Pied Hornbill	Enggang Belulang	TP	LC	Sighting
		Anthracoceros malayanus	Black Hornbill	Enggang Gatal Birah	TP	VU	Sighting
		Buceros rhinoceros	Rhinoceros Hornbill	Enggang Badak	TP	NT	Call
7	Campephagidae	*Pericrocotus divaricatus*	Ashy Minivet	Mas Padang	TP	LC	Sighting
		Pericrocotus flammeus	Scarlet Minivet	Mas Belukar	TP	LC	Sighting
8	Caprimulgidae	*Caprimulgus affinis*	Savanna Nightjar	Tukang Savana	TP	LC	Call
		Caprimulgus macrurus	Large-tailed Nightjar	Tukang Kubur	TP	LC	Call
		Lyncornis temminckii	Malay Eared-nightjar	Tukang Tabtibau	TP	LC	Call

9	Chloropseidae	*Chloropsis cyanopogon*	Lesser Green Leafbird	Daun Kecil	TP	NT	Sighting
		Chloropsis moluccensis	Blue-winged Leafbird	Daun Sayap Biru	TP	LC	Expected
		Chloropsis sonnerati	Greater Green Leafbird	Daun Besar	TP	VU	Sighting
10	Cisticolidae	*Orthotomus atrogularis*	Dark-necked Tailorbird	Perenjak Belukar	TP	LC	Call
		Prinia rufescens	Rufescent Prinia	Perenjak Sampah	TP	LC	Sighting
11	Columbidae	*Chalcophaps indica*	Emerald Dove	Punai Tanah	P	LC	Sighting
		Treron curvirostra	Thick-billed Green-pigeon	Punai Lengguak	TP	LC	Sighting
		Treron olax	Little-green Pigeon	Punai Daun	P	LC	Sighting
		Treron vernans	Pink-necked Green-pigeon	Punai Gading	TP	LC	Sighting
12	Coraciidae	*Eurystomus orientalis*	Oriental Dollarbird	Tiung Batu	TP	LC	Sighting
13	Corvidae	*Corvus macrorhynchos*	Large-billed Crow	Gagak Paruh Besar	-	LC	Call
14	Cuculidae	*Centropus sinensis*	Greater Coucal	But-but Carik Anak	TP	LC	Call
		Cuculus micropterus	Indian Cuckoo	Sewah India	TP	LC	Call
		Eudynamys scolopaceus	Western Koel	Sewah Tahu	TP	LC	Call
		Hierococcyx fugax	Malay Hawk-cuckoo	Sewah Hantu	TP	LC	Call
		Phaenicophaeus diardi	Black-bellied Malkoha	Cenok Perut Hitam	TP	NT	Sighting
		Phaenicophaeus tristis	Green-billed Malkoha	Cenok Kera	TP	LC	Sighting
		Rhinortha chlorophaea	Raffles's Malkoha	Cenok Kerak	TP	LC	Call
		Surniculus lugubris	Square-tailed Drongo-cuckoo	Sewah Sawai	TP	LC	Sighting
15	Dicaeidae	*Prionochilus maculatus*	Yellow-breasted Flowerpecker	Sepah Puteri Raja	P	LC	Sighting
		Prionochilus percussus	Crimson-breasted Flowerpecker	Sepah Puteri Kayangan	P	LC	Sighting
16	Dicruridae	*Dicrurus annectens*	Crow-billed Drongo	Cecawi Sawai	TP	LC	Expected
		Dicrurus paradiseus	Greater Racquet-tailed Drongo	Cecawi Anting-anting	TP	LC	Sighting
17	Estrildidae	*Lonchura punctulata*	Scaly-breasted Munia	Pipit Pinang	P	LC	Sighting
		Lonchura striata	White-rumped Munia	Pipit Tuli	P	LC	Sighting
18	Eurylaimidae	*Corydon sumatranus*	Dusky Broadbill	Takau Rimba Hujan	TP	LC	Expected
		Cymbirhynchus macrorhynchos	Black-and-red Broadbill	Takau Rakit	TP	LC	Call

		Eurylaimus ochromalus	Black-and-yellow Broadbill	Takau Hitam Kuning	TP	NT	Sighting
19	Falconidae	*Microhierax fringillarius*	Black-thighed Falconet	Falko Rajawali	TP	LC	Sighting
20	Hemiprocnidae	*Hemiprocne comata*	Whiskered Treeswift	Layang-layang Jambul Kecil	TP	LC	Sighting
21	Hirundinidae	*Hirundo rustica*	Barn Swallow	Sualo Api	TP	LC	Sighting
22	Irenidae	*Irena puella*	Asian Fairy-bluebird	Dendang Gajah	TP	LC	Sighting
23	Lanidae	*Lanius cristatus*	Brown Shrike	Tirjup Tanah	TP	LC	Expected
		Lanius tigrinus	Tiger Shrike	Tirjup Rimau	TP	LC	Call
24	Megalaimidae	*Caloramphus hayii*	Malay Brown Barbet	Takur Dahan	TP	NT	Expected
		Psilopogon cyanotis	Blue-eared Barbet	Takur Akar	TP	LC	Sighting
		Psilopogon chrysopogon	Gold-whiskered Barbet	Takur Jambang Emas	TP	LC	Sighting
		Psilopogon mystacophanos	Red-throated Barbet	Takur Raya	TP	NT	Expected
25	Meropidae	*Merops philippinus*	Blue-tailed Bee-eater	Berek-berek Carik Dada	TP	LC	Call
		Merops viridis	Blue-throated Bee-eater	Berek-berek Tadah Hujan	TP	LC	Expected
		Nyctyornis amictus	Red-bearded Bee-eater	Berek-berek Janggut Merah	TP	LC	Call
26	Motacillidae	*Dendronanthus indicus*	Forest Wagtail	Pipit Rimba	TP	LC	Sighting
		Motacilla cinerea	Grey Wagtail	Pipit Batu	TP	LC	Expected
27	Muscicapidae	*Enicurus ruficapillus*	Chestnut-naped Forktail	Murai Cegar	TP	NT	Call
		Ficedula elisae	Green-backed Flycatcher	-	-	LC	Expected
		Kittacincla malabarica	White-rumped Shama	Murai Batu	P	LC	Call
		Larvivora cyane	Siberian Blue Robin	Murai Siberia	TP	LC	Expected
		Muscicapa dauurica	Asian Brown Flycatcher	Sambar Coklat Asia	TP	LC	Sighting
		Muscicapa sibirica	Dark-sided Flycatcher	Sambar Sibiria	TP	LC	Sighting
28	Nectariniidae	*Arachnothera flavigaster*	Spectacled Spiderhunter	Kelicap Jantung Besar	TP	LC	Expected
		Arachnothera hypogrammica	Purple-naped Spiderhunter	Kelicap Rimba	TP	LC	Expected
		Arachnothera longirostra	Little Spiderhunter	Kelicap Jantung	TP	LC	Call
		Cinnyris jugularis	Olive-backed Sunbird	Kelicap Bukit	TP	LC	Sighting
29	Pellorneidae	*Malacocincla abbotti*	Abbott's Babbler	Rimba Riang	TP	LC	Call
		Trichastoma malaccense	Short-tailed Babbler	Rimba Ekor Pendek	TP	NT	Expected
		Trichastoma rostratum	White-chested Babbler	Rimba Telunjuk	TP	NT	Expected

30	Phasianidae	*Argusianus argus*	Great Argus	Kuang Raya	TP	NT	Call
		Gallus gallus	Red Junglefowl	Ayam Hutan	P	LC	Call
31	Picidae	*Picus puniceus*	Crimson-winged Woodpecker	Belatok Mas	TP	LC	Sighting
		Sasia abnormis	Rufous Piculet	Belatok Kecil	TP	LC	Expected
32	Pittidae	*Pitta moluccensis*	Blue-winged Pitta	Pacat Sayap Biru	TP	LC	Sighting
33	Psittacidae	*Belocercus longicaudus*	Long-tailed Parakeet	Bayan Nuri	TP	VU	Call
		Loriculus galgulus	Blue-crowned Hanging-parrot	Bayan Serindit	P	LC	Sighting
		Psittinus cyanurus	Blue-rumped Parrot	Bayan Puling	TP	NT	Expected
34	Pycnonotidae	*Alophoixus phaeocephalus*	Yellow-bellied Bulbul	Merbah Perut Kuning	TP	LC	Sighting
		Brachypodius atriceps	Black-headed Bulbul	Merbah Siam	TP	LC	Sighting
		Pycnonotus brunneus	Red-eyed Bulbul	Merbah Mata Merah	TP	LC	Sighting
		Pycnonotus cyaniventris	Grey-bellied Bulbul	Merbah Kelabu	TP	NT	Sighting
		Pycnonotus erythropthalmos	Spectacled Bulbul	Merbah Kecil	TP	LC	Expected
		Pycnonotus finlaysoni	Stripe-throated Bulbul	Merbah Luris Leher	TP	LC	Call
		Rubigula flaviventris	Black-crested Bulbul	Merbah Jambul Hitam	TP	LC	Sighting
		Tricholestes criniger	Hairy-backed Bulbul	Merbah Bulu Panjang Tengkuk	TP	LC	Sighting
35	Phylloscopidae	*Phylloscopus borealis*	Arctic Warbler	Cekup Artik	TP	LC	Expected
36	Rhipiduridae	*Rhipidura albicollis*	White-throathed Fantail	Sambar Gila Gunung	TP	LC	Expected
		Rhipidura javanica	Sunda Pied Fantail	Sambar Murai Gila	TP	LC	Call
37	Sittidae	*Sitta frontalis*	Velvet-fronted Nuthatch	Patuk Baldu	TP	LC	Expected
38	Sturnidae	*Acridotheres fuscus*	Jungle Myna	Tiung Sawah	-	LC	Sighting
		Acridotheres javanicus	Javan Myna	Tiung Tongkeng Putih	-	VU	Sighting
		Acridotheres tristis	Common Myna	Gembala Kerbau	-	LC	Sighting
39	Strigidae	*Ketupa ketupu*	Buffy Fish-owl	Hantu Kuning	TP	LC	Sighting
		Otus lempiji	Sunda Scops-owl	Jampuk Melayu	-	LC	Call
		Strix leptogrammica	Brown Wood-owl	Hantu Punggor	TP	LC	Expected
		Strix seloputo	Spotted Wood-owl	Hantu Carik Kafan	TP	LC	Expected
40	Timaliidae	*Garrulax mitratus*	Chestnut-capped	Rimba Genting	TP	NT	Expected

			Laughingthrush				
		Macronus ptilosus	Fluffy-backed Tit-babbler	Rimba Pong Pong	TP	NT	Call
		Mixornis gularis	Pin-striped Tit-babbler	Rimba Berjalur	TP	LC	Call
41	Tytonidae	*Tyto alba*	Common Barn-owl	Jampuk Kubur	TP	LC	Expected
42	Vangidae	*Hemipus hirundinaceus*	Black-winged Flycatcher-shrike	Rembah Batu	TP	LC	Expected
		Hemipus picatus	Bar-winged Flycatcher-shrike	Rembah Bukit	TP	LC	Sighting
		Tephrodornis virgatus	Large Woodshrike	Rembah Kayu Besar	TP	LC	Sighting

Note:

1) Local protection status under **Wildlife Conservation Act, 2010 [amendment of schedule] Order 2012 (Act 716)**: **P –** Protected, **TP** - Totally Protected.

2) Global protection status under **International Union for Conservation of Nature Red List of Threatened Species version 2020-3: NE -** Not Evaluated**, DD -** Data Deficient**, LC** - Least Concern, **NT** - Near Threatened, **VU** - Vulnerable, **EN** - Endangered, **CR** - Critically Endangered, **EW** - Extinct in the Wild, **EX** - Extinct.

Mammal

Total of 30 mammals' species from 16 families were recorded at the proposed project site. 10 and 9 species were listed as protected and totally protected respectively, while another 11 species where not listed under the WCA 2010 (Act 716). As global IUCN status, 1 species were categorized as endangered, 3 species as vulnerable, 3 species as near threatened while another 23 species been categorized as least concern (**Table 6.4.2**). Four species (endangered and vulnerable) from the below list have been identified to be within the threatened group and are at risk of extinction. Largest family recorded were Sciuridae which comprise of 6 species followed by Cercopithecidae.

There is a vulnerable species recorded in this survey need to be highlight i.e., leopard, Malayan tapir, pig-tailed macaque, and sun bear. A vulnerable species is one which has been categorized by the IUCN as likely to become endangered unless the circumstances that are threatening its survival and reproduction being improve. Species belong to this category should be monitored cause of the potential to become increasingly threatened. Those listed species under vulnerable may be common in ex-situ captivity program but somehow, need to be monitored repeatedly in its natural habitat as it's normally facing difficulties to survive influencing by internal (i.e., inbreeding, high mortality rate, low birth rate, disease, etc.) and external (habitat loss, illegal hunting, poaching, etc.) factor.

The leopard is one of the five extant species in the genus Panthera, a member of the Felidae family. It inhabits foremost throughout savanna and rainforest, grasslands, woodlands, and riverine forest. It is listed as vulnerable because the population are threatened by habitat loss through fragmentation and uncontrolled conversion of forested areas to agriculture land which lead to a declining natural prey base. Besides that, leopards are hunted illegally and their body parts are smuggled in wildlife trade for superstitious medicinal practices and decoration (Bergin & Nijman, 2014; 2015; Stein et al., 2020).

