CHAPTER 7 : EVALUATION OF IMPACTS

7.1 INTRODUCTION

The execution of Proposed Rubber Forest Plantation on Parts of Compartment 126, 131 & 132 (Block 1) And Parts Of Compartment 125, 126, 131 &132 (Block 2) With An Area Of 1,600.00 Hectares (3,953.67 Acres) At Piah Forest Reserve, District of Hutan Kuala Kangsar, Perak Darul Ridzuan will include the development of basic infrastructure and a variety of utilities within the project site.

The Project will inescapably have some impacts on the environment especially during the early stage of the Project implementation. The magnitude and scale of these impacts will be recognised and assessed at every stage of the development. The assessments of significant environmental effects in both of these terms of magnitude and scale during construction and operation phase were based mostly on published and unpublished local and foreign literature.

The development will increase the currents site value with its transformation into rubber forest plantation (*Hevea Brasiliensis* of the TLC variety) project area that will provide better basis need. In addition, it will be able to upgrade the socioeconomic value of the surrounding area while at the same time will generate many employment and business opportunities to the local and nearby communities. The adverse impacts, which may arise, are normally limited to a particular area and can be classified as a short-term impact and some impacts will occur temporarily in nature during various stages of development.

The undesirable impacts on the environment which have been predicted from the proposed Project will be mitigated and need to be carried out by the environmental consultant through this Detailed EIA study. This mitigation process can be execute by preparing a proper planning and implementation of works during site preparation, earthwork, terracing and planting in order to reduce soil erosion and incorporating the environmental control measures. These planning,

implementation and operation of the overall project will involve several inter-related activities. Each of these activities has its own mode and impacts on the environment either direct or indirect way. There are five (5) main activities involved in rubber forest plantation, which are:

i. Activities during site preparation stage
ii. Activities during planting stage
iii. Activities during maintenance
iv. Activities during harvesting stage
v. Activities re-planting stage

7.2 POTENTIAL IMPACTS AND ACTIVITIES

The activities, which usually constitute potential impacts, are site preparation, logging, clearing, planting, harvesting and maintenance. These are normal activities undertaken in any plantation project development. The resulting impacts from the activities are identified as the following:

i. Soil Erosion
ii. Noise Generation
iii. Air Pollution
iv. Water Pollution
v. Solid Waste Disposal
vi. Scheduled Waste
vii. Traffic Congestion
viii. Ecology (Flora and Fauna)
ix. Socio-economy

The potential impacts, which could arise, are confined to a particular area and only impermanent in nature during various stages of the development. These potential impacts, either beneficial or unbeneficial, and its mitigating measures are discuss in detail in the proceeding section of this chapter. Hence, the project proponent can easily fulfil implementation of the mitigation and rehabilitation measures of the environment.

7.3 SOIL EROSION

7.3.1 Introduction

As is well known, erosion is the process by which soil and rock on the Earth's surface are moved by exogenic processes and then deposited in other locations as sediment. This natural process is caused by the dynamic activity of erosive agents, that is, water, ice (glaciers), snow, air (wind), plants, animals, and humans. In accordance with these agents, erosion is sometimes divided into water erosion, glacial erosion, snow erosion, wind (aeolic) erosion, zoogenic erosion, and anthropogenic erosion. Erosion acts on all elements of the earth's surface, but first of all it is the soil cover that is exposed to its destructive impact (Apollo et. al., 2018).

Natural erosion or geological erosion is not detrimental to human being and is wholly beyond human control. In contradiction of this, when nature's balance is disturbed by human activities like large scale cutting of forest, levelling and cultivation, the process of erosion is speeded vigorously. Thus, soil erosion is a process that occurs naturally but can be accelerated by man-made structures.

The erosion potential for a given area is dependent on several factors or characteristics. These characteristics can be grouped as those pertaining to soil composition, topography, climate and landuse and management, especially soil cover. Erosion can be considered as detachment of soil particles from the surface and their movement, which requires a source to carry the detached particle away. No substantial erosion is possible unless both of the processes are operative. Soil particles must be dislodged first from their mass before they can be splashed, rolled, slid or carried in suspension along the surface.

The major variable affecting soil erosion are climate, soil, vegetation and topography of the area. To some extent, soil and topography conditions may be controlled. The rainfall intensity and soil properties play the most important role in soil erosion process in the tropics. Actual measurements of soil loss, however, are time consuming and expensive. Therefore, the need to develop a predictive model for

estimating soil loss from various land uses is vital. The first model for predicting soil loss was developed in USA, so called as Universal Soil Loss Equation (USLE). The USLE was developed based on agricultural plots with certain rangers of variations in soil, climatological and slope conditions. W.H Wischmeier and D.D Smith from the US Agriculture Research and Purdue University pioneered the development of USLE in the late 1950.

The USLE was developed to predict long term, average soil losses in runoff from specific field areas in specified cropping and management systems in agriculture. This means if the site and cover conditions remain fixed, the average erosion for 20 or more years could be estimated by USLE. Since a lot of unpredictable short-term variations such as erodibility, rainfall, runoff, practice, slope, cover and management factor, the USLE is substantially less accurate in predicting specific events and short periods. In general, this method was prepared to provide a technique for forest managers and researchers to estimate soil loss in a forested area such as in preparing the Environmental Impact Assessment (EIA) report.

7.3.2 Potential Impact of Erosion on Soil Productivity

Soil damage and erosion due to timber latex clone plantation development can affect the environment either directly or indirectly. The direct impact is on-site accelerated soil and nutrient loss, soil compaction and slope instability, while indirect impact is water pollution as a result of sediment runoff and agrochemicals or fertilisers usage from the proposed project site. To understand the effect that soil characteristics have on soil productivity (and the impact of erosion on soil productivity), producers need a working knowledge of soil properties.

Topsoil Thickness

Preserving topsoil is important because deep surface layers generally translate into higher crop yields. Topsoil material is enriched with organics matter. Organic matter provides soil with large pores, thus

reducing soil density and enhancing water infiltration. The vertical cross section of soil is divided into three parts; topsoil, subsoil, and parent material. The soil profile is the name for this combination of vertical layers in the soil. As the slope gradient increases, topsoil thickness usually decreases, especially where cultivation has occurred. Thin top soils usually mean lower organic matter content and less rooting depth and plant-available water capacity. When topsoil is eroded, yield usually suffers.

Texture Distribution

The textural distribution within the soil profile determines how much plant-available water will be present. Soils with coarse textures throughout the profile tend to dry out fast because water drains away easily. Conversely, soils with fine textures tend to puddle or have standing water on or near the surface with frequent rain. Therefore, in areas where rainfall is moderate, soils with medium textures are preferred because they have a high percentage of silt and adequate amount of sand clay. This textural profile moderates dry and wet tendencies and provides optimum water holding capacity. Soils with loam, silt loam, silt clay loam, and clay loam textures hold to 10 to 11 inches of plant-available water in the first 60 inches of the soil profile.

Rooting Depth

As crops approach maturity, roots extend through the topsoil layer into the subsoil to find available water. Subsoil properties, such as coarse sand and gravel. Shallow depth to bedrock, high soil densities, and clay content in excess of 42 percent can limit root elongation and development. Therefore, total rooting depth has a direct impact on yield.

Soil Density

The ideal soil density for topsoil material is 1.25 grams per cubic centimetre or less. Erosion and reduced organic matter content increase topsoil density. Ideal soil density for subsoil material is 1.40 grams per cubic centimetre or less.

Soil Fertility

Soil fertility is vital to a productive soil, but a fertile soil is not necessarily a productive soil. Steep slopes, poor drainage and other factors can limit productivity.

Slope and Erosion

Erosion is directly affected by the steepness and length of slope. Greater slopes increase the runoff velocity and the movement of sediment carried in runoff. Severe or prolonged erosion can cause changes in yield potential and soil productivity, depending on topsoil thickness and subsoil properties. In addition, nearly all-organic matter is located in the topsoil, along with approximately 50 percent of plant-available phosphorus (P). A similar relationship exists for potassium (K). Losing topsoil to erosion, therefore contributes to a loss of nitrogen, P, and K, and a decline in potential crop yield.

The addition of animal manure and fertilisers can supply needed crop nutrients and help offset losses in soil fertility caused by erosion. However, the productivity of eroded soils can only be restored by added inputs if favourable subsoil material is present. Productivity lost by excessive soil erosion cannot be restored through additional nutrient inputs for soils with subsoil material that has unfavourable properties for plant root growth. And in soils with fragile subsoils, limited rooting depth, coarse sand and gravel, or high densities, there is little or no ability to recover yields losses with increased inputs the loss of potential yield can be devastating.

7.3.3 Estimated Soil Erosion

The Universal Soil Loss Equation (USLE) is a simple and quick method based on empirical approach. It may be considered to be the most practical and relatively simple technique in estimating surface

erosion of any landuse. The soil loss due to erosion can be predicted by using the universal soil loss equation expressed as follow:

Soil Loss Equation,
E = R.K.L.S.C.P.

Where;

E = Average soil loss (tonne/ha/year)

R = Rainfall erosivity index, is the number of rainfall erosion index units plus a factor for runoff from applied water where such runoff is significant.

K = Soil erodibility factor (tonne/ha/year) is the soil inherent susceptibility to erosion by rainfall and runoff.

L = Length of slope factor.

S = Steepness of slope factor, is the ratio of soil loss from the field slope gradient

C = Cropping management factor, is the ratio of soil loss from an area with specified cover and management to that from an identical area in tilled continuous fallow.

P = Conservation practice factor, is the ration of soil loss with a support practice like contour disking to that with straight-row farming up and down the slope.

This method was prepared to provide techniques for forest managers and researchers to estimate soil loss in forested areas such as in preparing **Detailed Environmental Impact Assessment (DEIA)** report. The proposed project area is generally mix surface profile with hilly in terrain in certain part whilst flatter area at certain part. Partial of the areas have steeper slope, which will produce high erosion rates whilst the flatter area normally will produce a low level of erosion rates.

Predicted Soil Erosion

The estimation is based on various scenarios from the worst case where the land is cleared and left bare without any soil conservation measures against where mitigated measure are being applied.

The soil erosion prediction risk has shown that soil losses from bare hillside could be high even on moderately steeps slopes. However, by adopting appropriate soil conservation measures, the estimated losses could be drastically reduced to an acceptable level.

Various values of factors are used under different conditions in the estimation of the soil erosion risk. For example, at sites where the bare soil surface may be compacted and smoothed by grading equipment, a P value of 0.3 is usually assigned. In such cases, the risk of soil erosion would be further decreased. The summary of the predicted soil loss is in **Table 7.1** and **Table 7.2** and sediment yields is summarized in **Table 7.3** and **Table 7.4**. For detailed calculation of predicted soil loss can be refer in **Appendix 7-A** and detail calculation for sediment yields can be refer in **Appendix 7-B**.