Malayan tapir was recorded in the proposed project site via its footprint. It is the largest of the four widely recognized species of tapir and the only one native to Asia (Grubb, 2005). This species is easily identified by its marking, most notably the light-colored patch that extends from its shoulder to its rear end. It is exclusively herbivorous, forage for the tender shoots and leaves through the forest. The population number are decreasing in recent years (Lynam et al., 2008) because of various threat includes human activities such as deforestation for agricultural purposes and illegal trade.

Pig-tailed macaque is a skilled climber even though it spends most of the time on the ground. They live in a large group but occasionally, they can be observed by a smaller group during day time searching for fruits, seeds, berries, cereals, fungi, and also invertebrates (omnivorous). This species is literally inhabiting rainforest up to 2,000 m a.s.l but sometimes can be observed in the adjacent plantations and gardens (Payne & Francis, 1998).

The sun bear is known as the “honey bear” which refers to its voracious appetite for honeycombs and honey (Legakul & McNeely, 1977). Sun bear are usually solitary except for females with young (Scotson, 2017) and active in day time (diurnal) as some are active at night for short periods. It considers as omnivores which consume variety of food include termites, ants, beetle larvae, bee larvae, fruits - includes figs and durian (Fredriksson et al., 2006), shoots, flower, birds, eggs, reptiles, turtle, deer, and several unidentified small vertebrates (Wong et al., 2002). They are mainly threatened by the loss of forest habitat and forest degradation arising from clear-cutting or unsustainable logging practices and commercial poaching for the wildlife trade (Meijaard, 1999).

Apart from that, there is near threatened black giant squirrel was recorded during this survey period. Black giant squirrel is a large arboreal squirrel in the genus *Ratufa* with weights 1.05 to 1.25 kg, head-and-body length 34 to 37 cm, and tail 41 to 42 cm. This species is typically distinctly bicolored with dark upperparts and pale underparts. This species prefers wild forest among tropical and subtropical forest; and rarely enters plantations or settlements searching for seeds, pine cones, variety of fruits, and leaves. Its

primarily threatened by habitat encroachment upon human settlement, timber harvesting, agriculture, and overhunting by human predation.

In addition, species i.e., wild boar was widely observed at the proposed project site. Wild boar can be recorded via its feces, footprints and wallows. It is classified as least concern by the IUCN based on the survival ability of adaptation to its surrounding, wide range and high population numbers as it has become an invasive species in part of its introduced range. It has a very successful breeding pattern as 114 to 140 days of gestation period can produce approximately 4 to 12 piglets. Wild boars inhabit a diverse array of habitats include forested areas, secondary forest, agricultural land, bushes, and can easily adjust near to human settlements as they pests around farm and villages. Furthermore, of the total 30 mammals' species recorded, about 76.7% (23 species) belong to the least concern category. They do not qualify as threatened or near threatened and presumably are pervasive and abundant after careful assessment. Apart from that, several species such as treeshrew, macaque and squirrels are diurnal species and can be widely observed on daytime throughout the proposed project site.

Table 6.4.2: List of mammals recorded in the proposed project site based on family.

NO	FAMILY	SPECIES			CONSERVATION PROTECTION STATUS		OBSERVATION METHOD
		SCIENTIFIC NAME	COMMON NAME	LOCAL NAME	LOCAL	GLOBAL	
1	Cercopithecidae	*Macaca fascicularis* ssp. *fascicularis*	Long-tailed Macaque	Monyet	P	LC	Sighting
		Macaca nemestrina	Pig-tailed Macaque	Beruk	P	VU	Sighting
		Presbytis siamensis	White-thighed Surili	Lotong Kokah	P	NT	Expected
		Trachypithecus obscurus	Spectacled Leaf Monkey	Lotong Cengkung	TP	NT	Expected
2	Cervidae	*Muntiacus muntjak*	Southern Red Muntjac	Kijang	P	LC	Camera Trap Photo
3	Erinaceidae	*Echinosorex gymnura*	Moonrat	Tikus Ambang Bulan	-	LC	Footprint
4	Felidae	*Panthera pardus*	Leopard	Harimau Kumbang	TP	VU	Camera Trap Photo
		Prionailurus bengalensis	Leopard Cat	Kucing Batu	TP	LC	Expected
5	Hystricidae	*Atherurus macrourus*	Asiatic Brush-tailed Porcupine	Landak Nibong	P	LC	Camera Trap Photo
		Hystrix brachyura	Malayan Porcupine	Landak Raya	P	LC	Camera Trap Photo
6	Muridae	*Leopoldamys sabanus*	Long-tailed Giant Rat	Tikus Bukit Besar	-	LC	Camera Trap Photo
		Maxomys surifer	Indomalayan Maxomys	Tikus Duri Hitam Pudar	-	LC	Expected
7	Pteropodidae	*Balionycteris maculata*	Spotted-winged Fruit Bat	Cecadu Sayap Berbintik	-	LC	Expected
8	Sciuridae	*Callosciurus caniceps*	Grey-bellied Squirrel	Tupai Perut Kelabu	-	LC	Sighting
		Callosciurus nigrovittatus	Black-striped Squirrel	-	-	LC	Sighting
		Callosciurus prevostii	Prevost's Squirrel	Tupai Gading	TP	LC	Sighting
		Ratufa bicolor	Black Giant Squirrel	Tupai Kerawak Hitam	TP	NT	Sighting
		Sundasciurus lowii	Low's Squirrel	Tupai Ekor Pendek	-	LC	Sighting
		Sundasciurus tenuis	Slender Squirrel	Tupai Cerleh	-	LC	Sighting
9	Spalacidae	*Rhizomys sumatrensis*	Indomalayan Bamboo Rat	Dekan Besar	-	LC	Expected
10	Suidae	*Sus scrofa*	Wild Boar	Babi Hutan	P	LC	Footprint
11	Tragulidae	*Tragulus kanchil*	Lesser Mousedeer	Pelanduk	P	LC	Expected
		Tragulus napu	Greater Mousedeer	Napuh	P	LC	Camera Trap Photo
12	Tapiridae	*Tapirus indicus*	Malayan Tapir	Tapir	TP	EN	Camera Trap Photo
13	Tupaiidae	*Tupaia glis*	Common Treeshrew	Tupai Muncung Besar	TP	LC	Sighting

		Tupaia minor	Lesser Treeshrew	Tupai Muncung Akar	TP	LC	Sighting
14	Ursidae	*Helarctos malayanus*	Sun Bear	Beruang Matahari	TP	VU	Sighting
15	Vespertilionidae	*Glischropus tylopus*	Common Thick-thumbed Bat	-	-	LC	Expected
		Tylonycteris robustula	Greater Bamboo Bat	-	-	LC	Expected
16	Viverridae	*Paradoxurus hermaphroditus*	Common Palm Civet	Musang Pulut	P	LC	Expected

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Herpetofauna (Amphibians and Reptiles)

Total of 26 herpetofauna's species from 15 families were recorded at the proposed project site during the survey period. Out of that number, 13 and 1 species were listed as protected and totally protected under the WCA 2010 (Act 716) respectively while another 12 species were not listed under the act. As on global IUCN status, 1 species was categorized as vulnerable, 1 as near threatened, 20 species as least concern while another 4 species were not listed (Table 1.3). Agamidae and Elapidae represent as the largest family with 4 species recorded each.

In term of reptiles, 10 species of snakes have been recorded. Species i.e., banded Malaysian coral snake, black spitting cobra, blue coral snake, and king cobra from Elapid is a venomous snake (neurotoxic) formerly inhabit tropics and subtropics region mostly in humid tropical environment, at some expected to be found in the proposed project site. Species from this family are mainly neurotoxic intentionally for immobilizing prey (as well as defense systems) which however can cause heart dysfunctions, cellular damage and potentially fatal (Das, 2006). Banded Malaysian coral snake is a small size species inhabit forested area and sometimes may also found in overgrown areas of parks and gardens. It is a ground dwelling species and feeds mainly on others smaller snake. Black spitting cobra have unique characteristics and known as the venom-spitting species in Southeast Asia where it can cause venom ophthalmia (Yap et al., 2014). Though not aggressive in nature, this snake will readily spit venom when they are cornered or threatened. It feed mainly on rodents, frogs, lizards, small mammals, and also on other snakes. Blue coral snake is a medium-sized coral snake with a slender body. It is considered semi-fossorial and found in the leaf litter of primary and secondary forest. It usually flees when threatened but it may remain in place with its red tail erect as a defensive message. Meanwhile, king cobra possess a fixed hollow fang filled by venom purposely to subdue their prey besides that, it also plays and important role as a defensive's system. Bites from all the members of this family are potentially fatal, some of which are even considered to be the world's most venomous snakes based upon their median lethal dose value LD_{50} - a measurement of the lethal dose of a toxin in

toxicology (Thomas & Griessel, 1999); often damages the body tissues or blood cells of their target.

Wagler's Keeled Green Pit Viper is a species of pit viper, a venomous snake from the family Viperidae. Its characterized by a large triangular-shaped head, with a relatively thin body. It is almost entirely nocturnal and arboreal with prehensile tail to aid in climbing. This species preferred natural habitat of forest, at altitudes from sea level to 400 m. It is quite sluggish as it remains motionless for long periods of time waiting for prey though, when prey does pass by, or if disturbed, it can strike quickly. Apart from that, others snake's species from Calamariidae, Colubrid, Typhlopidae, and Xenopeltid are only dangerous to their prey and harmless to humans but however can attack viciously and potential to cause serious injuries. There are 2 turtle species was recorded during the survey site i.e., Asian leaf turtle from Geoemydidae; and Malayan soft-shelled turtle from Trionychidae. Asian leaf turtle is a small size 15 to 24 cm species. It is an omnivorous species that feed upon vegetation, fish, insect, worms, and carrion. This species will squirt its digestive systems contents when it feels threatened. Meanwhile, Malayan soft-shelled turtle is a species of softshell turtle. Adult may attain a flat carapace length of 35 cm with straight sides. This species prefers to inhabit clean running water with rocky stream usually at higher elevations. Both species are often caught and sold for the pet trade, food, or superstitious traditional medicine.

Apart from that, lizards' (gecko, lipina, lizard, monitor lizard and mabuya) are among the common species found in the proposed project site. Therefore, from 9 species recorded, 6 species categorized as least concern while another 3 species were not listed under the IUCN's. Lizards group have special ability and make use of a variety of antipredator adaptations, including venom, camouflage, reflex bleeding, and the ability to sacrifice and regrow their tails purposely to avoid larger predator or in term of catching preys. They can be found from sea level to 5,000 m elevations, adaptable various climates (except extreme environments), exploitable numbers of habitat and primarily live on the ground (others may live in rocks, trees, underground, and in water).

Others amphibians' e.g., arcuate-spotted pygmy frog and Asian grass frog are widely distributed and normally found around proposed project site within reservoir, rivers and

stream with clean water flow systems. Though declining in recent times due to unsustainable forested habitat management, they're widely distributed and plentiful species around the proposed project site, and there is evidence that these species is tolerable to small amount of pollution.

Amphibians and reptiles recorded below (**Table 6.4.3**) may only constitute small percentage of total number inhabiting at the proposed project site. Many amphibians and reptile's species are small in size and active mostly at night time that detecting them are more challenging. Tropical forests are home to myriad of these cold-blooded creatures with a number of them being very colorful. Amphibians and reptiles are almost exclusively carnivores and many species keep each other in balance especially by predator-prey relationship. Given a longer period of time and greater efforts, it is expected to recorded higher number of herpes's in the proposed project site.

Table 6.4.3: List of herpetofauna's (amphibians and reptiles) species recorded in the proposed project site base on family.

NO	FAMILY	SPECIES			CONSERVATION PROTECTION STATUS		OBSERVATION METHOD
		SCIENTIFIC NAME	COMMON NAME	LOCAL NAME	LOCAL	GLOBAL	
1	Agamidae	*Draco sumatranus*	Common Flying Lizard	Cicak Kobin	P	-	Sighting
		Draco melanopogon	Black-bearded Flying Lizard	-	P	-	Sighting
		Draco quinquefasciatus	Five-banded Flying Lizard	Cicak Terbang Lima Jalur	P	-	Sighting
		Gonocephalus grandis	Great Anglehead Lizard	Cicak Kepala Segi Besar	P	LC	Expected
2	Calamariidae	*Calamaria schlegeli*	Red-headed Reed Snake	-	-	LC	Sighting
		Calamaria lumbricoidea	Variable Reed Snake	-	-	LC	Sighting
3	Colubridae	*Lepturophis albofuscus*	Dusky Wolf Snake	-	-	LC	Expected
4	Dicroglossidae	*Fejervarya limnocharis*	Asian Grass Frog	-	-	LC	Sighting
		Limnonectes hascheanus	Hill Forest Frog	-	-	LC	Expected
5	Elapidae	*Calliophis intestinalis*	Banded Malaysian Coral Snake	Ular Pantai Belang	P	LC	Sighting
		Naja sumatrana	Black Spitting Cobra	Ular Senduk Sembur	P	LC	Carcases
		Calliophis bivirgata	Blue Coral Snake	Ular Pantai Biru-biru	P	LC	Sighting
		Ophiophagus hannah	King Cobra	Ular Tedung Selar	P	VU	Expected
6	Gekkonidae	*Ptychozoon lionotum*	Smooth-backed Flying Gecko	-	-	LC	Expected
7	Geoemydidae	*Cyclemys dentata*	Asian Leaf Turtle	Kura-kura Bergerigi	P	NT	Expected
8	Megophryidae	*Leptobrachium hendricksoni*	-	Katak-serasah Mata-bara	-	LC	Sighting
		Leptolalax heteropus	Variable Litterfrog	-	-	LC	Expected
9	Microhylidae	*Microhyla heymonsi*	Arcuate-spotted Pygmy Frog	-	-	LC	Sighting
10	Scincidae	*Eutropis multifasciata*	Common Mabuya	Bengkarung	-	LC	Sighting
		Lipinia vittigera	Banded Lipinia	-	-	LC	Sighting
11	Trionychidae	*Dogania subplana*	Malayan Soft-shelled Turtle	Labi Melayu	P	LC	Expected
12	Typhlopidae	*Indotyphlops braminus*	Brahminy Blind Snake	-	-	-	Sighting
13	Varanidae	*Varanus bengalensis*	Bengal Monitor Lizard	Biawak Tikus	TP	LC	Sighting
		Varanus salvator	Common Water Monitor	Biawak Air	P	LC	Sighting
14	Viperidae	*Tropidolaemus wagleri*	Wagler's Keeled Green Pit Viper	Ular Kapak Tokong	P	LC	Sighting

15	Xenopeltidae	*Xenopeltis unicolor*	Sunbeam Snake	Ular Pelangi	P	LC	Sighting

Note:

1) Local protection status under **Wildlife Conservation Act, 2010 [amendment of schedule] Order 2012 (Act 716)**: **P** - Protected, **TP** - Totally Protected.

2) Global protection status under **International Union for Conservation of Nature Red List of Threatened Species version 2020-3: NE** - Not Evaluated**, DD** - Data Deficient**, LC** - Least Concern, **NT** - Near Threatened, **VU** - Vulnerable, **EN** - Endangered, **CR** - Critically Endangered, **EW** - Extinct in the Wild, **EX** - Extinct.

Table 6.4.4 below shows an existence of faunas which been recorded in the proposed project site during survey period.

Table 6.4.4: List of faunas recorded

 *Irena puella* Asian Fairy-bluebird Dendang Gajah	 *Eurylaimus ochromalus* Black-and-yellow Broadbill Takau Hitam Kuning
 *Rubigula flaviventris* Black-crested Bulbul Merbah Jambul Hitam	 *Psilopogon cyanotis* Blue-eared Barbet Takur Akar

Pitta moluccensis
Blue-winged Pitta
Pacat Sayap Biru

Accipiter trivirgatus
Crested Goshawk
Lang Sika

Spilornis cheela
Crested Serpent-eagle
Helang Berjambul

Tropidolaemus wagleri
Wagler's Keeled Green Pit Viper
Ular Kapak Tokong

Carcass of *Naja sumatrana*
Black Spitting Cobra
Ular Senduk Sembur

Camera Trap Image of *Muntiacus muntjak*
Southern Red Muntjac
Kijang

	
Camera Trap Image of *Helarctos malayanus* Sun Bear Beruang Matahari	Camera Trap Image of *Tapirus indicus* Malayan Tapir Tapir

6.4.2 Flora

6.4.2.1 Existing Habitat

The proposed study site was categorized as lowland forest. It is one of the most complexes, dense and species-rich forest. It has a great value for wildlife conservation and scientific research. The term tropical forest is used to describe forest where there is little or no seasonal water shortage and where the climate is continuously warm. The study on flora was carried out in 1st until 9th December 2020, the main purpose is to examine the species diversity and composition as well as estimation of above ground biomass in the proposed project site.

The specific objectives of the survey are:

- To identify flora species within the proposed project site;
- To determine flora conservation status recorded within designated boundaries of the proposed project site based on the Malaysia Red List and the IUCN Red List of Threatened species;
- To identify the potential impacts on flora species and to recommend the necessary mitigation measures.

6.4.2.2 Methodology

A study has been carried out in the proposed project site in order to get the representative data based on Before Felling Forest Inventory (Pre-F) technique. This inventory was based on systematic line plot. The detail explanation as in **Figure 6.4.6** (*"Panduan kerja Luar Inventory Hutan Sebelum Tebangan")*. Flora sampling point of the Project site is shown in **Figure 6.4.2**.

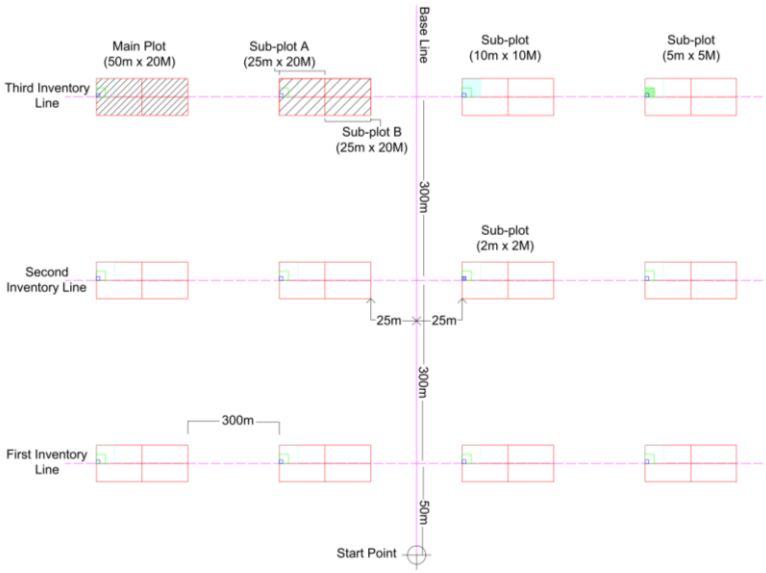


Figure 6.4.6: Arrangement of the inventory plots.

Note: first line of inventory will be 50m from the start point.

Inventory design:

Base Line

- Base line must be in perpendicular (straight line) in order to cover all the project site.

Inventory line

- The inventory line must be 90˚ to the base line (**Figure 6.4.6**);
- The inventory line shall start at 50 m from the starting point followed by 300m in distance between each inventory line.

Main inventory plot

- The first main plot must be 25 m from the baseline;

- Distance between the main inventory plots must be 300 m from each main plots. (**Figure 6.4.6**);
- The main inventory plot will be 20 m x 50 m (1st plot) and contains 5 sub-plots (**Figure 6.4.7**). There are:
    - Two sub-plot (25 x 20 m) 'A' and 'B'
    - One sub-plot (10 x 10 m)
    - One sub-plot (5 x 5 m)
    - One sub-plot (2 x 2 m)
- The location of the sub-plot (10 x 10 m), (5 x 5 m) and (2 x 2 m) will be at the first left sub-plot 'A' (25 x 20 m) on the inventory line (Figure 2.1).

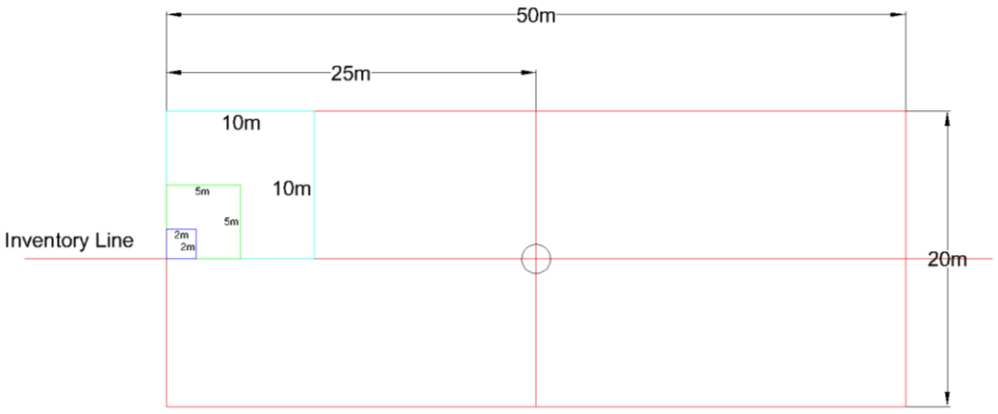


Figure 6.4.7: Detail of the main inventory plot.

Survey Method:

- In the main plot (50 x 20 m), all tree with diameter > 30 cm with or without climber must be measured;
- In the sub-plot (25 x 20 m), all tree with diameter > 15 cm to 30 cm with climber will be measured;
- DBH of for all trees will be measured at 1.3 m from the ground or 0.3 m from the buttress.
- Only trees at front and right of the boundary will be measured in order to avoid double counting;
- Details explanations for survey in every sub-plot as in **Table 6.4.5**;

- The presence of clumps of rotan, palm, & climber will be recorded in the main plot (50 x 20 m).

Table 6.4.5: Details of survey in every sub-plots.

Plot	Measurement (meter)	Area		Intensity Inventory (%)	Tree Class	Explanation
		m^2	Hectare			
Main	50 x 20	1,000	0.1	10%	> 45 cm diameter > 30 cm to 45 cm	Big tree Small tree
Second 'A' & 'B'	25 x 20	500	0.05	5%	> 15 cm to 30 cm diameter	Kayu Jaras besar
Third	10 x 10	100	0.01	1%	> 5 cm to 15 cm diameter	Kayu jaras kecil
Forth	5 x 5	25	0.0025	0.25%	> 1.5 cm height to 5 cm diameter	Small tree
Fifth	2 x 2	4	0.0004	0.04%	> 15 cm height to 1.5 m height	Seedling

Biomass estimation

The volume of each tree (D^2xH) was used to calculate the biomass. To estimate the biomass, the following coefficients of allometric equations of Kato *et. al.* (1978) was used.

$$\mathbf{Y = 0.2544*DBH^{2.3684}}$$

*DBH= Diameter Breast Height

Classification for Flora Conservation Status and Habit

Results of floristic composition for the proposed project site was divided into 5 categories referred to habit of the plants which are tree, lianas (climbers), fern/fern-allies, herbaceous and rattans/palms. The classification of plant habit refers to terminology that usually applied in botany, which may refer to the form in which a given species of plant grows. It describes the general appearance of the plant include size, form growth, orientation and shape (**Table 6.4.6**).

Table 6.4.6: Explanation on the plant habit according to life form and structure of the plant.

T	Tree	Woody plant, growth more than >5 m tall
S	Shrubs	Woody plant, usually small, that growth less than 5 m tall
C	Climber	Woody or herbaceous plants with stems that are not self-supporting, but are climbing or straggling on some support
H	Herbaceous	Non woody plant, usually in small size
P	Palmae	Family of flowering plants having a single cotyledon (embryonic leaf) in the seed
F/FA	Fern/Fern allies	Nonflowering vascular plant and produce spore

Conservation status for trees, lianas, ferns/ferns-allies, herbaceous and rattans/palms are based on conservation status listed by IUCN Red List and Malaysia Plant Red List (by FRIM). However, the Malaysia Plant Red List only recorded for family Dipterocarpaceae and other species of non-Dipterocarp group are not evaluated/no recorded. The code of classification conservation as shown in **Table 6.4.7**.

Table 6.4.7: IUCN Red list code for plants.

STATUS CODE	DESCRIPTION
EX	Extinct
CR	Critically Endangered
EN	Endangered
VU	Vulnerable
NT	Near Threatened
LC	Least Concern
DD	Data Deficient
NE	Not Evaluated

Sources: IUCN 2018. The IUCN Red List of Threatened Species. Version 2020-3.

6.4.2.3 Result

Total of 81 family, 194 genera, and 273 species of plants from 174 species of tree (T), 31 species of shrub (S), 16 species of herbaceous (H), 34 species of climber (C), 6 species of palm (P), and 12 species of ferns (F) was recorded. Leguminosea is the largest family with 16

species 10 genera, followed by family of Rubiaceae with 15 species 13 genera and others family are Euphorbiaceae and Anacardiaceae recorded with 13 species each. Besides that, other family such as Moraceae, Myristicaceae and Clusiaceae also contributed numbers of species in this area. **Table 6.4.8** below show diversity of the 10 dominant families in the proposed project site.

Table 6.4.8: Ten dominant family at the proposed project site.

FAMILY	NO. OF GENUS	NO. OF SPECIES
Leguminosae	10	16
Rubiaceae	13	15
Euphorbiaceae	10	13
Anacardiaceae	9	13
Malvaceae	9	13
Dipterocarpaceae	3	11
Annonaceae	7	10
Burseraceae	3	8
Fagaceae	2	7
Arecaceae	6	6

This study recorded 48 family of 116 genus from 174 tree species. The top 3 most dominant tree family was from Euphorbiaceae which consist of 13 species of tree with 10 genera, followed by Anacardiaceae with 13 species and 9 genera. Besides that, other family such as Dipterocarpaceae, Malvaceae and Leguminosae also contributed numbers of species in this area. **Figure 6.4.8** show top 10 number of tree species recorded within the proposed project site.