Table 7.1 : Estimated Erosion Rate with Conservation Practice

Block	Phase	Area (ha)	R	K	LS	C	P	E (ton/ha/yr)
1A	1	67.19	11000	0.013	46.20	0.13	0.30	257.64
	2	83.64	11000	0.013	39.28	0.13	0.30	219.06
	3	96.14	11000	0.013	48.85	0.13	0.30	272.43
	4	71.29	11000	0.013	50.62	0.13	0.30	282.28
	5	81.99	11000	0.013	55.41	0.13	0.30	309.04
2A	1	70.92	11000	0.013	84.53	0.13	0.30	471.44
	2	66.58	11000	0.013	81.38	0.13	0.30	453.83
	3	95.50	11000	0.013	64.42	0.13	0.30	359.26

	4	97.45	11000	0.013	109.53	0.13	0.30	610.86
	5	68.45	11000	0.013	37.59	0.13	0.30	209.66
1B	1	96.46	11000	0.013	74.14	0.13	0.30	413.50
	2	88.04	11000	0.013	231.42	0.13	0.30	1290.65
	3	81.6	11000	0.013	22.44	0.13	0.30	125.16
	4	84.53	11000	0.013	61.71	0.13	0.30	344.16
	5	47.50	11000	0.013	19.40	0.13	0.30	108.19
2B	1	89.23	11000	0.013	59.50	0.13	0.30	331.81
	2	80.45	11000	0.013	75.17	0.13	0.30	419.23
	3	87.46	11000	0.013	69.64	0.13	0.30	388.41
	4	80.38	11000	0.013	113.46	0.13	0.30	632.78
	5	63.67	11000	0.013	22.45	0.13	0.30	125.18

Table 7.2: Estimated Erosion Rate for Worst Case Scenario

Block	Phase	Area (ha)	R	K	LS	C	P	E (ton/ha.yr)
1A	1	67.19	11000	0.013	46.20	1.00	1.00	6606.03
	2	83.64	11000	0.013	39.28	1.00	1.00	5616.93
	3	96.14	11000	0.013	48.85	1.00	1.00	6985.27
	4	71.29	11000	0.013	50.62	1.00	1.00	7238.05
	5	81.99	11000	0.013	55.41	1.00	1.00	7924.11
2A	1	70.92	11000	0.013	84.53	1.00	1.00	12088.14
	2	66.58	11000	0.013	81.38	1.00	1.00	11636.64
	3	95.50	11000	0.013	64.42	1.00	1.00	9211.82
	4	97.45	11000	0.013	109.53	1.00	1.00	15663.02
	5	68.45	11000	0.013	37.59	1.00	1.00	5375.88
1B	1	96.46	11000	0.013	74.14	1.00	1.00	10602.48
	2	88.04	11000	0.013	231.42	1.00	1.00	33093.61

	3	81.6	11000	0.013	22.44	1.00	1.00	3209.22
	4	84.53	11000	0.013	61.71	1.00	1.00	8824.70
	5	47.50	11000	0.013	19.40	1.00	1.00	2774.00
2B	1	89.23	11000	0.013	59.50	1.00	1.00	8507.83
	2	80.45	11000	0.013	75.17	1.00	1.00	10749.60
	3	87.46	11000	0.013	69.64	1.00	1.00	9959.21
	4	80.38	11000	0.013	113.46	1.00	1.00	16225.02
	5	63.67	11000	0.013	22.45	1.00	1.00	3209.774

Table 7.3 : Comparison of Estimated Erosion by Block

With Mitigation Measure				
Block	Area (ha)	E (ton/ha/yr)	Duration (days)	ton
1A	400	268.22	88	25,866.70
1B	400	494.9	66	35,795.51
2A	400	429.6	88	41,429.92
2B	400	390.24	66	28,225.58
Worst Case Scenario				
Block	Area (ha)	E (ton/ha/yr)	Duration (days)	ton
1A	400	6877.30	88	663,235.84
1B	400	12689.66	66	917,827.80
2A	400	11015.32	88	1,062,299.23
2B	400	10008.81	66	723,925.05

The erosion rate, E is taken as the average from each phases in each block. The duration of work for each block is based on the work programme as discussed in chapter 5. From the comparison in **Table 7.3**, it clearly shows that, with a proper mitigation measure, total volume of soil erosion can be reduce by a factor of 25 times.

Table 7.4 : Estimated Soil Yield with Conservation Practice

Block	Phase	Q (m^3/s)	V(m^3)	K	LS	C	P	Total (mt/event)
1A	1	3.27	11758.25	0.013	46.20	0.13	0.30	774.77
	2	4.07	14637.00	0.013	39.28	0.13	0.30	841.89
	3	4.67	16824.50	0.013	48.85	0.13	0.30	1223.74
	4	3.47	12475.75	0.013	50.62	0.13	0.30	907.13
	5	3.99	14348.25	0.013	55.41	0.13	0.30	1161.48
2A	1	3.45	12411.00	0.013	84.53	0.13	0.30	1506.16
	2	3.24	11651.50	0.013	81.38	0.13	0.30	1350.91
	3	4.64	16712.50	0.013	64.42	0.13	0.30	1601.77
	4	4.74	17053.75	0.013	109.53	0.13	0.30	2785.90
	5	3.33	11978.75	0.013	37.59	0.13	0.30	643.76
1B	1	4.69	16880.50	0.013	74.14	0.13	0.30	1864.35
	2	4.28	15407.00	0.013	231.42	0.13	0.30	5253.38
	3	3.97	14280.00	0.013	22.44	0.13	0.30	467.89
	4	4.11	14792.75	0.013	61.71	0.13	0.30	1338.46
	5	2.31	8312.50	0.013	19.40	0.13	0.30	220.63
2B	1	4.34	15615.25	0.013	59.50	0.13	0.30	1371.01
	2	3.91	14078.75	0.013	75.17	0.13	0.30	1542.53
	3	4.25	15305.50	0.013	69.64	0.13	0.30	1569.30
	4	3.91	14066.50	0.013	113.46	0.13	0.30	2325.98
	5	3.10	11142.25	0.013	22.45	0.13	0.30	354.43

Table 7.5 : Estimated Soil Yield for Worst Case Scenario

Block	Phase	Q (m^3/s)	V(m^3)	K	LS	C	P	Total (mt/event)
1A	1	4.67	16797.50	0.013	46.20	1.00	1.00	29621.04
	2	5.81	20910.00	0.013	39.28	1.00	1.00	32186.88
	3	6.68	24035.00	0.013	48.85	1.00	1.00	46785.81
	4	4.95	17822.50	0.013	50.62	1.00	1.00	34681.24
	5	5.69	20497.50	0.013	55.41	1.00	1.00	44405.69
2A	1	4.93	17730.00	0.013	84.53	1.00	1.00	71277.73
	2	4.62	16645.00	0.013	81.38	1.00	1.00	20815.08
	3	6.63	23875.00	0.013	64.42	1.00	1.00	17888.31
	4	6.77	24362.50	0.013	109.53	1.00	1.00	51171.66
	5	4.75	17112.50	0.013	37.59	1.00	1.00	8435.11
1B	1	6.70	24115.00	0.013	74.14	1.00	1.00	21101.59
	2	6.11	22010.00	0.013	231.42	1.00	1.00	51647.68
	3	5.67	20400.00	0.013	22.44	1.00	1.00	61238.67
	4	5.87	21132.50	0.013	61.71	1.00	1.00	106510.26
	5	3.30	11875.00	0.013	19.40	1.00	1.00	24612.26
2B	1	6.20	22307.50	0.013	59.50	1.00	1.00	52416.43
	2	5.59	20112.50	0.013	75.17	1.00	1.00	58973.93
	3	6.07	21865.00	0.013	69.64	1.00	1.00	59997.25
	4	5.58	20095.00	0.013	113.46	1.00	1.00	88926.45
	5	4.42	15917.50	0.013	22.45	1.00	1.00	13550.67

7.3.4 Potential Impacts during Site Preparation Activity

Topographical surveys are necessary to obtain contours, height measurements and delineation of ground boundary to identify adjacent land boundaries as well as prepare the proposed land for scheduled development. They are necessary for exact location and orientation of the proposed development. Some part of the proposed project site observed has been previously logged, thus providing an existing network of logging tracks within the site. This track does provide a sufficient mobility required at this stage. No adverse impacts are expected from the usage of existing tracks except for the destruction of the creeping vegetation that have grown over some sections of the tracks.

However, at certain part of the proposed project site, construction of the logging road is needed. The early stages of logging activities require the penetration of road into previously undisturbed forest. Heavy logging equipment is used to cut, bulldoze and push earth during the initial and subsequent extraction phases of logging activity. The work involving main logging road construction would be minimal, as the existing logging road (from previous operations) would continue to be used. The logging activity will be carried based on compartment by compartment. However, it is expected area involved in felling and transportation of trees will create a small area of expose land.

Use of heavy machinery during logging operations prior to planting often causes local soil compaction. In areas, which have previously been cultivated there, may be plough base panning compaction. Compaction may also occur during clearing, land preparation and planting. With increasing use being made of heavy machinery during clearing operations, compactions problems have multiplied. Soil compaction in the surface layer can increase runoff, thus increasing soil and water losses. In a number of areas, this has caused both growth of young plants to be significantly retarded.

Problems are greatest on heavier clay soils, including the poorer-drained coastal soils, although the problem of compaction can also

arise on coarser-textured soils. The resulting compaction retards development, delays maturity and is quite likely to lead to long-term yield reduction, which is potentially of much greater value than the extra cost of manual labour for the clearing operation. When compaction does occur, frequently the first indication is the occurrence of small areas with poor surface drainage. There is concomitant retardation in plants growth and the appearance of induced symptoms of nitrogen deficiency. Other indications sometimes do not become visible until sometime after planting, usually through apparently inexplicable poor development of plants over an irregular area.

In general, losses tend to occur more readily by leaching after logging. When the root-mat and surface litter are disturbed, there is no longer the same filtering effect, which helps to capture nutrients washed down from the canopy or released from the litter on the forest floor. The sum result is increased drainage into the stream network and more leaching of soluble nutrients.

Exposure and compaction of soil leads to hydrological change, increased erosion rates and water quality problems. During the course of the log extraction process, there may be multiple passes of heavy machines on skid trails, coupled with the movement of tractors, loaders and trucks on roads and landings during the log production, all of which contribute towards the exposure and compaction of soil. In addition, increased rates of erosion occur when there is disturbance of the tree canopy and litter layer, resulting in increased exposure of the soil surface. Once exposed, erosion takes place through a sequence of process starting with the detachment of soil particles by rainfall splash, progressing onto sheet, rill and gully erosion.

Individual raindrops strike the soil surface at velocities up to 9 m/s, creating very intense hydrodynamic forces at the point of impact. The total raindrops will create the major producer impact of sediment. The factor variations in rainfall, runoff, soil, slope and cover conditions gives the non-uniformity in time and space of the rate of detachment. The soil particles will be loosened from the surface detached and

dispersed on the way down to the lower area and usually tend to follow the water flow into the river and the sea. The particles will be slowly deposited under the base of the river. **Figure 5.2** shows the proposed phasing for this project.

Earthwork process can normally have deleterious impact on the environment if not properly conducted. The main impacts of the proposed project will be the removal of vegetation, land clearing and planting of rubber forest plantation at a later stage. The damage increases with the interval of time between clearing and plantation establishment which the longer the delay, the more the erosion, sedimentation and siltation. Some of the related earthworks activities are as follows:

- Removal of vegetation, tree stumps, roots, etc. exposes soil surface to high rates of erosion.
- Removal of topsoil reduces site productivity
- Compaction of soil through movement of excavation, bulldozers and tractors reduces planting site productivity.
- Site disturbance and erosion is significantly higher on steep slopes and where no proper terracing is practiced.
- Clearing of steep areas can lead to loss of site productivity, increased sediment downstream, loss of aquatic life, stream channels blockage and flooding.
- Deposition of eroded materials may contribute to a change in the hydraulics of larger rivers downstream of the proposed project site that receive the eroded sediment from the proposed project site. This may have an effect on the profile, flooding frequency and flooding intensity of these rivers. Furthermore, shifting and new sandbanks may affect the navigation in these rivers and subsequently increase maintenance cost to keep them navigable.
- Any disturbance to the riparian reserves would cause an increase in the suspended sediment load discharged into the river thus would affect aquatic habitats in these rivers. More serious for the aquatic life may be the loss of shade and the supply of food originating from the vegetation along the banks.

Any disturbance on the natural forest could potentially affect the natural nutrient cycle. Since the tropical soils is generally nutrient poor and has thin top horizon, the development would further jeopardize the nutrient status if the intended activities were carried out at a high intensity and in an uncontrolled manner. This are the possible ways by which nutrient could be loss is through timber harvesting, soil erosion, increased leaching and forest fires. The loss of nutrients from disturbed parts of forest will have implications on the recovery of the eroded sites. Although little is known on the actual quantities, it would appear that the impact is substantial.

7.3.5 Potential Impacts during Planting Activity

The process of planting starts when the seed germination of rubber forest plantation in the nursery area is transfer to the actual planting area. The plantation if possible shall follow the terrain of the project site. The planting activity should best be carried out during the wet days or during rainy season. However, due to the land clearing and earthwork activity, the soil structure is still unstable thus susceptible to erosion problem. Soil problems under rubber forest plantation normally due to one of the following reasons.

- Soil instability (erosion/land slides) due to cropping on too stoop slopes or fragile soils.
- Soil instability during intensive transport during harvesting.
- Soil damage by agrochemicals.
- A simplified natural nutrient cycle through litter fall under monocultures compared with that of a mixed, natural forest.

In a well-managed plantation, these effects are normally insignificant once the plantation is established and ground cover has been achieved.

7.3.6 Potential Impacts during Maintenance and Harvesting Activity

The soil erosion impact during maintenance is expected to be minimal due to the stabilised ground surface and after the project plantation has reached its completion stage. The planting of timber latex clone plantation and also cover crops will integrate an artificial landscape to the natural environment, thus will cover the exposed soil surface and finally reducing the possibly erosion problem.

7.3.7 Potential Impact during Replanting Activity

The process of replanting starts when the existing old and unproductive rubber forest tree is fell, removal of tree trunk, adjustment of planted area and planting activity. The potential impact is more a less similar during the early stage of plantation overall development. The level of impact may not be as high compared to the early stage of overall development.