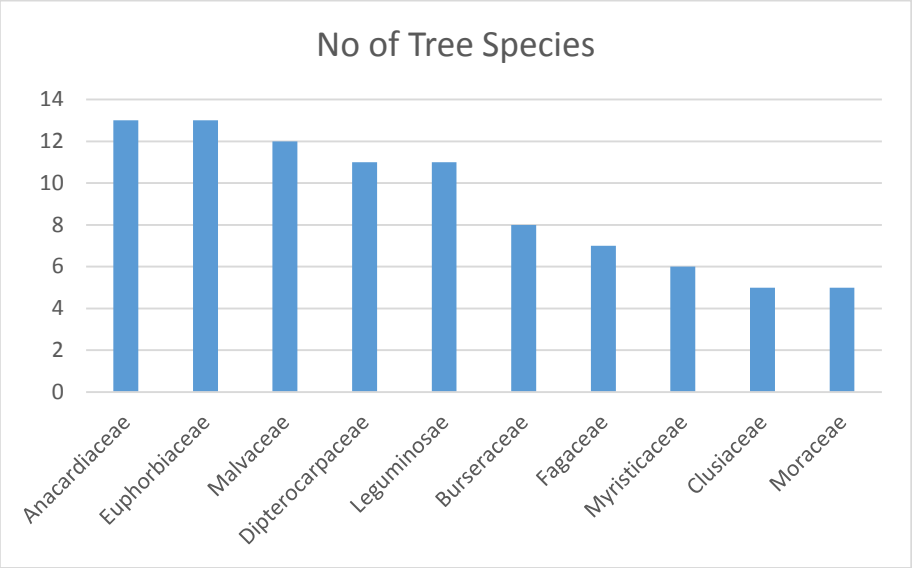


Figure 6.4.8: Ten highest tree species recorded in the proposed project site.

Meanwhile, shrubs comprise of 31 species from 26 genera and 17 families. Rubiaceae is the most abundant family with 9 species followed by Annonaceae and Primulaceae with 3 species each. Besides that, the most dominant species recorded was *Polyalthia* sp., and *Ixora* sp.

The herbaceous group consist of 16 species from 11 family and 14 genera. The most dominant species recorded in this area was *Alpinia* sp. and *Dracaena* sp. Others group was palm, that made up of 6 species from 6 genera in 1 family and the most dominant species recorded in this area was *Licuala* sp and *Calamus* sp.

Climbers (i.e., liana) were recorded with 34 species that came from 28 genera and 19 family. The most dominant species were *Aglaea* sp., *Rourea* sp., and *Bauhinia* sp. While fern recorded 12 species that derive from 12 genera and 7 families.

6.4.2.4 Endemic and Endangered Species

There is no endemic or endangered species was recorded during our survey in the proposed project site. However, this study recorded 11 species of Dipterocarpaceae, which is 6 of them were categories as least concern (LC), and 4 species under near threatened (NT) under Malaysia Red list (2010) (**Table 6.4.9**).

Table 6.4.9: List of species composition in the proposed project site.

FAMILY	SPECIES	STATUS MALAYSIA	PLANT HABIT
Acantaceae	*Asystasia gangetica* (L.) T. Anderson	NE	H
Acanthaceae	*Chroesthes longifolia* (Wight) B. Hansen	NE	S
Actinidiaceae	*Saurauia pentapetala* (Jack) Hoogland	NE	T
Adiantaceae	*Adiantum latifolium* Lam.	NE	F
Adiantaceae	*Taenitis blechnoides (Willd.)* Sw.,	NE	F
Anacardiaceae	*Bouea oppositifolia* (Roxb.) Meisn.	NE	T
Anacardiaceae	*Buchanania arborescens* (Blume) Blume	NE	T
Anacardiaceae	*Campnosperma auriculatum* (Blume) Hook.f.	NE	T
Anacardiaceae	*Gluta malayana* (Corner) Ding Hou	NE	T
Anacardiaceae	*Gluta wallichii* (Hook. f.) Ding Hou	NE	T
Anacardiaceae	*Mangifera caesia* Jack	NE	T
Anacardiaceae	*Mangifera griffithii* Hook. f.	NE	T
Anacardiaceae	*Mangifera magnifica* Kochummen	NE	T
Anacardiaceae	*Melanochyla angustifolia* Hook. f.	NE	T
Anacardiaceae	*Melanochyla auriculata* Hook. f.	NE	T
Anacardiaceae	*Parishia insignis* Hook. f.	NE	T
Anacardiaceae	*Pentaspadon velutinus* Hook. f.	NE	T
Anacardiaceae	*Swintonia schwenkii* (Teijsm. & Binn.) Teijsm. & Binn.	NE	T
Ancistrocladaceae	*Ancistrocladus tectorius* (Lour.) Merr.	NE	C
Anisophylleaceae	*Anisophyllea disticha* (Jack) Baill.	NE	S
Anisophylleaceae	*Anisophyllea scortechinii* King	NE	T
Annonaceae	*Artabotrys suaveolens* (Blume) Blume	NE	C
Annonaceae	*Fissistigma fulgens* (Hook. f. & Thomson) Merr.	NE	C
Annonaceae	*Friesodielsia glauca* (Hook. f. & Thomson) Steenis	NE	C
Annonaceae	*Goniothalamus fulvus* Hook. f. & Thomson	NE	S
Annonaceae	*Polyalthia brunneifolia* J. Sinclair	NE	S
Annonaceae	*Polyalthia bullata* King	NE	S
Annonaceae	*Drepananthus pruniferus* Maingay ex Hook.f. & Thomson	NE	T
Annonaceae	*Goniothalamus scortechinii* King	NE	T
Annonaceae	*Xylopia ferruginea* (Hook. f. & Thomson) Hook. f. & Thomson var. *ferruginea*	NE	T
Annonaceae	*Xylopia malayana* Hook. f. & Thomson var. malayana	NE	T
Apocynaceae	*Chilocarpus costatus* Miq.	NE	C
Apocynaceae	*Willughbeia edulis* Roxb	NE	C
Apocynaceae	*Alstonia macrophylla* Wall. ex G. Don	NE	T
Apocynaceae	*Dyera costulata* (Miq.) Hook. f.	NE	T
Araceae	*Homalomena rostrata* Griff.	NE	H
Araliaceae	*Schefflera ridleyi* (King) R. Vig. var. *ridleyi*	NE	C
Arecaceae	*Calamus javensis* Blume	NE	P

Arecaceae	*Korthalsia hispida* Becc.	NE	P
Arecaceae	*Licuala spinosa* Wurmb	NE	P
Arecaceae	*Oncosperma horridum* (Griff.) Scheff.	NE	P
Arecaceae	*Pholidocarpus macrocarpus* Becc.	NE	P
Arecaceae	*Pinanga auriculata* Becc. var. *leucocarpa* C.K. Lim	NE	P
Aristolochiaceae	*Thottea grandiflora* Rottb.	NE	S
Aristolochiaceae	*Thottea tomentosa* (Blume) Ding Hou	NE	S
Blechnaceae	*Blechnum orientale* L.,	NE	F
Burseraceae	*Canarium littorale* Blume	NE	T
Burseraceae	*Canarium pilosum* Benn.	NE	T
Burseraceae	*Canarium pseudosumatranum* Leenh.	NE	T
Burseraceae	*Dacryodes costata* (Benn.) H.J. Lam	NE	T
Burseraceae	*Dacryodes kingii* (Engl.) Kalkman	NE	T
Burseraceae	*Dacryodes rugosa* (Blume) H.J. Lam	NE	T
Burseraceae	*Santiria apiculata* Benn.	NE	T
Burseraceae	*Santiria laevigata* Blume	NE	T
Celastraceae	*Kokoona littoralis* Laws.	NE	T
Chrysobalanaceae	*Atuna nannodes* (Kosterm.) Kosterm.	NE	T
Chrysobalanaceae	*Parinari oblongifolia* Hook. f.	NE	T
Clusiaceae	*Calophyllum teysmannii* Miq. var. *inophylloide* (King) P.F. Stevens	NE	T
Clusiaceae	*Garcinia nigrolineata* Planch. ex T. Anderson	NE	T
Clusiaceae	*Garcinia parvifolia* (Miq.) Miq.	NE	T
Clusiaceae	*Garcinia scortechinii* King	NE	T
Clusiaceae	*Mesua ferrea* L	NE	T
Compositae	*Mikania micrantha* Kunth	NE	C
Compositae	*Vernonia arborea* Buch.-Ham	NE	T
Connaraceae	*Agelaea borneensis* (Hook. f.) Merr.	NE	C
Connaraceae	*Cnestis palala* (Lour.) Merr.	NE	C
Connaraceae	*Connarus ferrugineus* Jack	NE	C
Connaraceae	*Rourea rugosa* Planch.	NE	C
Cornaceae	*Alangium javanicum var. ebenaceum (C.B.Clarke) Berhaman*	NE	T
Cornaceae	*Alangium nobile* (C.B. Clarke) Harms	NE	T
Cucurbitaceae	*Trichosanthes tricuspidata* Lour.,	NE	C
Cyperaceae	*Mapania cuspidata* (Miq.)	NE	H
Cyperaceae	*Mapania kurzii* C.B. Clarke	NE	H
Dilleniaceae	*Tetracera indica* (Christm. & Panz.) Merr.	NE	C
Dilleniaceae	*Dillenia grandifolia* Wall. ex Hook. f. & Thomson	NE	T
Dilleniaceae	*Dillenia ovata* Wall. ex Hook. f. & Thomson	NE	T
Dilleniaceae	*Dillenia reticulata* King var. *psilocarpella* Hoogl.	NE	T
Dipterocarpaceae	*Dipterocarpus cornutus* Dyer	LC	T
Dipterocarpaceae	*Dipterocarpus costulatus* Slooten	NT	T

Dipterocarpaceae	*Dipterocarpus crinitus* Dyer	NT	T
Dipterocarpaceae	*Dipterocarpus grandiflorus* (Blanco) Blanco	NT	T
Dipterocarpaceae	*Hopea* sp.	NE	T
Dipterocarpaceae	*Shorea acuminata* Dyer	LC	T
Dipterocarpaceae	*Shorea leprosula* Miq.	LC	T
Dipterocarpaceae	*Shorea macroptera* Dyer .	LC	T
Dipterocarpaceae	*Shorea ovalis* (Korth.) Blume ssp. Ovalis	NT	T
Dipterocarpaceae	*Shorea parvifolia* Dyer ssp. *Parvifolia*	LC	T
Dipterocarpaceae	*Shorea pauciflora* King	LC	T
Dracaenaceae	*Dracaena longifolia* Ridl.	NE	H
Dracaenaceae	*Dracaena porteri* Baker	NE	H
Ebenaceae	*Diospyros buxifolia* (Blume) Hiern	NE	T
Ebenaceae	*Diospyros wallichii* King & Gamble ex F.N. Williams	NE	T
Elaeocarpaceae	*Elaeocarpus ferrugineus* (Jack) Steud. ssp. *Ferrugineus*	NE	T
Elaeocarpaceae	*Elaeocarpus floribundus* Blume var. *floribundus*	NE	T
Elaeocarpaceae	*Elaeocarpus griffithii* (Wight) A. Gray	NE	T
Elaeocarpaceae	*Elaeocarpus nitidus* Jack var. *nitidus*	NE	T
Euphorbiaceae	*Agrostistachys longifolia* (Wight) Benth. var. *longifolia*	NE	T
Euphorbiaceae	*Blumeodendron kurzii* (Hook. f.) J.J.Sm. ex Koord. & Valeton	NE	T
Euphorbiaceae	*Blumeodendron tokbrai* (Blume) J.J.Sm.	NE	T
Euphorbiaceae	*Croton laevifolius* Blume	NE	T
Euphorbiaceae	*Drypetes pendula* Ridl.	NE	T
Euphorbiaceae	*Elateriospermum tapos* Blume	NE	T
Euphorbiaceae	*Endospermum diadenum* (Miq.) Airy Shaw	NE	T
Euphorbiaceae	*Macaranga gigantea* (Rchb. f. & Zoll.) Müll.Arg.	NE	T
Euphorbiaceae	*Macaranga hypoleuca* (Rchb. f. & Zoll.) Müll.Arg.	NE	T
Euphorbiaceae	*Macaranga triloba* (Blume) Müll.Arg.	NE	T
Euphorbiaceae	*Mallotus griffithianus* (Müll.Arg.) Hook. f.	NE	T
Euphorbiaceae	*Pimelodendron griffithianum* (Müll.Arg.) Benth.	NE	T
Euphorbiaceae	*Sapium discolor* (Champ. ex Benth) Mull.Arg	NE	T
Fagaceae	*Castanopsis lucida* (Nees) Soepadmo	NE	T
Fagaceae	*Castanopsis schefferiana* Hance PETAK 3)	NE	T
Fagaceae	*Lithocarpus bancanus* (Scheff.) Rehder	NE	T
Fagaceae	*Lithocarpus kunstleri* (King ex Hook. f.) A. Camus	NE	T
Fagaceae	*Lithocarpus lucidus* (Roxb.) Rehder	NE	T
Fagaceae	*Lithocarpus rassa* (Miq.) Rehder	NE	T
Fagaceae	*Lithocarpus wallichianus* (Lindl. ex Hance) Rehder	NE	T
Flacourtiaceae	*Casearia capitellata* Blume	NE	S
Flacourtiaceae	*Hydnocarpus castanea* Hook. f. & Thomson	NE	T
Flacourtiaceae	*Scaphocalyx spathacea* Ridl.,	NE	T