7.4 NOISE GENERATION

Noise can be considered as any unwanted sound that may adversely affect the health and well-being of individuals or population exposed for a long period. Principal noise health effects are both health and behavioural in nature. Sound is a particular auditory impression perceived by the sense of hearing. The presence of unwanted sound is called noise pollution. These unwanted sounds can seriously damage and effect physiological and psychological health. For instance, noise pollution can cause annoyance and aggression, hypertension, high stress levels, tinnitus, hearing loss, and other harmful effects depending on the level of sound.

Furthermore, stress and hypertension are the leading causes to health problems, whereas tinnitus can lead to forgetfulness, severe depression and at times panic attacks. Noise intensity is measured in decibel units. The decibel scale is logarithmic; each decibel increase represents a tenfold increase in noise intensity. Noise is

recognise as a controllable pollutant that can yield to abatement technology. Development of timber latex clone plantation activities are expected to generate the main sources of noise within the proposed project area during logging, planting and maintenance period. Noise from plantation activities usually come from movement of vehicle activities but it occurs only during a fixed period.

Continual exposure in noise pollution can be a source of nuisance and distress for people. Among the common sources of noise during development of rubber forest plantation activities include the following matters:

- Chain saw and any other cutting tree machines.
- Generator and workshop equipment.
- Road construction equipment such as bulldozers, graders, scrapers and compactors.
- Earthmoving equipment such as logging trucks, backhoes, shovels and front-loader.

The typical noise level of some of the development of the rubber forest plantation equipment and various exposure limits are as shown in **Table 7.6** and **Table 7.7**. Excessive noise level would not only be a nuisance to human and animal, but it can also cause harm if any particular individual is being exposed for certain duration and various noise levels. Noise measurement carried out in the proposed project site area showed that the recorded noise levels average at 53.1 dBA for daytime. Based on the previous literature, noise at level 54 dBA, communications start to become difficult. The international standard for permissible noise exposure is set at less than 85 dBA for continuous exposure. Commonly noise becomes hazardous to the hearing at 85 dBA and above. Subjected to 45 decibels of noise, the average person cannot sleep. At 120 decibels, the ear registers pain, but hearing damage begins at a much lower level, about 85 decibels. The duration of the exposure is also important.

Table 7.6 : Noise Level Generation from Plantation Equipment

Equipment	Noise Level (dBA)

Diesel gen set (250 kVA)	74 to 81
Backhoe	83 to 86
Scraper	85 to 88
Lorries	85 to 88
Clippers	85 to 88
Jackhammer	85 to 88
Pile Driver	97 to 103

Table 7.7 : Noise Exposure Limit

Duration	dBA
8 hrs	90
4 hrs	93
2 hrs	96
1 hr	99
30 mins	102
15 mins	105
8 mins	108
4 mins	111
2 mins	114
1 min	117
30 secs	120

The mechanism for chronic exposure to noise leading to hearing loss is well established. The elevated sound levels cause trauma to the cochlear structure in the inner ear, which gives rise to irreversible hearing loss. The pinna (visible portion of the human ear) combined with the middle ear amplifies sound levels by a factor of 20 when sound reaches the inner ear. It is proven that hearing loss due to aging is insignificant, but instead hearing loss is associated with chronic exposure to moderately high levels of environmental noise. High noise levels can contribute to cardiovascular effects. Exposure to moderately high (e.g. above 70 dBA) levels during a single eight hours period causes a statistical rise in blood pressure of five to ten mmHg. A clear and measurable increase in stress and vasoconstriction leading to the increased blood pressure noted above as well as to increased incidence of coronary artery disease. Though it pales in comparison to the health effects noted above, noise

pollution constitutes a significant factor of annoyance and distraction in modern artificial environments as listed as follow:

- The meaning listeners attribute to the sound influences annoyance, so that, if listeners dislike the noise content, they are annoyed. What is music to one is noise to another.
- If the sound causes activity interference, noise is more likely to annoy (for example, sleep disturbance).
- If listeners feel they can control the noise source, the less likely the noise will be annoying.
- If listeners believe that the noise is subject to third-party control, including police, but control has failed, they are more annoyed.
- The inherent unpleasantness of the sound causes annoyance.
- If the sound is, appropriate for the activity it is in context. If one is at a racetrack, the noise is in context and the psychological effects are absent. If one is at an outdoor picnic the racetrack, noise will produce adverse psychological and physical effects.

Table 7.8 shows the percentage risk which can develop a hearing handicap if whoever being exposed in a long period. The health risk associated with noise relates mainly to hearing loss as well as the psychological wellbeing of individuals who exposed in this type of condition. The main concern of noise is normally associated with hearing loss as an occupational disease. This aspect however relates to the working environment and not the general environment of the area. As mentioned earlier, the location as well as surrounding nature of condition which cover with trees, bushes and natural vegetation can naturally preventing any noise generated from the proposed project site from transfer out and create a nuisance to the nearby local community.

Table 7.8 : Percentage Risk of Developing a Hearing Handicap

Noise level dB (A)	Exposure – Years						
	5	10	15	20	25	30	35
85	1.0	2.6	4.0	5.0	6.1	6.5	8.0
90	3.0	6.6	10.0	11.9	13.4	15.6	17.5
95	5.7	12.3	18.2	21.4	24.1	26.7	28.3

100	9.0	20.7	30.0	35.9	38.1	40.8	41.5
105	13.2	31.7	44.0	49.9	54.1	57.8	57.5
110	19.0	46.2	61.0	68.4	73.1	73.8	71.5
115	26.0	61.2	79.0	83.9	86.1	84.3	89.5

7.4.1 Potential Impacts during Site Preparation Activity

Noise from the machineries for the cutting vegetation, site clearance and terracing activity will create an adverse noise impact to the surrounding environment. The impact is temporary and will be diminished as the activity is finished. There is also some noise from the vehicles moving in and out of the site. During this stage, higher noise levels will also be generated during the maintenance of the machineries at the workshop located nearby the site office. In this situation, there will also be some temporary displacement of faunal habitats and under growths. However, the duration and intensity of these operations are short and localised in nature. Hence, the adverse impacts can be considered insignificant and within the control range as compared to the standard requirements.

7.4.2 Potential Impacts during Planting Activity

The noise level is expected to remain significantly above the desirable 55 dBA during this stage, representing daytime outdoor noise level in a community. Planting machineries and trucks may generate high noise level in excess of 85 dBA which is a hazardous noise level for persons exposed for long hours. Impacts of noise from such machineries affect only workers at close vicinity; therefore, they must be use ear protection gears. In practice, attenuation by natural barriers and trees could lower the noise level considerably. The development site constitutes a large area of trees and other vegetation, which are very appropriate for the natural noise mitigation.

7.4.3 Potential Impacts during Maintenance and Harvesting Activity

It is expected that the source of noise generation during maintenance activities be mainly from moving traffic especially trucks, lorries and machineries which is infrequent.

7.4.4 Potential Impact during Replanting Activity

The potential impact that may occur is similar during the early stage of overall development. Noise from the machineries for the cutting trees, site clearance and planting activity will create an adverse noise impact to the surrounding environment. The impact is temporary and diminished as the activities is finished.

7.5 AIR POLLUTION

Air pollution is defined as the transfer of harmful amounts of natural and synthetic materials into the atmosphere as direct or indirect consequence of human activity. Major air pollution could be generated during the logging activity and traffic movements during the plantation and operational stages. The disposal of uprooted vegetation and trees, could be a short term but significant impact to the localized area surrounding, if it is being carry out without proper management control. Air pollutant emitted would be dust and smoke that could result in haze problem.

Vehicle movements will result in higher level in carbon release and lead particulate including gaseous pollutant such as CO, CO_2, SO_2 and NO_x. Being exposed in a long period and high density of these gaseous pollutant may give an indirectly impact not only to the surrounding material but also to human life. **Table 7.9** and **Table 7.10** give basic information on the effect of air pollution problem to the materials and humans. Whilst **Table 7.11** shows the major consequences associated with criteria air pollution. The potential impacts of the proposed development on air quality would occur mostly during the site preparation, logging and planting phases which are summarised as follow:

- Dust generated during site preparation and logging activity especially trucks and bulldozers and also movement of vehicle within the site.

- Increasing the level of CO, CO_2, SO_2, and NO_x from the vehicle movement and plant machinery.
- Generation of the particulates and suspended particulate matter from various traffic sources.

Table 7.9 : Air Pollutants and Effect on Materials

Material	Air Pollutants	Other Factors	Effect
Building material	SO_2, acid, gases and adhering	Moisture	Discoloration erosion
Metals	SO_2, acid, gases	Moisture, Temperature	Transiting of surface, loss of metal
Textiles	SO_2	Moisture Sunlight	Reduction in tensile strength and staining
Rubber	Oxidants	Sunlight	Cracking
Paper	SO_2, acid	Sunlight	Embrittlement

Source: Environmental Pollution and Control, 2003

Table 7.10 : Effect of Air Pollutants on Humans

Air Pollutants	Effects on Human
Sulphur Dioxide (SO_2)	Breathing rate increases while breathing itself become less deep and a general feeling of air starvation is experienced. Some even show signs of bronchial spasms and asthmatics are badly affected. Any SO_2 which oxidizes to SO_3 may dissolve in body fluids to form H_2SO_4 a very strong corrosive acid.
Carbon Monoxide (CO)	CO combines with the haemoglobin of the blood to form carboxyl haemoglobin and when about half of the haemoglobin of the blood is used up, death ensures as the carboxyl haemoglobin is useless for respiratory purposes. Person poisoned by CO exhibit a characteristics bright pink colour of flesh due to the presence of carboxyl haemoglobin in the blood.

Nitrogen Oxides (NO_x)	Prolonged exposure of human being to even low concentrations of NO_x, can cause a chronic irritation of the respiratory tract headache, loss of appetite and corrosion of teeth. Nitric oxides react with air to form brown nitrogen oxide, which is very poisonous.
Total Suspended Matter (TSP)	Corrosion of metals. Reduced visibility. Reduced sunlight. Respiratory diseases and Chronic bronchitis.

Source: Environmental Pollution and Control, 2003

Table 7.11 : Major Consequences Associated with Criteria Air Pollution

Pollutant	Impact
Sulphur Dioxide (SO_2)	Major contributor to acid rain problem; sulphate particles may lead to respiratory ailments and damage buildings and other materials.
Carbon monoxide (CO)	Tropospheric ozone precursor, health impacts include interference with ability of blood to circulate oxygen within the body.
Volatile Organic Compounds (VOCs)	Volatile Organic Compounds contributes reactions with NO_2 and SO_2; causes eye irritation, exacerbates respiratory problems, suspected carcinogen.
Nitrogen Oxides (NO_x)	Major contributor to acid rain problem, smog and tropospheric ozone cause eye irritation, exacerbates asthma (especially in small children).
Particulates Lead (Pb)	Leads to respiratory problems; some particulates are carcinogens leads, like other heavy metal, is extremely toxic. It damaged all the body's major systems including the nervous, reproductive and circulatory systems. Leads to permanent learning disabilities in small children.
Ozone	Formed when SO_2 or NO_2 reacts with VOCs; damages human health and the health of other organism, especially agricultural crops and forests.

A part of that, the "greenhouse effect" may become a serious issue if the plantation project is being carried out without proper environmental management. Even though it is more consider as a global issue and very hard to proof it but with an environmental knowledge in implementing the plantation activity, it may contribute in preventing the greenhouse effect.

Greenhouse effect can lead to rapid temperature rise and could resulted in several consequences as highlighted:

- These changes in global temperature, although apparently small, could cause very large changes in climate.
- A rapid extinction of species.
- Rising sea levels – water expands as it warms and glaciers melt, adding water to the oceans, thus we can expect widespread flooding of coastal areas as sea levels rise.
- Greater frequency and scale of extreme weather conditions, e.g. drought and flood.
- Changes in the distribution of disease-bearing organisms so that people, domestic, animals, and crops might be exposed to diseases previously absent from an area.

The threat of a human-induced global warming, greenhouse effect as well as air pollution has dramatically increased the interest in climate/human health studies. The impact of weather on human well-being goes beyond mortality, even birth rates and sperm counts appear to be affected by climatologically phenomena. However, the majority of the climate/human evaluations have concentrated on mortality and most all of the studies correlate a number of climate variables with daily or weekly mortality statistics.

One of the key factors that contribute to the greenhouse effect is carbon dioxide. It consists of one carbon atom with an oxygen atom bonded to each side. When its atoms are bonded tightly together, the carbon dioxide molecule can absorb infrared radiation and the molecule starts to vibrate. Eventually, the vibrating molecule will emit the radiation again, and yet another greenhouse gas molecule will likely absorb it. This absorption-emission-absorption cycle serves to keep the heat near the surface, effectively insulating the surface from the cold of space. The primary of carbon dioxide release is the consumption of fossil fuels.

The secondary source is the oxidation of carbon compounds in marshes and forests by the natural degradation. In natural ‘carbon cycle’, atmospheric carbon dioxide is normally removed by two (2)

majors 'sinks', the plants which absorb carbon dioxide during the process of photosynthesis and the oceans. However, the problem has arisen because we are producing carbon dioxide faster than the sinks can absorb it. Therefore, the level of carbon dioxide in the atmosphere is increasing. Increasing concentration of CO_2 may increase the atmospheric pressure. It would broaden the absorption bands and will increase the capacity of the atmosphere to the outgoing log wave terrestrial radiation. It may increase to such an extent that the whole biosphere may come to a grinding halt.

Presently more than 10,000 million tons of carbon dioxide is released into the atmosphere every year due to the combustion of fossil fuels with about 25% of it from industries. The rest come from the agriculture and other project development activities. This carbon dioxide acts like as grass layer at atmosphere where sun radiation can pass through and heat up the earth but will stops the same heat being re-emitted by the earth.

Carbon dioxide, while transparent to visible light, is very efficient at absorbing the infrared heat radiation emitted by earth's warm surface. It traps the heat in air close to earth's warm surface. It traps the heat in air and can reemit it back towards earth. In order words, carbon dioxide is transparent to short wave radiation from the sun but absorbs the longer wave radiation from the earth. The net result of all this is that there is a danger of the earth gradually being heated up. Ecologists are of the opinion that the situation will worsen due to the additional inputs of carbon dioxide to the atmosphere if the destruction of forests is not control and integrate with environmental mitigation measure. Instead of the carbon dioxide there are also other gases which has been classified as a greenhouse gaseous **(refer Table 7.12)**.

Table 7.12 : Major Source of Greenhouse Gases in the Atmosphere

Sources	Greenhouse Gases

	Carbon Dioxide	Methane	Nitrous Oxide	Chlorofluorocarbons
Anthropogenic	-Carbon-based Fuel combustion -Deforestation/ land use charges	-Rice paddy cultivation -Rearing of ruminants (e.g. cows) -Biomass burning -Natural gas releases	-Nitrogen fertilizer use -Combustion processes -Land conversion for agriculture	-Solvents -Refrigerator fluids -Spray propellants -Foam packaging
Natural	-Organic Decomposition -Oceanic transfer	-Anaerobic decay in oceans, lakes and marshes -Herbivorous animals	-Microbial process in soil and water	-None

Another raise problem, which associates with air pollution, is the acid rain. Acid rain is caused by the release of the gases SO_2 (Sulphur dioxide) and NO_x (nitrous oxides). The main sources of SO_2 are coal-fired power stations and metal working industries whilst the main sources of NO_x emissions are vehicles and fuel combustion. Sulphur dioxide reacts with water vapour and sunlight to form sulphuric acid. Likewise, NO_x form nitric acid in the air. These reactions take hours, or even days, during which polluted air may move hundreds of kilometres. Thus, acid rain can fall far from the source of pollution. When mist or fog droplets condense, they will remove pollutants from the air and can become stronger acid than acid rain.

Acid rain can increase the acidity of lakes, dams and streams and cause the death of aquatic life. It can also increase the acidity of soil, water and shallow groundwater. It seems likely that acid rain weakens the trees, perhaps helped by other pollutants such as ozone and then

leaves the trees open to attack by disease. Acid rain also disrupts the availability of soil nutrients. The final death of a tree may result from a combination of stresses such as heat, cold, drought, nutrient disruption and disease. Other possible problem from the acid rain that it can erodes buildings and monuments. Acid particles in the air are suspected of contributing to respiratory problems in people.

7.5.1 Potential Impacts during Site Preparation Activity

Some air pollution is expected during site preparation and logging activity. The particulate from an exposed soil would be dispersed to the air by the movement of truck container and loader from/to the proposed site. Minor impact is due to the smoke from the machineries and vehicles used for the site clearing activities. The “greenhouse effect” as described earlier in this chapter may possible occur if felling and earthwork activity being carry out one shot at the proposed project site without immediately planting the timber latex clone plantation trees and cover crops as recommended. If this happens it may reduce the volume biomass sink, thus increase the level of carbon dioxide and at the same time depleting the level of oxygen in the atmosphere.

Carbon dioxide is also expected to influence intensely the process of depletion of ozone layer, which would further make the climate hot. According to World Health Organization (WHO), mosquitoes may have longer life and breed in larger numbers due to global warming and hence may spread malaria. Warmer and humid conditions may also enhance the growth of bacteria and moulds and their toxic products resulting in increased amounts of contaminated and spoilt food. This situation however is expected to be a short terms event only and mainly occur during the initial part of overall project development. There is potential for increase of fire hazards from logging and plantation activities.

7.5.2 Potential Impacts during Planting Activity

The air quality impact during planting activities is expected to be contributed by the dust from vehicles movement. Some smoke expected from combustion engine of machineries but it is not significant and will not be damaging to the surrounding area.

7.5.3 Potential Impacts during Maintenance and Harvesting Activity

The air quality impact during harvesting activities is also mostly due the dust from vehicles movement. Some smoke expected from combustion engine of machineries but it is not significant. There will be no significant air pollution impact during project operation due to the proposed area is isolated, traffic movement is very limited and since the wind blowing from surrounding area could easily disperse and dissipate the smoke away from the area.

7.5.4 Potential Impact during Replanting Activity

Impact on the air quality during the replanting activities is also mostly due the dust from vehicles movement. Some smoke expected from combustion engine of machineries but it is not significant. There will be no significant air pollution impact during project operation due to the proposed area is isolated, traffic movement is very limited and since the wind blowing from surrounding area could easily disperse and dissipate the smoke away from the area.

7.6 WATER POLLUTION

Water pollution occurs when a body of water is adversely affected due to the addition of large amounts of materials to the water.

Water pollution and water quality are another issue however, leaching of pesticides and other agrochemicals, runoff, sedimentation, pollution by effluent discharge and hydrocarbon contamination all affect water and can be significant impacts of timber latex clone tree cultivation. Normally in an aspect and impact register, anything which

enters either ground or surface water has attached to it a significant risk factor as the magnitude is spread over a very wide area and the impact is easily seen.

The proposed rubber forest plantation project was identified to have some potential impacts on the river water quality during site preparation, planting, harvesting, maintenance and also during replanting stages. Some of the measures described in this section are standard control steps that would mitigate the impacts so that a successful planting of the proposed project is possible. The main contributory sources of water pollution within this area are expected to come from soil erosion, sewage from workers houses, fertilizers, pesticides and agriculture chemicals application. Excessive growth of these types of organisms consequently clogs our waterways, use up dissolved oxygen as they decompose, and block light to deeper waters.

This, in turn, proves very harmful to aquatic organisms as it affects the respiration ability of fish and other invertebrates that reside the water. Suspended solids may adversely affect water users and the available aquatic ecosystem. The impact is particularly significant if water users downstream of the site are abstracting water for drinking as well as domestic use. Increased suspended sediment load may degrade portable water use and fish spawning spots resulting in fishing activity by local population hampered, while improper waste disposal from overall timber latex clone plantation activity such as oil, grease and other refuse may cause health hazard.

Pollution in the form of organic material enters waterways in many different forms as sewage, as leaves and grass clippings. When natural bacteria and protozoan in the water break down this organic material, they begin to use up the oxygen dissolved in the water. Many types of fish and bottom-dwelling animals cannot survive when levels of dissolved oxygen drop below two to five parts per million. When this occurs, it kills aquatic organisms in large numbers, which leads to disruptions in the food chain. Finally, the dissolved oxygen level would be depleted which result in anaerobic condition and death

to its life forms and other types of micro-organism in the respective water body.

7.6.1 Sewage and Sullage

A proper sewage disposal is needed for temporary workers houses during site preparation, planting and if the developer changed the planned to build a permanent worker houses during harvesting. Sewage would also pollute the localized water around the plantation area if not disposed properly. Even with the used of septic tanks, treatment is incomplete due to the generally lack of maintenance and in suitable soil condition in certain areas. The common parameters associated with sewage and sullage is COD, BOD_5, NH_3N and E-Coli.

Domestic wastewater or sewage is the spent water originating from all aspects of human water usage. Sewage contains pathogens, which cause typhoid, cholera and gastroenteritis if there is inadequate sanitation. Nutrients in sewage cause eutrophication. Sewage comprises 99.9% water and the remaining 0.1% comprises contaminants which are potentially harmful to waterways, causing adverse impacts to fish and other aquatic life and consequently to human utilization. These contaminants include oxygen-demanding substances. Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), pathogenic micro-organisms and nutrients (Nitrogen and Phosphorus) may result in the growth of algae and weed. All these may lead to a reduction in dissolved oxygen levels, deterioration in the water quality, possibly cause eutrophication and emit odour, creating an unpleasant environment. The magnitude of the impact will depend on the actual population and the strategies put in place to avoid pollution of this nature. In order to quantify the environmental impact caused by untreated sewage, the projected population estimated using the recommended population equivalent factors as stipulated in the **Guidelines for Developers published by the Ministry of Housing and Local Government (Sewerage Services Department).**

7.6.2 Fertilisers and Agricultural Chemicals

Coinciding with the increasing use of fertilizers is a growing use of pesticides, herbicides and other chemicals for the control of insects, weeds and fungal pathogens. A large number of these chemicals, with a wide range of different physical and chemical properties are currently used in agriculture, where they have helped to increase crop yields. As analytical methods become more sophisticated, agricultural chemicals have been detected in water supplies more frequently. Most (> 95%) of these chemicals are at trace levels, with detections rates being higher in agricultural areas using these chemicals intensively. WHO has recommended guideline values for a number of specific pesticides. The degree to which agricultural chemicals can enter into groundwater through normal agricultural use depends on a number of factors. These include the extent to which the chemicals are absorbed onto organic matter in soils, the extent to which they are volatized from the soil, the rate of degradation within the soil, their solubility in water and the amount of percolating water that is available to mobilize them. The degree to which such chemicals can contaminate runoff to surface waters depends mainly on local rainfall and the extent to which the chemicals are absorbed onto soil.

The highest concentrations of agricultural chemicals in water supplies generally result from the percolation of contaminated runoff into natural and human-made pathways through the soils, although over spraying of water courses and poor disposal practices may also be important. Groundwater may be contaminated by leaching through highly cracked soils and fissured rocks. Some very soluble and mobile herbicides may leach to groundwater if they are applied at a time when the net movement of water is downwards and there is little transpiration by plants.

Agricultural chemicals are generally applied directly to plants (foliar spraying etc) or to the soil, and concentrations in surface waters are dependent on factors such as application rates (including over application and misapplication), interception loss on plants, soil characteristics and climate (particularly rainfall) and whether or not irrigation is used. Surface water is particularly prone to contamination

by poor agricultural practices, such as inappropriate disposal of excess chemicals, water from the washing of application equipment and spills. Other important potential point sources of contamination include chemical storage facilities (particularly those near water sources), mixing sites for chemicals and animal treatment sites (e.g. dips and sprays) where concentrations, and the chance of spills, are likely to be high.

Pollution reaching waters can be related either to point sources or to diffuse (non-point) sources, according to its pathway and characteristics. Point sources of water pollution such as those from industries and sewage treatments works are more easily identified, measured, and amenable to practical control. In contrast, diffuse sources of pollution from non-point locations (e.g. the land surface or the atmosphere) are by nature, more difficult to identify, measure and control. Fertilizer and pesticide chemicals in agriculture land are one from of non-point sources of water pollution.

Health Hazards from Nitrate Pollution

High nitrate concentrations in drinking water are widely recognized to be a health risk to bottle-fed infants, since they may lead to “methemoglobinemia”. The disease reduces the oxygen-carrying capacity of blood. A few cases of methemoglobinemia have been associated with nitrate levels in water of less than 50 mg/l, however, most cases occur with nitrate levels exceeding 90 mg/l. Nitrates in water may cause death to the infant, but the threshold level of fatality is difficult to ascertain at present. Nitrates can react with amines to form nitrosamines and nitroamides. The precursors of these N-nitrosa compounds are widely distributed in various environmental media. It was found that more than 80% of over one hundred N-nitrosa compounds proved to be carcinogenic in animal experiments giving rise to tumors in many organs and also producing tumors trans placentally.