Gnetaceae	*Gnetum* gnemon L. var. *griffithii* (Parl.) Markgr.	NE	S
Hypoxidaceae	*Molineria latifolia* (Dryand.) Herb. ex Kurz var. *latifolia*	NE	H
Ixonanthaceae	*Ixonanthes icosandra* Jack	NE	T
Ixonanthaceae	*Ixonanthes reticulata* Jack	NE	T
Lauraceae	*Actinodaphne sesquipedalis* Hook. f. var. *glabra*	NE	T
Lauraceae	*Cinnamomum mollissimum* Hook. f.	NE	T
Lauraceae	*Cryptocarya costata* Blume	NE	T
Lauraceae	*Litsea ferruginea* (Blume) Blume	NE	T
Lecythidaceae	*Barringtonia macrostachya* (Jack) Kurz	NE	T
Leguminosae	*Bauhinia bidentata* Jack	NE	C
Leguminosae	*Bauhinia ferruginea* Roxb	NE	C
Leguminosae	*Dalbergia parviflora* Roxb	NE	C
Leguminosae	*Spatholobus ferrugineus* (Zoll. & Moritzi) Benth. var. ferrugineus	NE	C
Leguminosae	*Dalbergia velutina* Benth.	NE	S
Leguminosae	*Adenanthera malayana* Kosterm.	NE	T
Leguminosae	*Callerya atropurpurea* (Wall.) Schot	NE	T
Leguminosae	*Cynometra malaccensis* Meeuwen	NE	T
Leguminosae	*Dialium indum* L.	NE	T
Leguminosae	*Dialium platysepalum* Baker	NE	T
Leguminosae	*Dialium* sp.	NE	T
Leguminosae	*Koompassia excelsa* (Becc.) Taub.	NE	T
Leguminosae	*Koompassia malaccensis* Maing. ex Benth.	NE	T
Leguminosae	*Parkia speciosa* Hassk.,	NE	T
Leguminosae	*Sindora velutina* Baker	NE	T
Leguminosae	*Sindora wallichii* Grah. ex Benth.	NE	T
Loganiaceae	*Strychnos axillaris* Colebr.	NE	C
Loganiaceae	*Strychnos ignatii* Berg.	NE	C
Lycopodiaceae	*Lycopodium cernua* (L.) Pic.Serm.	NE	F
Lygodiaceae	*Lygodium microphyllum* (Cav.) R. Br.	NE	C
Magnoliaceae	*Magnolia maingayi* King	NE	T
Malvaceae	*Leptonychia caudata* (Wall. ex G. Don) Burret	NE	S
Malvaceae	*Commersonia bartramia* (L.) Merr.	NE	T
Malvaceae	*Durio griffithii* (Mast.) Bakh.	NE	T
Malvaceae	*Durio singaporensis* Ridl.	NE	T
Malvaceae	*Heritiera javanica* (Blume) Kosterm.	NE	T
Malvaceae	*Microcos hirsuta* (Korth.) Burret	NE	T
Malvaceae	*Microcos latifolia* Burret	NE	T
Malvaceae	*Neesia malayana* Bakh.	NE	T
Malvaceae	*Pentace* sp.	NE	T
Malvaceae	*Pentace strychnoidea* King	NE	T
Malvaceae	*Pterospermum diversifolium* Blume,	NE	T
Malvaceae	*Scaphium linearicarpum* (Mast.) Pierre	NE	T

Malvaceae	*Scaphium macropodum* (Miq.) Beumée ex Heyne	NE	T
Melastomataceae	*Dissochaeta celebica* Blume	NE	C
Melastomataceae	*Clidemia hirta* (L.) D. Don	NE	S
Melastomataceae	*Melastoma malabathricum* L.	NE	S
Melastomataceae	*Lijndenia laurina* Zoll. & Moritzi	NE	T
Melastomataceae	*Pternandra echinata* Jack	NE	T
Meliaceae	*Aglaia forbesii* King	NE	T
Meliaceae	*Aglaia rubiginosa* (Hiern) Pannell	NE	T
Meliaceae	*Sandoricum koetjape* (Burm. f.) Merr.	NE	T
Memeylaceae	*Memecylon amplexicaule* Roxb	NE	T
Memeylaceae	*Memecylon excelsum* Blume	NE	T
Moraceae	*Ficus sp.*	NE	C
Moraceae	*Artocarpus integer* (Thunb.) Merr. var. *silvestris* Corner	NE	T
Moraceae	*Artocarpus rigidus* Blume	NE	T
Moraceae	*Artocarpus scortechinii* King	NE	T
Moraceae	*Ficus fulva* Reinw. ex Blume	NE	T
Moraceae	*Streblus elongatus* (Miq.) Corner,	NE	T
Myristicaceae	*Gymnacranthera farquhariana* (Hook. f. & Thomson) Warb. var. *zippeliana* (Miq.) R.T.A. Schouten	NE	T
Myristicaceae	*Horsfieldia irya* (Gaertn.) Warb.	NE	T
Myristicaceae	*Horsfieldia* sp.	NE	T
Myristicaceae	*Knema hookeriana* (Wall. ex Hook.f. & Thomson) Warb.	NE	T
Myristicaceae	*Knema laurina* (Blume) Warb.	NE	T
Myristicaceae	*Myristica malaccensis* Hook. f.	NE	T
Myrtaceae	*Rhodamnia cinerea* Jack	NE	T
Myrtaceae	*Syzygium cerinum* (M.R. Hend.) I.M. Turner var. *cerinum*	NE	T
Myrtaceae	*Syzygium sp.*	NE	T
Ochnaceae	*Campylospermum serratum* (Gaertn.) Bittrich & M.C.E. Amaral	NE	T
Olacaceae	*Ochanostachys amentacea* Mast	NE	T
Olacaceae	*Scorodocarpus borneensis* (Baill.) Becc.	NE	T
Olacaceae	*Strombosia javanica* Blume	NE	T
Opiliaceae	*Champereia manillana* (Blume) Merr.	NE	S
Oxalidaceae	*Sarcotheca laxa* (Ridl.) Knuth	NE	T
Oxalidaceae	*Sarcotheca griffithii* (Planch. ex Hook. f.) Hallier f.	NE	T
Pandaceae	*Galearia fulva* (Tul.) Miq.	NE	T
Pandanaceae	*Freycinetia angustifolia* Blume	NE	C
Pandanaceae	*Freycinetia sumatrana* Hemsl.	NE	C
Pandanaceae	*Pandanus atrocarpus* Griff.	NE	T
Pentaphragnataceae	*Pentaphragma ellipticum* Poulsen	NE	H
Phyllanthaceae	*Baccaurea parviflora* (Müll.Arg.) Müll.Arg.	NE	S
Phyllanthaceae	*Aporosa microstachya* (Tul.) Müll.Arg.	NE	T

Phyllanthaceae	*Baccaurea javanica* (Blume) Müll.Arg.	NE	T
Phyllanthaceae	*Glochidion superbum* Baill.	NE	T
Piperaceae	*Piper porphyrophyllum* N.E. Br.	NE	C
Piperaceae	*Piper ribesioides* Wall.	NE	C
Poaceae	*Dendrocalamus pendulus* Ridl.	NE	H
Polygalaceae	*Xanthophyllum eurhynchum* Miq.	NE	T
Polypodiaceae	*Leptochilus macrophyllus*	NE	F
Polypodiaceae	*Microsorum membranifolium* (R.Br.) Ching	NE	F
Polypodiaceae	*Paragramma longifolia* (Blume) T. Moore	NE	F
Polypodiaceae	*Platycerium coronarium* (D. Koenig ex O.F. Müll.) Desv.	NE	F
Primulaceae	*Marantodes pumilum* (Blume) Kuntze	NE	H
Primulaceae	*Ardisia elliptica* Thunb.	NE	S
Primulaceae	*Ardisia purpurea* Reinw. ex Blume	NE	S
Primulaceae	*Maesa ramentacea* Wall. ex Roxb.	NE	S
Rhamnaceae	*Ventilago maingayi* Lawson,	NE	C
Rhamnaceae	*Ziziphus affinis* Hemsl.	NE	C
Rhamnaceae	*Ziziphus calophylla* Wall. ex Hook.f.	NE	C
Rhizophoraceae	*Gynotroches axillaris* Blume	NE	T
Rhizophoraceae	*Pellacalyx axillaris* Korth.	NE	T
Rubiaceae	*Uncaria callophylla* Blume ex Korth.	NE	C
Rubiaceae	*Uncaria cordata* (Lour.) Merr. var. *cordata*	NE	C
Rubiaceae	*Aidia densiflora* (Wall.) Masam.,	NE	S
Rubiaceae	*Ixora concinna* Hook. f.	NE	S
Rubiaceae	*Ixora javanica* (Blume) DC. var. *javanica*	NE	S
Rubiaceae	*Lasianthus attenuatus* Jack	NE	S
Rubiaceae	*Mussaenda glabra* Vahl	NE	S
Rubiaceae	*Pavetta sp.*	NE	S
Rubiaceae	*Psychotria* sp.	NE	S
Rubiaceae	*Tarenna* sp.	NE	S
Rubiaceae	*Timonius wallichianus* (Korth.) Valeton	NE	S
Rubiaceae	*Gardenia tubifera* Wall.	NE	T
Rubiaceae	*Nauclea officinalis* (Pierre ex Pit.) Merr. & Chun	NE	T
Rubiaceae	*Neonauclea calycina* (DC.) Merr.	NE	T
Rubiaceae	*Porterandia anisophyllea* (Jack ex Roxb.) Ridl.	NE	T
Rutaceae	*Maclurodendron porteri* (Hook. f.) T.G. Hartley	NE	T
Rutaceae	*Melicope glabra* (Blume) T.G. Hartley	NE	T
Sapindaceae	*Lepisanthes tetraphylla* (Vahl) Radlk.,	NE	T
Sapindaceae	*Pometia pinnata* J.R. Forst. & G. Forst.	NE	T
Sapindaceae	*Pometia ridleyi* King ex Radlk.	NE	T
Sapindaceae	*Xerospermum noronhianum* (Blume) Blume	NE	T
Sapotaceae	*Madhuca selangorica* (King & Gamble) J. Sinclair	NE	T

Sapotaceae	*Palaquium gutta* (Hook. f.) Baill.	NE	T
Sapotaceae	*Payena lucida* A. DC.	NE	T
Sapotaceae	*Pouteria malaccensis* (C.B. Clarke) Baehni	NE	T
Schizaeaceae	*Lygodium auriculatum* (Willd.) Alston	NE	F
Selaginellaceae	*Selaginella intermedia* (Blume) Spring var*. intermedia*	NE	F
Simaroubaceae	*Eurycoma longifolia* Jack	NE	S
Smilacaceae	*Smilax calophylla* Wall.	NE	C
Smilacaceae	*Smilax megacarpa* A. DC. & C. DC.	NE	C
Solanaceae	*Solanum lasiocarpum* Dunal	NE	S
Taccaceae	*Tacca integrifolia* Ker Gawl.	NE	H
Thelypteridaceae	*Mesophlebion chylamydophorum* (Rosenst. *ex* C.Chr.) Holttum	NE	F
Thelypteridaceae	*Pronephrium repandum* (Fée) Holttum,	NE	F
Thymelaeaceae	*Gonystylus confusus* Airy Shaw	NE	T
Thymelaeaceae	*Gonystylus maingayi* Hook. f.	NE	T
Tiliaceae	*Grewia laevigata* Vahl	NE	T
Torricelliaceae	*Aralidium pinnatifitidum* (Jungh. & de Vriese) Miq.	NE	T
Ulmaceae	*Gironniera hirta* Ridl.	NE	T
Ulmaceae	*Gironniera nervosa* Planch.	NE	T
Ulmaceae	*Gironniera parvifolia* Planch.	NE	T
Ulmaceae	*Gironniera subaequalis* Planch.	NE	T
Urticaceae	*Poikilospermum cordifolium* (Barg.-Petr.) Merr.	NE	T
Verbenaceae	*Clerodendrum deflexum* Wall.	NE	S
Verbenaceae	*Clerodendrum laevifolium* Blume	NE	S
Verbenaceae	*Teijsmanniodendron coriaceum* (C.B. Clarke) Kosterm.	NE	T
Verbenaceae	*Vitex pinnata* L.,	NE	T
Verbenaceae	*Vitex vestita* Wall. ex Schauer	NE	T
Zingiberaceae	*Alpinia javanica* Blume var. *javanica*	NE	H
Zingiberaceae	*Alpinia sp.*	NE	H
Zingiberaceae	*Elettariopsis curtisii* Baker	NE	H
Zingiberaceae	*Etlingera littoralis* (J. König) Giseke	NE	H
Zingiberaceae	*Globba patens* Miq. var. *patens*	NE	H

*****Note; Tree(T), Lianas/climber(L), Shrub(S), Herbaceous (H), Fern(F), Palm/Rattan (P).

6.4.2.5 Biomass Estimation

Estimation of biomass for the study area is based on the DBH (diameter at breast height) measurement of the tree. Total estimated aboveground biomass (TAGB) at proposed project site was 188.44t/ha.