Nitrate Pollution

Of all the fertilizer nutrients, nitrogen generally produces the greatest growth response in plants. However, unlike phosphorus, it usually is not the limiting nutrient for algae growth in lakes. This is because many of the blue-green algae can use nitrogen gas from the air and do not depend on ionic sources dissolved in the water. Nitrogen is present in soils as nitrate ion, ammonium ion, and as a component of soil organic matter. In all but very wet or dry soils, the ammonium form is readily converted to the nitrate form. This nitrate form is completely soluble and not tightly held by soil particles. Therefore, nitrate can readily leach downward with percolating water and contaminate groundwater supplies. Water with over 10 parts per million nitrate-nitrogen can cause methemoglobinemia (inability to use oxygen) in infants. This is why health authorities are concerned about keeping nitrate out of drinking water supplies. Nitrogen fertilizer can also contribute to nitrate pollution, especially on sandy, coarse textured soils. This is because the nitrates not used by the plants can leach through the soil when excessive rainfall occurs. Nitrate pollution in rivers may also affect underground water sources. The following points should be noted:

- Various factors influence nitrate leaching from the soil, in particular the application rate of inorganic and organic nitrogen fertilizer.
- High intake rate of soil would result in high loss of nitrate through leaching that would ultimately pollute ground water source.
- Nitrate is highly soluble in water and therefore water draining from soils will have significant nitrate concentrations. In general, water which runs off the surface of the soil, has had less contact time with soil, and has therefore lower nitrate concentration. Losses by leaching depend on few factors such as nitrate availability in the soil, the vegetation cover, the weather pattern and the soil type. For forest soil, nitrate leaching is generally very low, but in cases of deforestation up to 60kg N/ha per year may be leached. For cultivated soil the losses could exceed 150 kg/ha per year.

- Nitrate and phosphate transported to rivers from the soil by surface runoff have travel times. For this reason, their concentration in rivers tends to have a strong positive relationship with runoff rates. A considerable proportion of nitrate loss takes place through vertical leaching and therefore affects aquifers. Many aquifers eventually discharge to rivers. For those rivers with a significant ground water component, trend in nitrate concentrations in the aquifer feeding the river are reflected in the base load of nitrates in the river. Rivers can therefore have a two-phase response to nitrate losses from the soil zone, one rapid, caused by the runoff component, and the other slow, caused by ground water component.

Nitrate promotes undesirable growth of aquatic micro flora in water courses which affects the health of aquatic life. Consumption of high nitrate water can be fatal to infants as it may lead to 'Blue Baby Syndrome', a manifestation of nitrate toxicity. Phosphorus in the form of phosphate has the same eutrophication effect in surface water as nitrate, causing excessive algae growth, and preventing sunlight from reaching aquatic life in deeper water. Fertilizers applied correctly at the recommended rates and at the correct time will not pose any environment hazards as most of them are readily absorbed by the dense fibrous roots of timber latex clone. Any surplus would be taken up by the ground cover vegetation or are immobilized in the soil and later released slowly thereby posing no pollution problem. Only excessive and ill-timed application will have undesirable impacts.

Phosphorus Pollution

Phosphorus is one of the macronutrients essential for plant growth. This nutrient can also be a primary cause for lake enrichment leading to growth of algae and weeds (a process called eutrophication). Sometimes phosphorus in lawn and garden fertilizers is implicated as the source of pollution, but this is not always an accurate assessment of the problem. Although misuse or misapplication can pollute lakes,

proper application following soil test recommendations does not pose a significant threat of lake pollution and may reduce pollution possibility. The major sources of phosphorus in runoff are from lawn clippings and tree leaves left in the streets and gutters. Other sources of phosphorus may come from soil particles either blown into the lakes by wind erosion or carried in runoff over bare soil.

Inorganic phosphorus moves very little in soil. When applied and incorporated as a fertilizer, phosphorus is quickly bound by soil particles. Most of it is not immediately available to plants and does not leach (wash) through the soil into lakes or groundwater. Although phosphorus is relatively immobile in soils, some runoff containing soil particles and dissolved phosphorus can still occur. Phosphorus taken up by plants is incorporated into organic compounds. If not mixed into the soil, organic phosphorus from plant residues such as lawn clippings and tree leaves is soluble and a potential pollution source. Soils with excessive phosphorus levels, if not managed properly, can be a source of soluble phosphorus contamination via runoff into surface waters. Excessive soluble phosphorus in water can cause excessive plant and algal growth that can lead to fish kills as a result of depleted oxygen levels in the water. Using appropriate methods for storage and application of fertilizer will assure maximum values and environmental protection for the nearby water body.

Pesticide and Herbicides Pollution

The term “pesticide” is a composite term that includes all chemicals that are used to kill or control pests. In agriculture, this includes herbicides (weeds), insecticides (insects), fungicides (fungi), nematicides (nematodes), and rodenticides (vertebrate poisons). In timber latex clone plantation, the level of pesticide usage is normally in average quantity. Hence, impacts from these sources are usually not significant. However, herbicides are more widely used. Common herbicides used in timber latex clone plantations are paraquat dichloride, glyphosate, methyl mesopleuron and glyphosate ammonium. Paraquat dichloride salts are very soluble in water. Any stray chemical that falls into the ground is inactivated by inert clays and anionic surfactants such an organic matter. Paraquat is degraded

by microbial action to CO_2 and other naturally occurring products. The intermediates produced are of low toxicity. The residue is also degraded by the photolytic and microbial degradation processes on plant leaves. 50% of paraquat would be degraded within 2 weeks. It is reported not to accumulate in the ecosystem even through prolonged use. As it is strongly absorbed in clay and organic matter it is not easily leached to contaminate groundwater. It presents little risk to aquatic life.

Glyphosate isopropyl-ammonium salts are very soluble in water. They are strongly absorbed by the soil in which decomposition is mainly by microbial action at the rate of 50% loss in less than 60 days. Mesopleuron methyl salts are again soluble in water. When the chemical falls on foliage it is transmitted to the root system causing damage to the stem and root tissues. The residue degrades microbiologically. Glyphosate-ammonium salts are also very water soluble.

After application its residue is readily absorbed by soil components and is rapidly degraded to CO_2 and water by soil microorganisms. Its active ingredient does not accumulate in the food chain. Its relatively short half-life and high LD50 value make it a very environmentally safe herbicide. It is particularly safe for aquatic life and birds and non-toxic to beneficial insects such as bees, weevils and earthworms. It has been estimated that 75 – 95% of the spray usually lands on the foliage. Most of the rest land on the soil and gets deactivated. Unless sprayed under windy conditions very little will get into streams. Spraying of drains and waterweeds is not recommended, as it would be hazardous. Certain pesticides, when they are not stored, handled, or applied properly, can lead to several issue as listed:

- Human exposure to toxic materials, which may cause injury, death, or long-term health effects (e.g., cancer, asthma)
- Contamination of water, air, soil, and habitat
- Direct wildlife exposure to toxic materials that may harm natural predators, pollinators, beneficial soil organisms, fish, birds, and other wildlife – particularly with spills, but also with drift and leaching into water bodies

- Bio-accumulation of some products in body tissues – this presents a risk to the food chain

- Excess residue on food through overuse and/or improper timing of use on food products such as fruits and vegetables – this could lead to seizure of the crop
- Pest resistance, which occurs when the same material or products within the same chemical group are used continually
- Economic losses due to crop damage or poor pest control
- Disruption of natural control agents. Many pesticides are non-selective and upset the predator-parasite balance. The removal of natural pest control increases dependence on chemical pesticides.

Pesticides and their breakdown products can contaminate surface water and groundwater resources by following the pathways of the water cycle or by artificial means. **Table 7.13** shows the ecological impacts of pesticide to the water body. Therefore, care must be taken in areas of porous soil materials, shallow aquifers, poorly protected wells, and concentrated storage or use of pesticides. Ponds and wells, including abandoned ones, not only access aquifers but can also provide direct conduits for infiltrating waters. Surface waters can be contaminated by pesticides through leakage, spills, and surface runoff.

Rates of runoff increase with slope, lower infiltration rates (e.g., clay soils), and higher volumes of water due to snowmelt, rainfall, and storms. Sometimes, runoff from farmland will reach natural areas such as watercourses, ponds, and wetlands. There is a higher risk to natural areas when the rate of runoff is high, the distance from source is short, and there is no barrier in place to divert the flow. Some pesticides will follow this path of the water cycle: this is particularly a concern in the case of a spill. Some pesticides, like triazines, attach to soil particles and can contaminate natural areas if best management practices are not put in place to control erosion and reduce runoff.

Table 7.13 : Ecological Impacts of Pesticides in Water

Items	Ecological Impacts
Toxicity	Mammalian and non-mammalian toxicity usually expressed as LD_{50} (Lethal Dose). Concentration of the pesticide which will kill half the test organisms over a specified test period). The lower the LD_{50}, the greater the toxicity and values of 0-10 are extremely toxic. Toxic response (effect) can be **acute** (death) or **chronic** (an effect that does not cause death over the test period but which causes observable effects in the test organism such as cancers and tumors, reproductive failure, growth inhibition, teratogenic effects, etc.). Drinking water and food guidelines are determined using a risk-based assessment. Generally, Risk = Exposure (amount and/or duration) × Toxicity
Persistence	Measured as half-life (time required for the ambient concentration to decrease by 50%). Persistence is determined by biotic and abiotic degradational processes. Biotic processes are biodegradation and metabolism; abiotic processes are mainly hydrolysis, photolysis, and oxidation (Calamari and Barg, 1993). Modern pesticides tend to have short half lives that reflect period over which pest needs to be controlled.
Degradates	The degradational process may lead to formation of “degradates” which may have greater, equal or lesser toxicity than the parent compound. As an example, DDT degrades to DDD and DDE.
Fate (Environmental)	The environmental fate (behavior) of a pesticide is affected by the natural affinity of the chemical for one of four environmental compartments (Calamari and Barg, 1993): solid matter (mineral matter and particulate organic carbon), liquid (solubility in surface and soil water), gaseous form (volatilization) and biota. This behavior is often referred to as “partitioning” and involves, respectively, the determination of the soil sorption coefficient (K_{OC}), solubility; Henry’s Constant (H) and the n-octanol/water partition coefficient (K_{OW}). These parameters are well known for pesticides and are used to predict the environmental fate of the pesticide.

7.6.3 Potential Impacts during Site Preparation Activity

Water pollution is identified due to the site preparation especially if the soil detachment is transport to the river water refer to the surface flow of runoff to the river. There is also effluent discharge from the workers base camp during the site clearing and earthwork activities. The changes in land use from a forestland to the agriculture likely to create impermeable areas would contribute to the increase in surface runoff, nearby major river and small rivulets. Increasing of the surface runoff can created a flood and serious erosion problem at the proposed project site. Due to the influx of sediments in the form of sand, silt and mud the structure of the riverbed is changed.

Favourable conditions that are conducive for fishes habitats and other aquatic organisms to thrive are as listed:

- Ponding effects along the stream offer space for the fish to thrive.
- Shelter, protection and hiding places under the boulders for fish.
- Surfaces of boulders supports colonies of algae whose growth is controlled by the limited sunlight and rushing water, these algae is fed on by many invertebrates.
- Fishes and other aquatic organisms attached their eggs to the lee side and under-side of boulders.

7.6.4 Potential Impacts during Planting, Maintenance and Harvesting Activity

Development of a rubber forest plantation estate requires some application of agricultural chemicals for fertilization and pesticides. Synthetic fertilizers can cause nitrate and phosphorus pollution of water if used very intensively. Of the two, nitrate pollution is more prominent due to the steady increase in N application as compared to stability of K applications in recent years. If the project proponent has a plan to develop workers housing area within the proposed project site during this stage, the water pollution impact also is due to the wastewater from the sewage discharges and sullage. Sewage

and sullage need at least a basic treatment (septic tank) before being discharged to the water resources.

7.6.5 Potential Impact during Replanting Activity

The potential impact that may occur is basically similar as during the early stage of overall plantation development. Partially clearance work of the existing project site area may generate surface water movement which contains eroded material and transport to the river water nearby. There is also effluent discharge from the workers base camp during this stage. However, the level of potential impact may not as high as during early stage of overall plantation development.

7.7 SOLID WASTE DISPOSAL

Solid waste is not a significant environmental problem since the proposed project is rubber forest plantation development activities and expected not to generate serious impact to the surrounding environment. Solid waste is normally produced at the stage of site preparation, logging, and planting. Most of the solid waste is an agriculture waste and can easily biodegraded through the nature process. It was estimated that the average of biomass generated is approximately 375, 744 tonne. The amount however, is very much depend on existing condition of the proposed project site area that are going to be developed into rubber forest plantation area. Based on the past experience, normally the project proponent will staged the biomass and left to rot on-site.

7.7.1 Potential Impacts during Site Preparation Activity

Site preparation and logging activity will involve cutting vegetation and felled trees from the ground. All the bushes and shrubs will be cleared at the project site to allow for lining, terracing as well as rubber forest plantation planting activity. All these mass should be dumped aside after which are to be collected away or being left to

rot naturally. Quantity of biomass from plantation is significant. It is normally left along the logging/plantation roads or stumping points allowing them to rot to improve soil fertility. However, these materials should be properly manage to ensure that they do not enter the waterways.

7.7.2 Potential Impacts during Planting Activity

At this stage, the generation of solid waste is from polybags used during the planting stage. The polybags will be taken out from the rubber forest plantation trees during planting activity. Even though it was in small quantity, it has to be properly being disposed at designated disposal area since it is hard to biodegrade through natural process.

7.7.3 Potential Impacts during Maintenance and Harvesting Activity

At this stage, the generation of solid waste is from rubber forest plantation branches that have been trim from the timber latex clone. It can easy biodegrade and non-toxic to the fauna. If the project proponent planned to build the workers quarters during this stage, it may create solid waste from it workers population such as rubbish, food, plastic container and paper waste, etc. The solid waste generation usually depends on the estimated daily average population generated from the worker quarters, nursery area as well as site office.

7.7.4 Potential Impact during Replanting Activity

Replanting activity will involve in cutting existing old timber latex clone from the ground. All the trunks will be cleared at the project site to allow for replanting activity. All these masses should be dumped aside after which are to be collected away or being left to rot naturally. Quantity of biomass from plantation is significant and will

be left rot naturally within the project site area. These materials should be properly manage to ensure they do not enter waterways.

7.8 SCHEDULED WASTE DISPOSAL

Schedule waste is waste material, often in chemical form that can cause death or injury to living creatures. It usually is the product of industry or commerce, but comes also from residential use, agriculture, the military, medical facilities, radioactive sources, and light industry, such as dry-cleaning establishments. As with many pollution problems, toxic waste began to be significant issue during the industrial revolution. The term is often use interchangeably with “hazardous waste” or discarded material that can pose a long-term risk to health or environment.

During the implementation of various activities in the rubber forest plantation, it will involve quite a number of heavy machinery vehicle and other equipment (generator, water pump, etc). The project proponent will setup a workshop in order to maintain all these machinery, vehicle and equipment, thus expected to generate an oil waste, classified as a schedule waste under Environmental Quality (Scheduled Waste) Regulations, 2005. Improper management of the oil waste may potentially affected the water sources available within the proposed project site area. In addition, even though the generation of schedule waste on-site might be in small quantity, it can give a major potential impact once it enters water body. It will not only affect the living organism in the water but also to the human who use the water as their water supply. Therefore, various mitigating measures is suggested to be carried out by the project proponent in order to control, minimise and resolve the issues.

7.8.1 Potential Impacts during Site Preparation and Planting Activity

The maintenance of the heavy machinery, vehicle and equipment (generator, water pump, etc) will generate the waste oil. A part of that, improper handling and storage of used oil container may also potentially create an oil spillage problem on-site. Improper disposal of oily wastes such as hydraulic or motor oil from logging as well as

plantation machinery and garbage from campsite and from accidental spills off oil may also cause land and water pollution. Plantation activity is normally associated with use of various chemicals including herbicide, pesticide and fertilizer. Improper application, storage and handling of these chemicals may cause environmental problems as well as health risk. Impact on chemicals usage could be significant, if no proper health, safety and environmental procedures in application, storage and handling.

7.8.2 Potential Impacts during Maintenance and Harvesting Activity

At this stage, the usage of heavy machinery, vehicle and equipment will decrease since most of the major activity has reached its completion stage. However, the generation of oil waste still exist but expected to be in small quantity. Improper disposal of oily wastes such as hydraulic or motor oil from logging machinery and garbage from campsite and from accidental spills of oil may also cause land and water pollution.

7.8.3 Potential Impact during Replanting Activity

The potential impact that may also arise on the scheduled waste management is basically the same as during the early stage of overall plantation development such as generation used oil, used oil container, chemical from the usage herbicide, pesticide and fertilizer. Improper application, storage and handling of these material will not only may cause environmental problems but also may affect the health of the workers as well as nearby community.

7.9 TRAFFIC CONGESTION

The environmental impacts resulting from changes in transportation are usually perceive as being adverse however; transportation also has positive impacts such as improving the residential environment by permitting the developments of homes in areas with new roads or

by the removal of through traffic following the construction of new urban roads. **Table 7.14** highlighted the general environmental impact resulting from the road and traffic. The development would result in increase in traffic level at the nearest existing road to the proposed project area. The traffic flows will increase according to the project activities. The access road has been identified and as shown in previous chapter (see **Figure 5.3).**

Table 7.14 : The Environmental Effects of Roads and Traffic

Impacts	Effects
Vehicular impacts	Noise & Vibration Air Pollution Litter Physical damage Anxiety
Safety and capacity impacts	Accidents Effects on the operation of roads and intersections
Roadway impacts	Visual intrusion and aesthetics Severances Land consumption and loss of property Changes in land access and land values Planning blight Effects on wildlife, plants and the aquatic ecosystem Impacts on historic and cultural resources Impacts on utilities and drainage Employment/ business impacts
Construction impacts	Damage to local roads Disturbances to roadside residents and other road users Effects on ecosystem and drainage Impact at source of materials Litter, mud, odours, etc.

7.9.1 Potential Impacts during Site Preparation, Planting, Maintenance and Harvesting Activity

Some traffic congestion during the early stage of plantation development is expected due to the vehicles moving in and out from the proposed site. The lorries and trucks leaving the site would

usually be loaded with disposed vegetation and waste material from the site clearance. Currently, due to the average traffic volume, the access road to the proposed project site could cater for an increment of vehicles from the proposed project activities. Based on the traffic survey conducted revealed that average vehicles of about 103 numbers during day time consisted of car, four wheel drive, tractors, lorry and motorcycles using the Kg. Bagan Serai – Kg Sungai Semaliang. This situation is expected to create an inconvenience condition to the nearby local community. As the number of lorry/truck trips per day generated by the proposed project development is low, the potential socio-economic impact is expected to be minimal.

7.9.2 Potential Impact during Replanting Activity

At this stage, the usage of heavy machinery, vehicle and equipment will be increased back however the volume is much lesser as compared during the early stage of overall development. Some traffic congestion during the replanting stage is expected due to the vehicles moving in and out from the proposed site. The lorries and trucks leaving the site would usually be loaded with disposed trunk generated from the cutting and felling of existing old rubber forest tree trunks.

7.10 ECOLOGY

7.10.1 Flora

The Project area is located within the Piah Forest Reserve and nearby Air Chepam Forest Reserve (based on JPSM 2016) and were logged-over at different logging cycles. The northern part of the Project area can be considered as a part of lowland forest with past logging history. Flora in the area are nearly restored by natural forest succession with the mixture of medium-sized pole and mature native tree species. The southern part of the Project area is experiencing first phase of forest succession with the growth of pioneer and late-seral tree species with the invasion of weed species. Overall, the Project area can be considered as a disturbed lowland forest remnant

with the evidence of massive anthropogenic disturbances (logging activities, monoculture plantations) and experiencing edge effect at nearly 50% of the total land of the Project area.

Based on ground observation as per documented in Chapter 6, impact assessment is carried out to identify any significant impacts which require further attention. The following sections shall further discussed the impacts predicted to take place during the Project execution.

7.10.1.1 Potential Impacts during Site Preparation Activity

Vegetation Loss

Since the site have been logged over previously, the site is mostly covered with regenerated lowland forest. As such, much of vegetation removal is expected to be carried out to provide the platform for the forest plantation or common term known as “Cuci mangkuk”. Euphorbiaceae was the most speciose family recorded during ground observation, represented by the sum of 21 species and followed by Dipterocarpaceae (15 species).

Impact on Flora Biodiversity

Most of the vegetation at the Project area were represented by typical lowland and hill dipterocarps canopy and sub-canopy trees such as Meranti group (*Shorea* spp.), Keruing group (*Dipterocarpus* spp.), Kapok (*Ceiba pentandra*), Sesenduk (*Endospermum diadenum*), Kedondong (*Dacryodes* spp., *Santiria* spp.), Jelutong (*Dyera costulata*), Kelat (*Syzygium* spp.) and Kempas (*Koompassia malaccensis*).

The disturbed area consists of several large open areas with direct sunlight onto the forest floor, thus caused regeneration of pioneer and invasive plants (*Macaranga* spp., *Melastoma malabatrichum*, and several weed species) to take place. Several mature late-seral and light demanding tree species were observed as dominating the transition zone between crop and forested lands at the northern part

of the Project area such as *Pometia pinnata* and *Azadirachta excelsa*. The slow-flowing streams were occupied by stream vegetation and several palm species. Other streams were disturbed by earthworks thus altered the natural formation of stream/ streambank and occupied by weeds and secondary vegetation. Crop plantations represented by rubber trees (*Hevea brasiliensis)* and wild bananas (Musa spp.)

Based on the complete plant survey, there were 3 plant species categorized by IUCN Red List as described in Malaysia Plant Red List as Near Threatened. These tree species were described as threated by restricted habitat and logging activities, namely Keruing Gombang Merah, Meranti Kepong and Paku Tanduk Rusa.

Biomass Generation

A total of 35 trees with DBH ≥ 5 cm were recorded in Plot 1and Plot 2 representing 15 families, 24 genera and 28 species. Biomass generated from the forested Project site was estimated by using the above-ground and below-ground method. The total biomass was obtained from calculation derived from formula for stem, branch and leaf.

Total biomass of trees in the Project area was estimated at 234.84 t/ha. From this amount, a total of 198.94 t/ha (84.71%) was contributed by above ground biomass (AGB) and 35.9 t/ha (15.29%) was contributed by below ground biomass (BGB). Detail biomass estimations of trees in the Project area based on Plot 1 and Plot 2 data is shown in **Table 7.15**.

Table 7.15 : Biomass Estimation of Forested Land at Project Area from Above-Ground and Below-Ground Method

	Above-ground Biomass (tonne/ha)	Below-ground Biomass (tonne/ha)	Total Biomass (tonne/ha)	Project Area (ha)	Total Biomass for the Project Area (tonne)
Plot 1	133.42	26.21	159.63	1600	255,408
Plot 2	264.46	45.59	310.05	1600	496,080
Average	198.94	35.9	234.84	1600	375,744

The estimated biomass value for Project area was made based on the assumption that the Project area was in full vegetation form. However, the actual biomass value was expected lower than the estimated value because of the extent of open cleared forest for rubber plantations towards the south part of the Project area as recorded by ground habitat assessment and NDVI value.

The established Plot 1 recorded a mixture of several native trees, secondary succession and growing (treelets/saplings) trees at different canopy layers based on the location of Plot 1, which was located at the forest fringe near to the old logging track. Plot 2 recorded a high number of mature dipterocarps and other timber trees (as established at the area with less disturbances), thus explaining the higher value of biomass. The area towards the north of the Project area was observed as having high number of mature trees (>30 cm DBH) and less treelet/saplings due to the nearly final stage of forest succession. The undulating hilly terrain provides larger surface area for tree existence, thus might increase the sum of tree basal area at certain areas.

7.10.1.2 Potential Impacts during Planting, Maintenance and Harvesting Activity

Potential impacts from use of fertilisers and herbicides to maintain replanted vegetation can be expected during operation and

harvesting. Extensive and indiscriminate use of these substances is likely to pollute underground water. Leachate that contains herbicide can be very harmful to biological species and human. Other potential impacts include improper discharge of sewage and sullage, which would deteriorate the quality of receiving water and become harmful to most biological life forms.

7.10.1.3 Potential Impact during Replanting Activity

The potential impact, which may occur, is similar to impact during the early stage of overall plantation development. However, the degree of the potential impact is slightly lower and expected to resolve within a short period of time.

7.10.2 Fauna

7.10.2.1 Potential Impacts during Site Preparation Activity

Forest and Habitat Loss and Degradation

Forests and other habitats are being constantly lost, fragmented and degraded in the ever-increasing human population and their activities. Human population on the planet was estimated to exceed 7,600,000,000 (7.6 billion) as of October 2018. The forest at the proposed project which is part of Piah Forest Reserve, had been serving as habitat for high number of wildlife and fauna population and diversity for millions of years.

It's a pity that plot petak 1B and 2B had been clear felled and petak 1B is already planted with rubber trees prior to EIA submission. There are also other known committed projects within Piah Forest Reserve and to the west and southwest of the proposed project where natural forests and habitat had been converted into plantations causing significant forest and habitat loss. Some portion of Piah Forest Reserve had also been revoked its gazette to make way for oil palm plantations. **Figure 7.1** shows deforestation visible within the proposed project and surroundings based on low

resolution Google Earth aerial view dated 31st December 2016. Although the status of the lands remains as forest reserves such as the proposed project, it's meaningless as the forest and habitat would perish. Even if reforestation effort is attempted later, it would take a very long time and the original biodiversity composition may not be as rich as it used to be.