6.4.2.6 Protected Endangered Species

Endangered species was defined as any species has potential threats from its habitat loss (IUCN 2019). In order to ensure the survival of that species in the future, that particular species need to be maintain, conserve and restore from extinction. Tree protection involves activities designed to preserve and protect tree health by avoiding damage to tree roots, trunk or crown on the site. There are several techniques can be applied as listed below:

i. The best way is to exclude or gazette some area around that tree species from development by maintain the tree in their natural habitats. Seed and seedling can be collected from the tree and plant in the in the future;
ii. To ensure the survival of that species for a single tree, 50-meter radius around the tree must be excluded from the logging or any activities. Habitat of that tree need to be secured from any disturbance that can affect that tree in the future. It is included any disturbance from any work or harmful activities to the tree such as earthwork, parking of heavy vehicles, equipment and machineries;
iii. During the cutting process, the felling direction should be out from the radius of the protecting tree;
iv. In addition, that particular tree needs to be marked and signage of “Protected Tree” should be placed;
v. Besides that, the authority can also classify that area as “Hutan Penyelidikan & Pendidikan” to encourage and promote scientific research to take place and knowledge enhancement in the future.

Table 6.4.10: Flora Species Recorded Within Proposed Project Site

 *Drepananthus pruniferus*	 *Sarcotheca iaxa*
 *Platycerium coronarium*	 *Agelaea borneensis*

	
Porterandia anisophyllea	*Vitex pinnata*

6.5 SOCIO-ECONOMIC STUDY

This section describes the background of the current socio-economic status, including the population distribution of the people living within the study area, their livelihood, and income sources. Information of the study area collects through two primary sources, viz. the conduct of social surveys (primary data) and published and unpublished reports on the study area's human environment (Population and Housing Survey 2010, Statistics Department of Malaysia 2011) as secondary data. Moreover, this study also identifies the potentially significant impacts (positive and negative) of the proposed project and recommends the appropriate mitigation measures to minimize the communities' impacts.

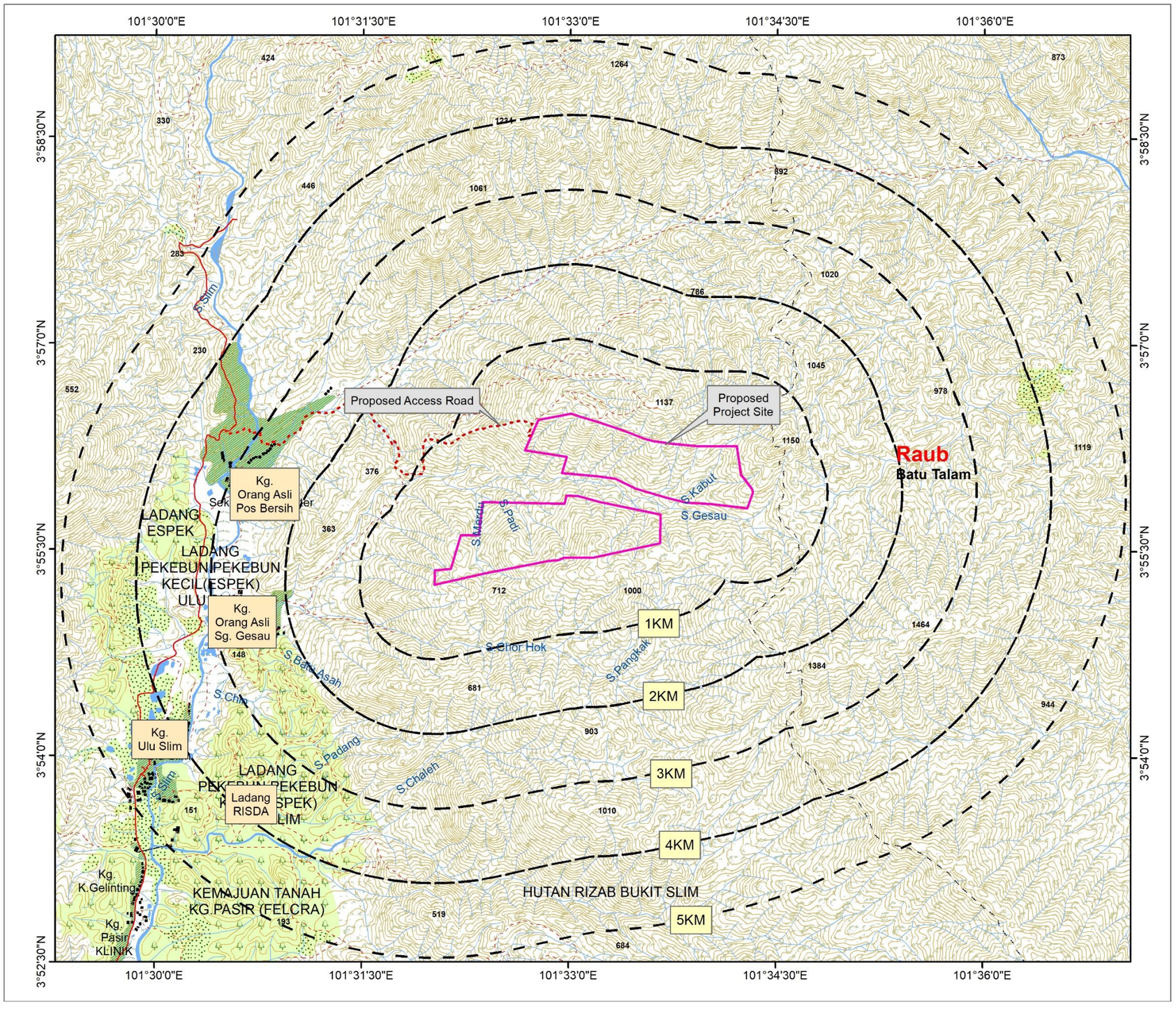
6.5.1 Background of Study Area

The project site is located in Mukim Slim, District of Muallim, Perak Darul Ridzuan (**Figure 6.5.1**). The overall economy of the Mukim is related to agriculture where most of the arable land have been under rubber, oil palm plantations and orchard. One hot spring is located in Kampung Ulu Slim, recreation activities such as water rafting and resorts (D'Pulau Tibang and RISDA Eco Park). The project site with a rural background where the Malays community is the major ethnic of the mukim. Slim is the nearest town, approximately 30 km from the project site. There are traditional villages found within the study area.

The general existing human environment of the study area

A. Population Distribution

In 2010, the total population in Mukim Slim had 21,066 people (Population Distribution and Basic Demographic Characteristics, Department of Statistics 2011). Mukim Slim has 5,343 families with 6,134 units (**Table 6.5.1**).



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Daerah Muallim
Mukim Slim
Hutan Rizab Bukit Slim

Legend

- Project Site
- Mukim
- Access Road
- Paved Road
- River
- Contour Line
- Settlement Area
- Main River
- Lake
- Grass
- Secondary Forest, Belukar, Riung, Jerami
- Sundry Tree Cultivation
- .1137 Spot Height
- Rubber Plantation
- Oil Palm Plantation
- Forest
- Swamp

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Figure 6.5.1: Socio Economy Study Area for Project Site

Table 6.5.1 Total Population in Mukim Slim 2010

Mukim	Population	Households	Living Quarters
Mukim Slim	21,066	5,343	6,134

Source: Computed and adapted from Population and Housing Census of Malaysia 2010

A. Population Age Distribution

Table 6.5.2 show the population age distribution in the study area. The age distribution is divided into three groups namely younger age populations (0 to 14 years old), the potential labour force (15 to 64 years old) and older age population (more than 65 years old). Mukim Slim have 6,200 persons, 13,527 persons and 1,339 persons respectively.

Table 6.5.2 Population Age Distribution in Mukim Slim 2010

District/Mukim	0-14 (years old)	15-64 (years old)	>65 (years old)
Mukim Slim	6,200	13,527	1,339

Source: Computed and adapted from Population and Housing Census of Malaysia 2010

B. Ethnic Composition

One of the demographic characteristics is an ethnic composition. Mukim Slim comprises several ethnic groups where Malays are the largest ethnic group with 51.3% of the mukim's population followed by Indians with 16.7%. Other Bumiputera mainly of Orang Asli made up of about 16.3%. **Table 6.5.3** shows the population distribution by ethnic composition.

Table 6.5.3: Ethnic Composition of Mukim Slim 2010

District/Mukim	Malay	Other Bumiputera	Chinese	Indians	Others	Non-Malaysian Citizen	**Total**
Mukim Slim	10,808	3,442	2,766	3,522	32	496	21,066
	51.3%	16.3%	13.1%	16.7%	0.2%	2.4%	100%

Source: Computed and adapted from Population and Housing Census of Malaysia 2010

6.5.2 Community Profile of the Study Area

A socio-economic survey has been conducted within 5 km in the study area. The social survey was conducted in December 2020. One hundred eight (108) respondents participated in this study using a purposive sampling technique. The sample of questionnaire as shown in **Appendix 10**. The distribution of the respondents interviewed by settlements is as given in **Table 6.5.4**.

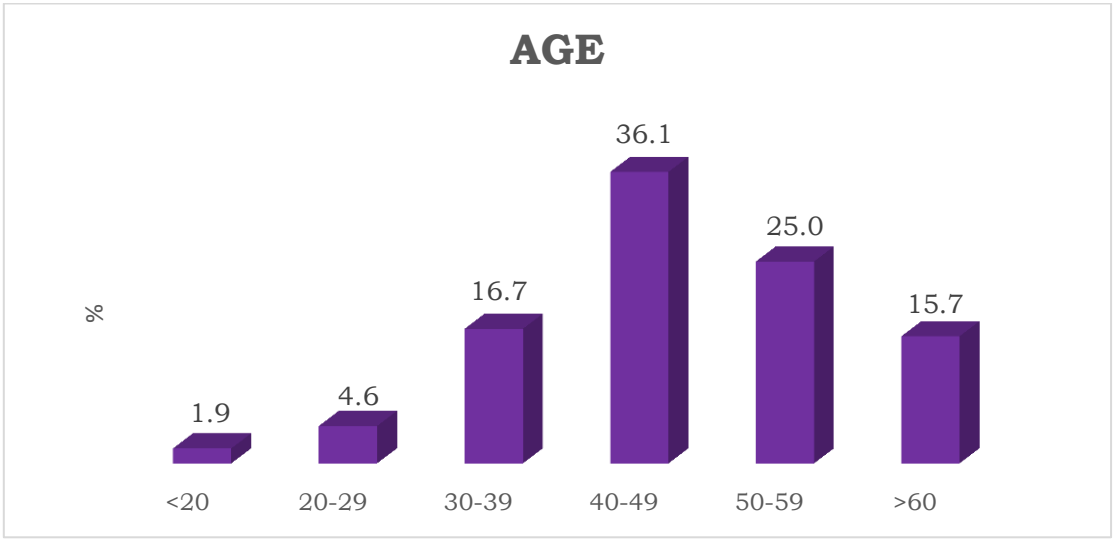
Table 6.5.4 Settlement located in 5km radius from proposed project

Settlement	Distance (Km Radius)	Estimation of Population	Estimation of Living Quarters	Sample Size
Kampung Orang Sungai Gesau	3	161 peoples 42 families	32	18
Kampung Orang Asli (Pos Bersih)	3	533 peoples 161 families	90	45
Ladang RISDA (kuarters)	4	31 staff (including foreign workers)	32	5
Kampung Ulu Slim	4	500	100	40
		TOTAL		**108**

Source: Social survey December 2020

6.5.2.1 Respondent Age Group

The respondent's age group was subdivided into 10 years old cohort. Majority of the respondents come from the range 40 – 49 years old which comprised 36.1% of the population. 1.9% of the respondents are younger, while the older group is more than 60 years old and shall consist of 15.7% (**Figure 6.5.2**).

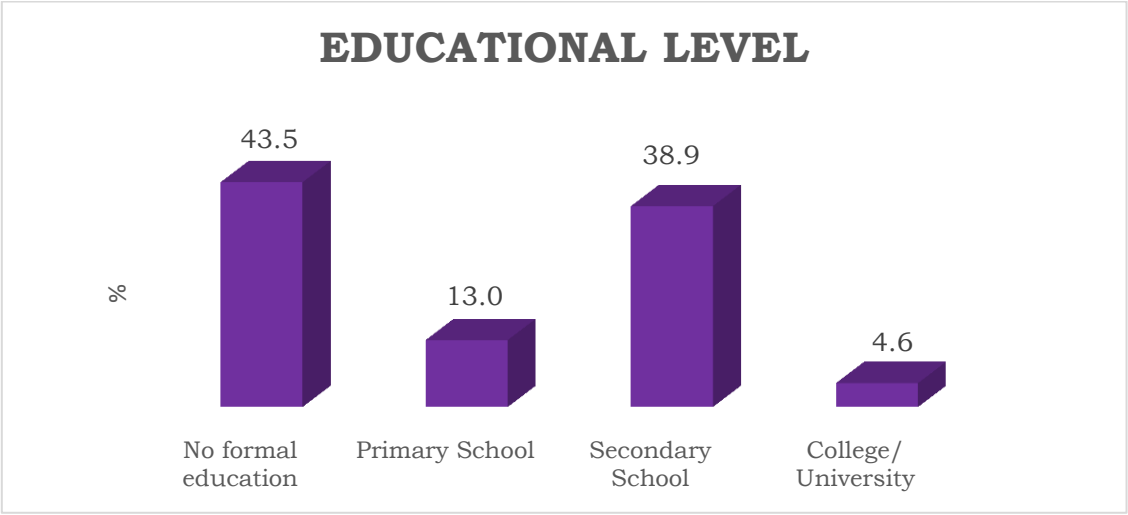


Source: Social survey December 2020

Figure 6.5.2: Age Structure of the Respondents in the Study Area

6.5.2.2 Educational Level

Figure 6.5.3 shows the educational level of the respondents in the study area—the illiterate respondents did not have formal education, about 43.5%. The rest of the respondents have achieved minimum academic (primary education) achievement with 13%, secondary education with 38.9% and those who have completed higher education include the college and university students/graduates with 4.6% of the total respondents.