There is also possibility of fire to occur intentionally or accidentally from the workers and contractors at the site from burning of wastes at their kongsi, cigarette butts, sparks from machines etc. which may spread to the forested habitat not only within the proposed project but also to the surroundings. **Figure 7.2** shows examples of open burning involving projects converting forests into plantations This would further jeopardize the wildlife and fauna surviving in already shrinking, fragmented and degrading habitats. While it is a serious offence to do open burning in Malaysia which carries penalty up to RM 500,000, it is keep on happening especially in projects converting forests into plantations. This is due to, among other, difficulty to monitor it at all times, lack of staff and resources, and the vast areas involved for the forest conversions.

During logging, earth works and plantation establishment, one of the effects anticipated is littering, which is quite a habit, be it among many Malaysians or foreign labours. Littering together with siltation and sedimentation may degrade the habitat quality including to the vicinity especially to rivers and affect the aquatic fauna as they may feed on the litter with elements not safe for them such as plastics and polystyrene. The proposed Project would cause another degrading effect known as edge effect. While edge effect may have positive effect, it could also have adverse impacts. Due to the high perimeter of the proposed Project consequently causing high exposed forest that it borders, the inhabitants of flora and fauna in the forest that the proposed Project borders would have higher detrimental effect from natural elements such as wind and storm and from human such as easier encroachment.

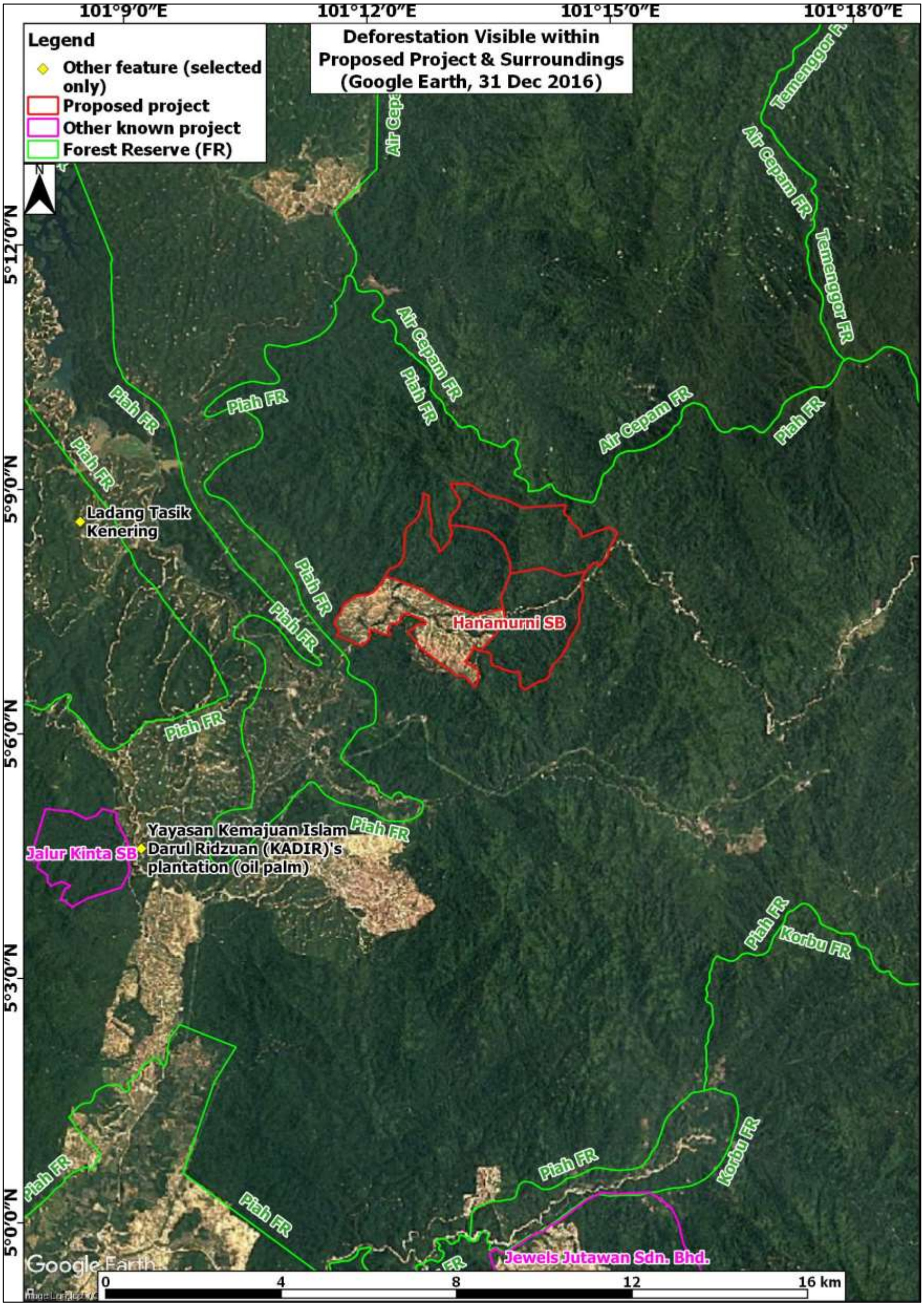

Figure 7.1 : Deforestation Causing Forest and Habitat Loss Visible Within the Proposed Project and Surroundings Based on Low Resolution Google Earth Aerial View Dated 31st December 2016.

Figure 7.2 : Examples of Open Burning Involving Projects Converting Forests into Plantations etc. Which May Also Destroy Remaining Forests and Habitats in The Surroundings.

Fauna Loss

There were numerous totally protected and threatened species recorded at the site such as:

i. Asian Elephant;
ii. Siamang;
iii. White-handed Gibbon;
iv. Sun Bear;
v. Great Argus.

The project would impact the local faunal populations since not all fauna would be able to make their escape especially those slow moving and small ones such as frogs, toads, lizards, some snakes etc. On top of that, many species are nocturnal (active during night

time) and become passive during day time that they would not be able to make their escape efficiently and timely. There also are species that are strictly arboreal (tree canopy dwelling) and fossorial (burrowing) that they could get trapped accidentally and could not make their escape. Not to forget, nest with chick and young where the parent(s) could not bring the eggs and chicks to safety and therefore reluctant to leave. Some fauna became disoriented when they lose their habitat causing them unable to make proper escape. Even if the fauna tries to make escape, there are possibilities that they may be run over or hit by the heavy machines operating in the project especially when the clearing is not well planned and fragmented.

Dr. Lim Boo Liat, a leading zoologist in the country and colleagues did a study from July 2002 – April 2003 in Lakum Forest Reserve in Pahang prior to a dam project. From the study, he estimated that the mortality percentages for certain fauna as follow:

Amphibians	: 100%
Reptiles	: 88%
Mammals other than bat	: 54%
Bats	: 45%

Nevertheless, this estimate was made with the assumption that no mitigating measures are implemented. With effective mitigating measures, the percentage is expected to be reduced.

Illegal Wildlife Hunting and Collecting

Without strict regulation and monitoring, illegal wildlife hunting and collecting is another likely impact to be experienced by the fauna component. It is not only possibly done by certain workers at the site but also outsiders whom would take the opportunity. Illegal collecting could possibly happen during the clearing works where the machine operators and loggers sometimes might find fauna trapped, exposed, in nest etc. Without strict regulation and supervision certain workers would definitely take the opportunity to collect them to be eaten, kept

as pet, sell etc. Although the project proponent and contractors may claim that they never let such activities to happen, in reality it is difficult to assure this on the ground on daily basis with many workers including foreign ones unless a knowledgeable and dedicate personnel is employed for this purpose.

Human-Wildlife Conflict

Jabatan PERHILTAN (Department of Wildlife and National Parks Peninsular Malaysia) defines human-wildlife conflict as follow:

"Behaviours or acts of wildlife species that may cause death, injury, property destruction, damage of crops, depredation of livestock or could cause fear on public safety."

The forest and habitat loss experienced by fauna and wildlife could cause some species to cause human-wildlife conflict especially by Asian Elephant, Wild Boar and Long-tailed Macaque which were recorded at the proposed project. Conversion of their natural habitat could cause these species to feed on the crops and damage properties. Due to the disturbance, the workers at the site may try to harm them. There are several aboriginal villages located near and within five-kilometre from the perimeter proposed project to the southwest as shown in **Figure 7.3** where human-wildlife conflict could occur. Additionally, the conflict is also likely to occur within the proposed project itself and other committed plantations nearby. In fact, there is a reported case of a baby Asian Elephant from Piah Forest Reserve where it wondered into a school canteen in Lintang town/ village after getting lost from its herd and habitat. **Figure 7.4** is an extract of the report in one of the local media. Jabatan PEHILITAN (Department of Wildlife and National Parks) of Perak state also recorded many human-wildlife conflict cases in Piah Forest Reserve and nearby areas as shown in **Table 7.16**.

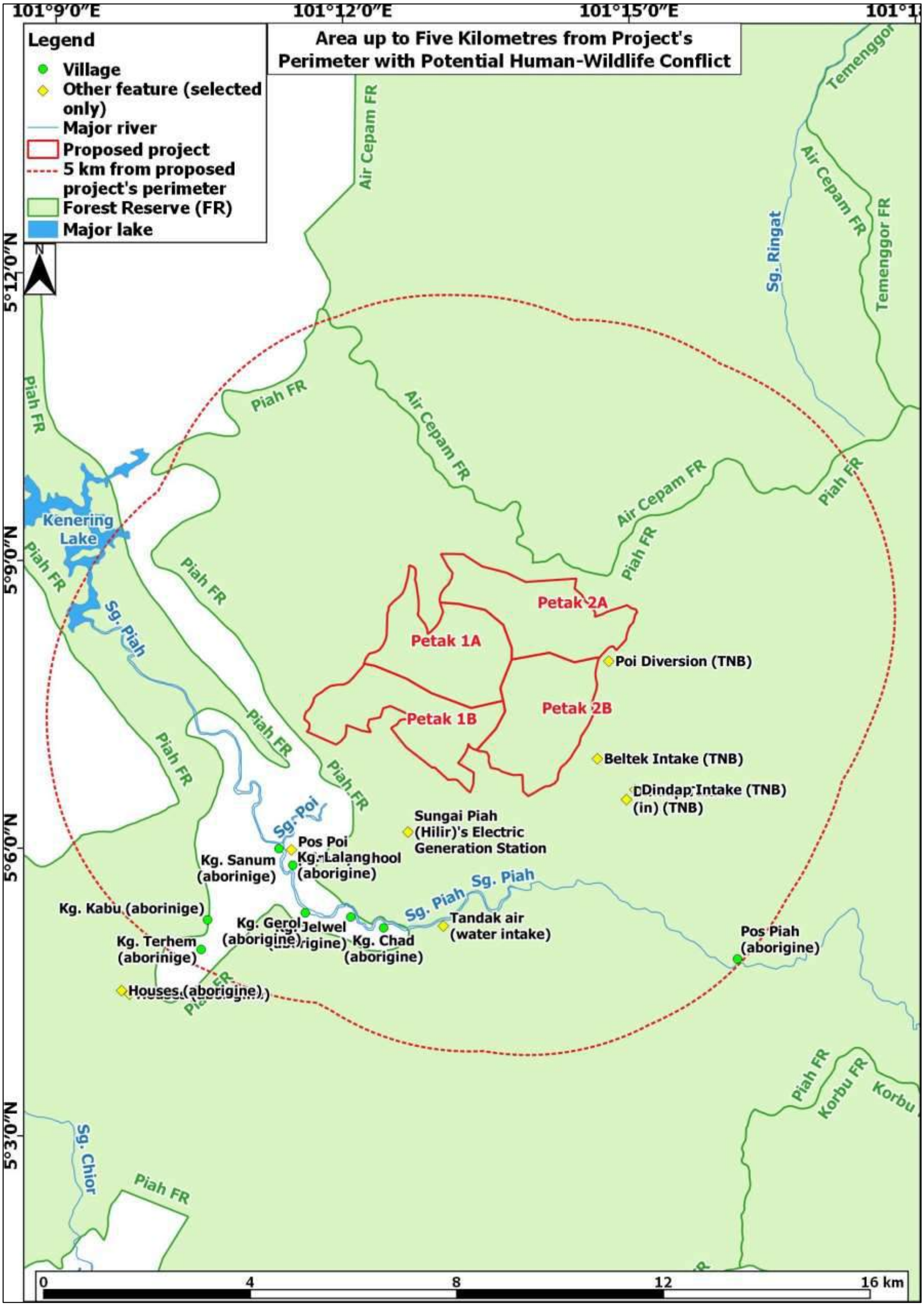

Figure 7.3 Area Up to 5km From the Proposed Project's Perimeter With Potential Human-Wildlife Conflict.