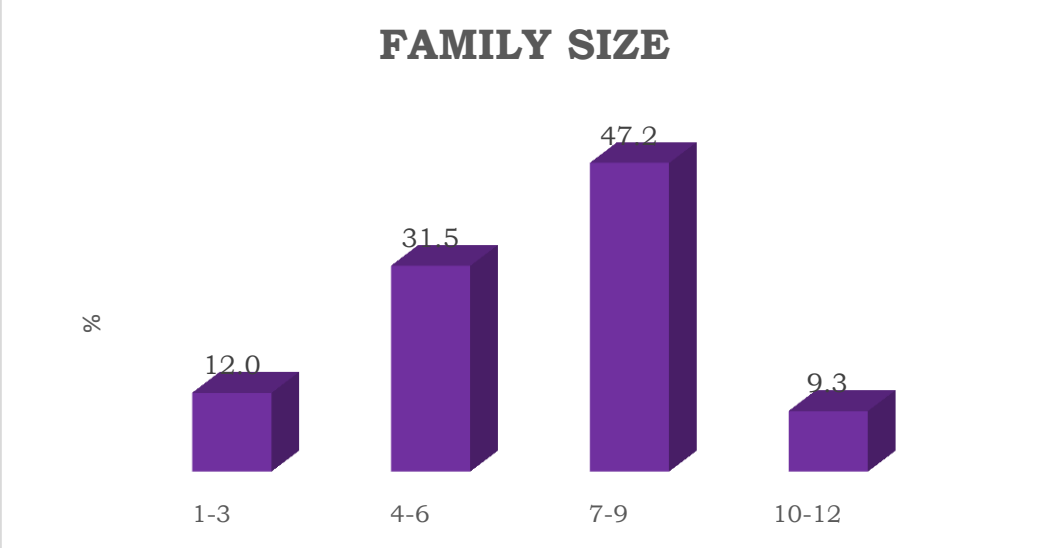


Source: Social survey December 2020

Figure 6.5.3: Educational Level in the Study Area

6.5.2.3 Family Size

Figure 6.5.4 shows that most of the respondents are families with 7 to 9 people per household (47.2%). 12% of the respondents have a small family size with less than three persons per household that have been senior citizens either living alone or young married couple. A larger family size with more than ten persons per household made up 9.3% of the respondents.

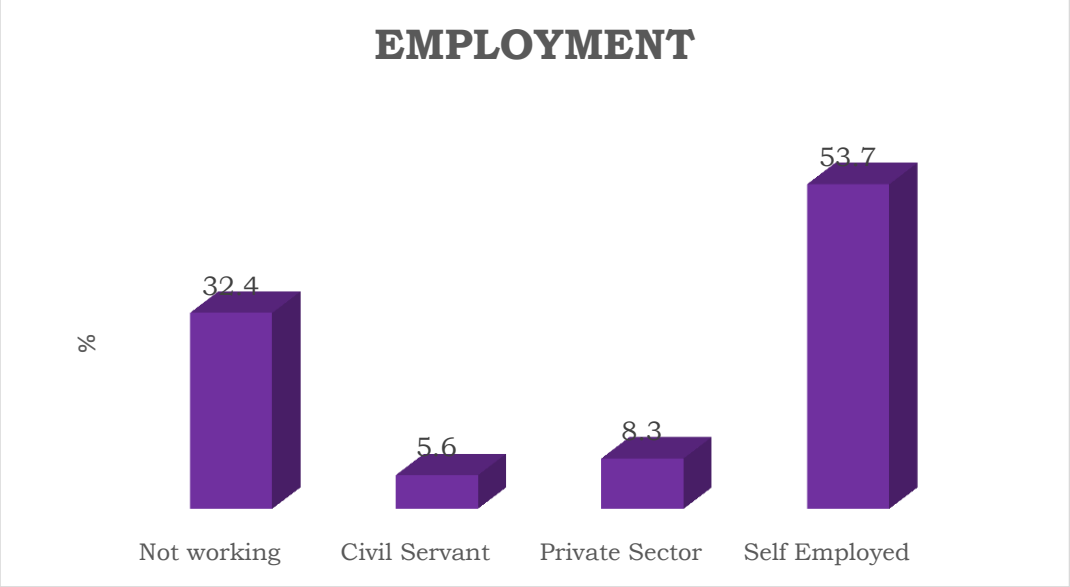


Source: Social survey December 2020

Figure 6.5.4: Family Size

6.5.2.4 Employment

The majority of the respondents (53.7%) were self-employed. They mainly work as farmers, rubber tappers, odd jobs (Kerja kampong), and small-time traders. Those who were unemployed (32.4%) included housewives and retirees. 5.6% of the respondents were government officers, while 8.3% worked in the private sector. **Figure 6.5.5** shows the types of employment in the study area.

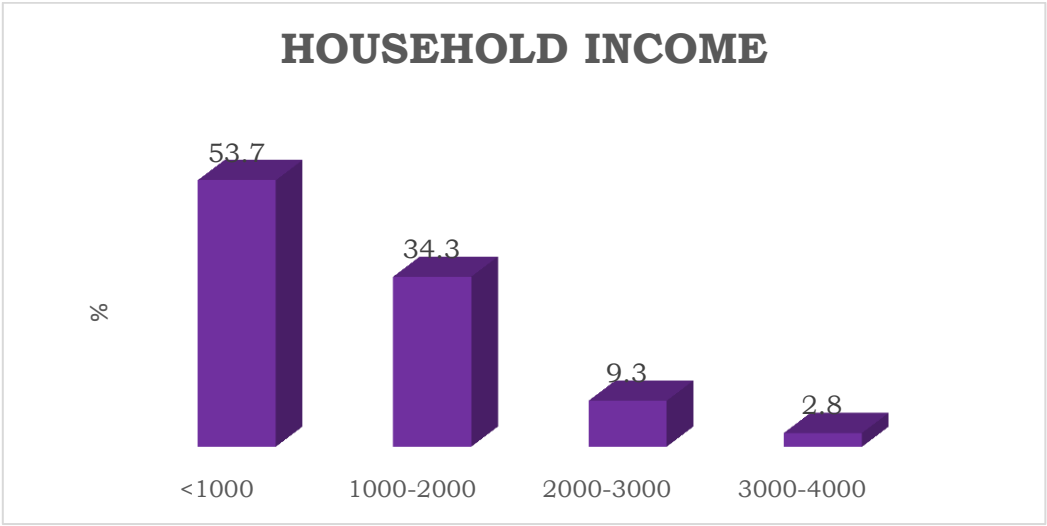


Source: Social survey December 2020

Figure 6.5.5: Employment

6.5.2.5 Household Income

Figure 6.5.6 shows the monthly household income of the respondents in the study area. The majority of those who earned less than RM1,000 per month made up about 53.7%. The respondent who earned between RM1,000 and RM2,000 made up 34.3% of the respondents. The income group of more than RM2,000 comprised 12.1% of the respondents.

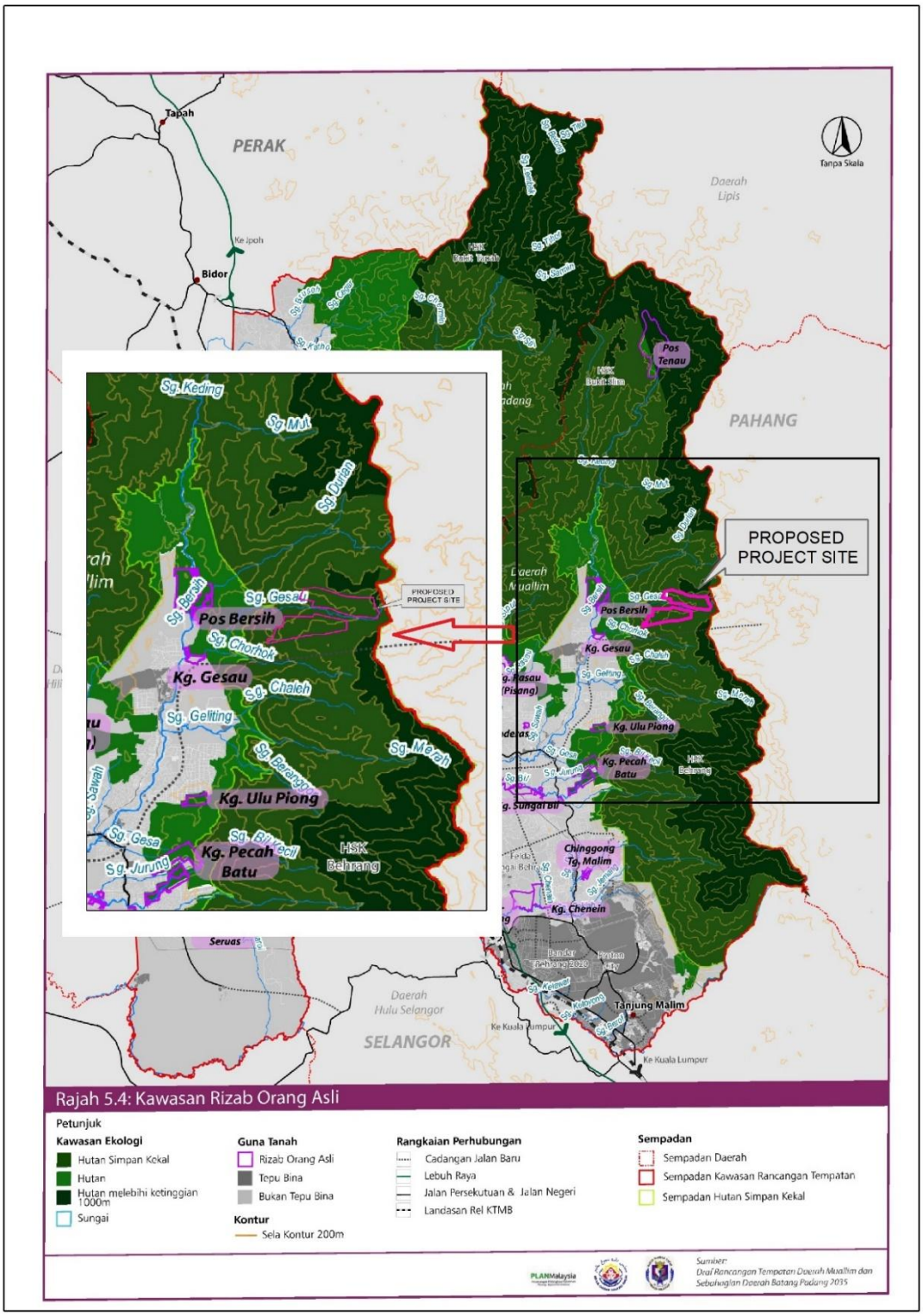


Source: Social survey December 2020

Figure 6.5.6: Household Income of the respondents

6.5.3 Orang Asli Community

There are two aboriginal settlements within the study area, Kampung Orang Asli (Pos Bersih) and Kampung Orang Asli Gesau, and they are from the Semai tribe. These settlements were located within a 3.0km radius from the project site. These Orang Asli find their forest product such as petai and gaharu in the forest nearby, while some work as rubber tappers. The Orang Asli have mentioned their Tanah adat (Kawasan rizab) near the proposed project site. Based on the Rancangan Tempatan Daerah Muallim, the location of their *tanah adat (kawasan rizab)* is not included in project site as shown in **Figure 6.5.7**.



Source: RTD Muallim dan sebahagian Daerah Batang Padang 2035

Figure 6.5.7 Kawasan Rizab Orang Asli

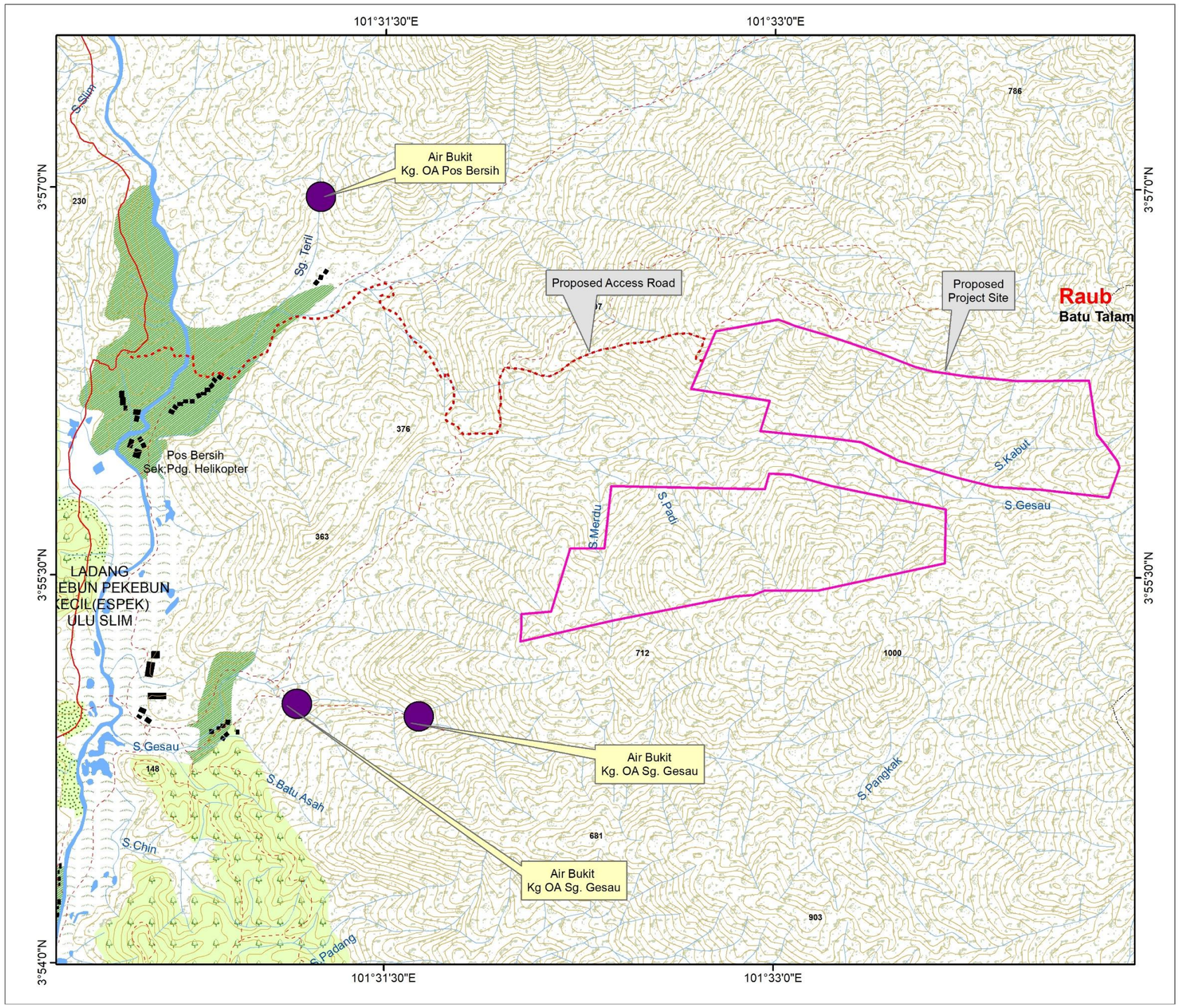
Water Intake

Both Orang Asli received a water supply from the *air bukit*. Kampung Orang Asli (Pos Bersih) received a water supply from Sungai Teril. In contrast, Kampung Orang Asli Sungai Gesau received a water supply from Sungai Chorhok. However, the villages' water intakes are not affected by the project as the location is not in the same catchment as shown in **Figure 6.5.8**.

Coordinate	Photo
(03°55'1"N, 101°31'11"E)	
(03°54'57"N, 101°31'38"E)	

6.5.4 Recreation Activity

There are two main resorts: RISDA Eco Park (Ladang RISDA Ulu Slim) and D'Pulau Tibang resort, located surrounding the proposed project site. The recreation activities involved river rafting (both resorts using the same tour guide rafting), jungle trekking, fishing, etc. The tourist mainly came by due to nature scenery and river activity, especially during weekends and public holidays.



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Daerah Muallim
Mukim Slim
Hutan Rizab Bukit Slim

Legend

- Project Site
- Mukim
- Access Road
- Paved Road
- River
- Contour Line
- Settlement Area
- Main River
- Grass
- Secondary Forest, Belukar, Riung, Jerami
- Sundry Tree Cultivation
- .1137 Spot Height
- Rubber Plantation
- Oil Palm Plantation
- Forest
- Air Bukit

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Figure 6.5.8 Water intake Kampung Orang Asli

6.5.5 Facilities & Amenities

The settlements of all villages are well facilitated. The settlement areas have been provided with schools, medical clinics, mosques, and halls. Clean tap water for Kampung Ulu Slim supplied from Lembaga Air Perak (LAP). Electricity is provided by Tenaga Nasional Berhad (TNB). Photographs of some of the respective amenities and villagers interviewed have been recorded in **Table 6.5.5.**

Table 6.5.5: Facilities and Amenities in the Study Area

Facilities		
	Primary school in Kampung Orang Asli Pos Bersih	Settlement in Kampung Orang Asli Pos Bersih
		
	Ladang RISDA estate	Settlement in Kg Orang Asli Sungai Gesau

		
	Livestock in Kg Ulu Slim	Orchard
Recreaction		
	RISDA Eco Park (Ladang RISDA Ulu Slim)	D'Pulau Tibang resort
Social survey		







Source: Social survey December 2020

Existing Environment Condition

The socio-economy survey also tried to assess the existing environmental condition of respondents. The highest number of yes responded by villages is fewer job opportunities (57.4%) and followed by flash flood (54.6%). The study area has good environmental conditions with low environmental and social impacts based on respondents' responses.

Table 6.5.6 Existing Environment Condition

Existing Environment Condition	Responses Yes (%)
Flash Flood	54.6
Heavy Vehicle egress and ingress	13.0
Nearest rivers have been pollute	28.7
Traffic Congestion	9.3
Frequent road accidents	7.4
Social problems	38.0
High number of foreign workers	25.0
Fewer job opportunities	57.4
No sufficient amenities and infrastructure	27.8
Disruption of electricity	19.4
Disruption of water supply	13.9
Disruption of communication	4.6

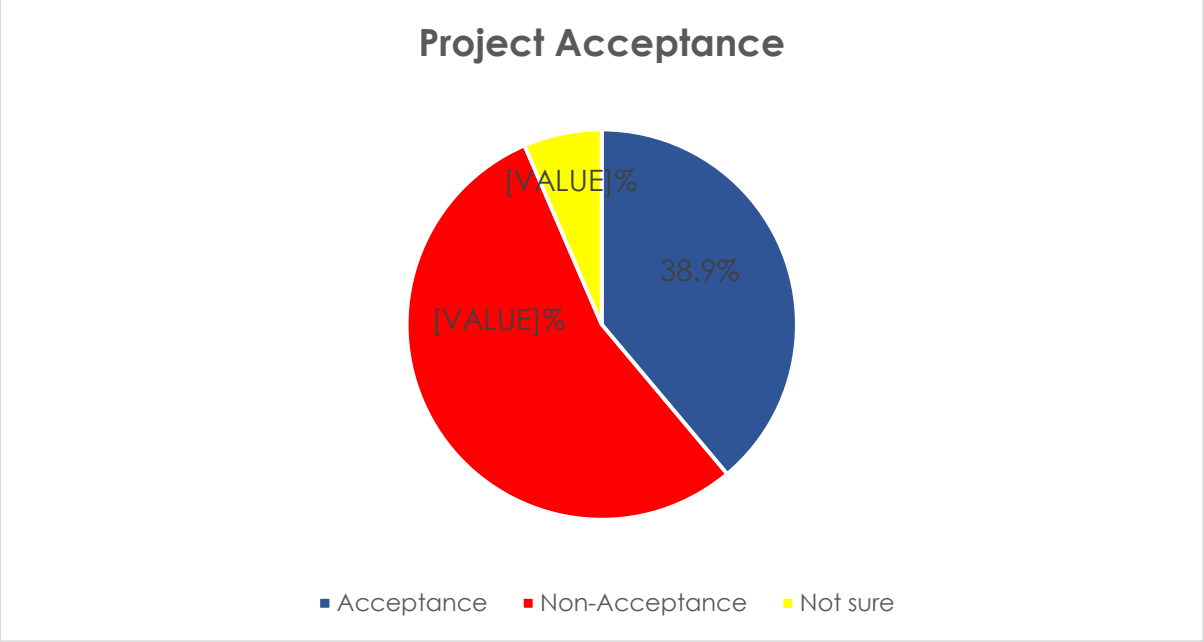
Source: Social survey December 2020

6.5.6 Awareness and Perception

The overall perception of the respondents from the 5-km radius of the proposed project site has been discussed. The respondents' responses showed that they acknowledge that the proposed project would generate positive impacts even if there will be negative impacts. The social survey showed a positive response from the total respondents, with 38.9% accepting the project. The respondents accept the project due to employment opportunities; they hope the project's proponent priority is for the local people.

Meanwhile 54.6% showed non-acceptance toward the proposed Project (**Figure 6.5.9**), most of the respondents did not accept the proposed project because they think the project will negatively impact the existing environmental conditions, especially to river water quality and worsen the flood. To address this issue, the project proponent should always follow the mitigation measure and best management practices (BMP) so that the impact can be controlled and minimized. Example of BMPs that will be constructed to control erosion and sedimentation problem to the nearby rivers are silt trap, sediment basin and check dam. Job opportunities of the proposed project also shall be prioritized to the local people. In addition, the project proponent shall update the progress of project development to prevent any misunderstanding and ensure the development of the proposed project can be operated smoothly.

Besides that, approximately 6.5% of the respondents were uncertain about their acceptance of the project, given their unawareness of the proposed project's location and following what others said.



Source: Social survey December 2020

Figure 6.5.9: Percentage of Acceptance

6.5.7 Perception of Potential Positive and Negative Environmental and Social Impacts

The study attempts to gauge the locals' perceptions of the proposed project's potential environmental and social impact during the construction and operation. In addition to that, this study also intends to gather their perceptions of the capabilities of proper mitigation measures to reduce potential environmental and social impacts. The respondent felt it is a significant positive impact on employment opportunities for the locals (56.5%). In comparison, intruding or reducing the roaming area for Orang Asli (69.4%) and increased risk of flooding around the village (56.5%) are potential significant negative impacts during the construction phase. Other potential environmental and social impacts during construction have more responses to an insignificant impact. During the operation phase, employment opportunities to the local population (57.4%) and generate local and state economies (46.3%) are the potential significant positive impacts. However, the respondents felt as it is significant negative impacts on decrease forest products and intrude roaming area for Orang Asli (60.2%), increased risk of flooding around the village (56.5%), and risk of river pollution (54.6%).

Table 6.5.7 Potential Positive and Negative Environmental and Social Impacts during construction and operation phase

No	Potential Positive Impact during Construction	Insignificant	Significant	Highly Significant
1	Employment opportunities to local population	38.9	56.5	4.6
2	Provide long-term economic benefits to the locals	79.6	13.0	7.4
3	Encourage development in the surrounding area	62.0	23.2	14.8
4	Business opportunities for the local population	54.6	37.1	8.3
5	Increase trade facilities and	71.3	23.1	5.6

	infrastructure			
	Potential Negative Impact during Construction	**Insignificant**	**Significant**	**Highly Significant**
1	Intrude or reduce roaming area for Orang Asli	26.0	69.4	4.6
2	Road damage due to heavy vehicle	52.8	37.0	10.2
3	Increase the number of foreign workers in the area	49.1	43.5	7.4
4	Increase noise due to increased movement of heavy vehicles	68.5	21.3	10.2
5	Potential pollute nearest rivers	52.8	39.8	7.4
6	Increase social problem to local	60.2	34.2	5.6
7	Traffic congestion at project site to settlement area	67.6	27.8	4.6
8	Increased risk of flooding around the village	34.2	56.5	9.3
9	Soil erosion and sedimentation during rainfall and at nearby river	61.1	28.7	10.2
10	Noise/air pollution	67.6	29.6	2.8
No	**Potential Positive Impact during Operation**	**Insignificant**	**Significant**	**Highly Significant**
1	Employment opportunities to local population	30.6	57.4	12.0
2	Business opportunities for the local population	60.2	25.0	14.8
3	Project development can reduce idle areas and make the surrounding area safer	64.8	27.8	7.4
4	Increase existing infrastructure	59.3	36.1	4.6

	facilities such as road connectivity			
5	Generate local and state economies	44.4	46.3	9.3
6	Increase the diversity of forest plant species	73.1	21.3	5.6
	Potential Negative Impact during Operation	**Insignificant**	**Significant**	**Highly Significant**
1	Risk of river pollution	40.8	54.6	4.6
2	Increase the number of foreign workers in the area	61.1	32.4	6.5
3	Increase social problem to local & crime rate	66.7	28.7	4.6
4	Decrease forest product and intrude roaming area for Orang Asli	37.0	60.2	2.8
5	Increased risk of flooding around the village	38.9	56.5	4.6
6	Soil erosion and sedimentation during rainfall	56.5	35.1	7.4