Sinar ONLINE Nasional Politik Edisi Semasa Bisnes Video Global Hiburan

Anak gajah sesat masuk sekolah

NORMAWATI ADNAN, NOOR 'AINON MOHAMED YUSOF
7 OGOS 20187 OGOS 2018

Anak gajah diberi minum susu.

A- A+ (Ubah saiz teks)

IPOH - Seekor anak gajah jantan dipercayai tersesat dikesan berkeliaran di pekan Lintang hingga masuk ke kawasan sekolah, pagi tadi.

Kehadiran haiwan comel seberat 200kg dengan saiz tapak kaki tujuh inci itu disedari sekitar jam 8 pagi oleh anggota Balai Polis Lintang.

Pemangku Pengarah Perhilitan negeri Perak, Wan Shaharuddin Wan Nordin berkata, anak gajah terbabit ditemui berada dalam ketakutan dan berlari-lari tanpa arah tujuan di kawasan laluan balai polis.

"Anak gajah ini dipercayai tersesat dan terpisah dengan ibunya dari Hutan Simpan Piah sebelum memasuki kawasan pekan.

"Operasi tangkapan telah dilancarkan membabitkan lapan anggota Unit Tangkapan Gajah (UTG) menggunakan pelali.

"Haiwan itu berada dalam keadaan sihat tanpa sebarang kecederaan dan kini ditempatkan sementara di Pejabat Perhilitan Sungai Siput," katanya ketika dihubungi Sinar Harian.

Figure 7.4 : Extract from A Report in One of The Local Media About A Baby Asian Elephant from Piah Forest Reserve, Which Wondered into A School After Losing Its Herd and Habitat.

Table 7.16 : Human-Wildlife Conflict Cases Recorded by Jabatan PERHILITAN Perak in Piah Forest Reserve and Nearby Areas.

Year	Asian Elephant	Malayan Tiger	Clouded Leopard	Others
2017	4	–	–	1
2016	4	2	–	2
2015	3	1	–	–
2014	2	–	–	–
2013	14	–	–	–
2012	13	1	1	1
2011	5	2	–	3
2010	17	–	–	1
2009	1	–	–	–
2008	5	–	–	1
2007	31	–	–	–
2006	21	–	–	23
Total	**120**	**6**	**1**	**32**

(Source: Jabatan PERHILITAN Perak, 2018)

7.10.2.2 Potential Impacts during Planting, Maintenance and Harvesting Activity

Impact during planting, maintenance and harvesting is minimal after complete transportation from a natural forest habitat to rubber forest plantation. Cover crops, natural or propagated will rapidly establish in the area with added fertilisation, aeration and adequate shade provided by the rubber forest plantation fronds. Regular weeding will remove undesired plant elements.

The rubber forest plantation development will open the door to the establishment of insects and pest animals as disease infestation. A monoculture practice and rich in food resources, the rubber forest plantation field development will quickly harbour such undesired elements.

The attractive and abundant food in proposed project site area will invite the attention from the other wildlife particularly the birds and rodent. Some of this will play the role as important pest such as the

green parrot, which have been recorded to incur occasional serious attacks on rubber forest plantation. Others will find food in the numerous insects and they build up steadily in replaced of forest counterparts.

Snakes and Owls will also build up in numbers due to the increase infestation of rats. Rubber forest plantations which close to jungle fringes or secondary swamp pit are often visited by wild pigs. They can displace and uproot young trees through their grubbing habits.

Monkeys have also been reported as pests of rubber forest plantations. Damage has so far been reported in nurseries and immature plantings. These pests either pull out the newly planted seedlings or the central spears of established trees. The incidence is infrequent and the damage is insignificant economically. Affected established trees usually recovered by producing new spears. Immature fruits are pulled out and tender portion eaten.

7.10.2.3 Potential Impact during Replanting Activity

The potential impact, which may occur, is similar to impact during the early stage of overall plantation development. However, the degree of the potential impact is slightly lower and expected to resolve within a short period of time.

7.11 SOCIO-ECONOMY

7.11.1 Potential Impacts during Site Preparation and Planting Activity

During site preparation and planting stage, there will be plantation workers from the appointed logging contractors. Some may even stay at the temporary houses (rumah kongsi) during the duration of the project.

The nearby local communities can gain a lot of benefit from the existence of workers since they can offer catering services for those

workers. To have temporary houses next to any neighbourhood is normally not acceptable to the people in the neighbourhood. People always associate temporary houses with unhygienic conditions, prone to the spread of diseases, and crime. Local surrounding community will always look with suspicious towards these workers, especially if they are foreigners (i.e. from Siamese, Indonesia or Bangladesh).

Furthermore, this situation is aggravated with the attitude of the workers itself of not caring for the hygiene, manners and local customs. Generally, the proposed project activity does not directly affect the nearby local community in terms of road access. Conversely, it provides good access to the area due to the absence of proper road networks. The nearby local community expressed hope that the proposed project development would bring greater benefits in term of transportation from opening of many new roads in the area.

7.11.2 Potential Impacts during Maintenance and Harvesting Activity

During these stages, the impact that may potentially occur is more on positive impact. The project owner of the proposed development, nearby local communities, as well as district members will gain a direct economic benefit from this development once the overall rubber forest plantation project is in operation and start entering the maintenance stage.

Residents from the surrounding area will have an opportunity to work for the rubber forest plantation. The local government or authority can also benefit from this project by means of increased revenue from taxes derived from quit rent and general services. The Gross National Product (GNP) for the state will also increase as the activities will contribute to increase the state income. It will contribute directly in line with the country's industrialization programme.

The rubber forest plantation industry is expected to play a major role in socio - economic development of the country. It will continue to be

an important component of the agriculture sector and a leading commodity in terms of its contribution to the expert earnings of the country.

7.11.3 Potential Impact during Replanting Activity

At this stage, the potential impact that may occur is reduction of revenue to the project proponent. Normally at this stage, project proponent has to allocate huge amount of financial to cater cutting and felling of existing old rubber forest, preparation of the project site, planting and maintenance activity. Whilst for the nearby local community, they will gain benefit in terms of job opportunity, small business opportunity as well as will gain indirect economic benefits from this stage.

7.12 DISEASE AND HEALTH

Table 7.17 shows the lists of nearest clinics related to the settlements involved in the study area while **Table 7.18** lists the medical reports for surrounding populations (*See **Appendix 7-C**).*

Table 7.17 : List of Nearest Clinics Closest to Project Site

No.	Nearest Settlements	Population	Mode of transport	Distance From the Nearest Clinic (KD Bawong)	Distance From the Nearest Clinic (KK Lintang)	Distance From the Nearest Hospital (Hospital Sungai Siput)	Frequency of Visits by PBOA
1	Kg Teras	245	Walking / motorcycles / cars	70km	75km	96km	1 x month
2	Kg Kembok	195		72km	77km	98km	1 x month
3	Kg Piah	228		70km	75km	96km	1 x month
4	Kg Gentes	214		74km	79km	100km	1 x month

Source: Pejabat Kesihatan Daerah Kuala Kangsar.

Table 7.18 : Medical Report (Type of Illness) for Surrounding Populations (Jan-Jun 2018)

1	**MCH (IBU & ANAK)**
	Children Children with underweight (KZM) - 18 Receive 'food baskets' aid 17 - join community feeding program (PCF) Developmental Delay - 0 Pregnant women Anemia - 1 Diabetes (GDM) - 1
2	**OPD (Pesakit luar)**
	Cough / Flu (URTI) - 36 High cholesterol (HPL) - 11 Diarrhea (AGE) - 70 Skin infections (impetigo / scabies) - 42 Asthma - 1 Dental caries- 10 Gastritis -60 Dermatitis and eczema- 40 Dizziness and giddiness - 67 Headache - 68 Malaise and fatigue - 9
3	**CDC**
	Influenza B - 6 cases Tuberculosis (TB) – 2 cases
4	**VECTOR**
	Malaria – no cases stated for this year Leptospirosis - no cases stated for this year

Source: Pejabat Kesihatan Daerah Kuala Kangsar.

Even though there is no cases for Malaria and Leptospirosis in the area, this remote area have high risk for this kind of diseases.

An infectious disease is a clinically evident disease of humans or animals that damages or injures the host so as to impair host function, and results from the presence and activity of one or more pathogenic microbial agents, including viruses, bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions.

Transmission of an infectious disease may occur through several pathways; including through contact with infected individuals, by water, food, airborne inhalation, or through vector borne spread. An infectious disease is transmitted from some source. Defining the means of transmission plays an important part in understanding the biology of an infectious agent, and in addressing the disease, it causes. Transmission may occur through several different mechanisms.

Respiratory and meningitis are commonly acquired by contact with aerosolized droplets, spread by sneezing, coughing, talking or even singing. Gastrointestinal diseases are often acquired by ingesting contaminated food and water. Sexually transmitted diseases are acquired through contact with bodily fluids, generally as a result of sexual activity. Some infectious agents may be spread as a result of contact with a contaminated, inanimate object (known as fomite), such as a coin passed from one person to another, while other diseases penetrate the skin directly.

Transmission of infectious diseases may also involve a 'vector. Vectors may be mechanical or biological. A mechanical vector picks up an infectious agent on the outside of its body and transmits it in a passive manner. An example of a mechanical vector is a housefly, which lands on cow dung, contaminating its appendages with bacteria from the faeces, and then lands on food prior to consumption. The pathogen never enters the body of the fly.

In contrast, biological vectors harbour pathogens within their bodies and deliver pathogens to new hosts in an active manner, usually a bite. Biological vectors are often responsible for serious blood-borne diseases, such as malaria, viral encephalitis, Chagas disease and African sleeping sickness. Biological vectors are usually, though not exclusively, arthropods, such as mosquitoes, ticks, fleas and lice. Vectors are often required in the life cycle of a pathogen. A common strategy, used to control vector borne infectious diseases, is to interrupt the life cycle of a pathogen, by killing the vector.

The relationship between virulence and transmission is complex, and has important consequences for the long-term evolution of a pathogen. Since it takes time for a microbe and a new host species to co-evolve, an emerging pathogen may hit its earliest victims especially hard. It is usually in the first wave of a new disease that death rates are highest. If a disease rapidly fatal, the host may die before the microbe can be pass along to another host. However, this cost may be overwhelmed by the short-term benefit of higher infectiousness if transmission is linked to virulence, as it is for instance in the case of choléra (the explosive diarrhoea aids the bacterium in finding new hosts) or many respiratory infections (sneezing and coughing create infectious aerosols).

In most cases, microorganisms live in harmony with their hosts. Such is the case for many tropical viruses and the insects, monkeys, or other animals in which they have lived and reproduced. Because the microbes and their hosts have co-evolved, the hosts gradually become resistant to the microorganisms. When a microbe jumps from a long-time animal host to a human being. It may cease to be a harmless parasite and become pathogenic.

With most new infectious diseases, some human action is involved, changing the environment so that an existing microbe can take up residence in a new niche. When that happens, a pathogen that had been confined to a remote habitat appears in a new or wider region, or a microbe that had infected only animals suddenly begins to cause human disease.

Several human activities have led to the emergence and spread of new diseases as listed below.

- Encroachment on wildlife habitats. The construction of new villages and housing developments in rural areas brings people into contact with animals and the microbes they harbour.
- Changes in agriculture. The introduction of new crops attracts new crop pests and the microbes they carry to farming communities, exposing people to unfamiliar diseases.

- The destruction of rain forests. As countries make use of their rain forests, by building roads through forests and clearing areas for settlement or commercial ventures, people encounter insects and other animals harbouring previously unknown microorganisms.

- Uncontrolled urbanization. The rapid growth of cities in many developing countries tends to concentrate large numbers of people into crowded areas with poor sanitation. These conditions foster transmission of contagious diseases.
- Modern transport. Ships and other cargo carriers often harbour unintended "passengers' that can spread diseases to faraway destinations. While with international jet-airplane travel, people infected with a disease can carry it to distant lands, or home to their families, before their first symptoms appear.

7.12.1 Potential Impacts.

Previously there is very little discussion on the disease and health impact being focused during any development of agriculture project. The matter however become more and more important since there is a lot new development involve in conversion of natural forest area which known to be natural habitat for most of wildlife, insect, birds, reptilian, etc. Disturbance of this natural habitat area may partially create havoc and force the forest living creature to migrate to a new area either nearby undisturbed forest area or nearby community area.

This occasion indirectly may let human living nearby the proposed project site area will become the prime target for this forest living creature such elephant, tiger, mosquito, fly, insect, reptilian, etc. Impact that may produce by the wildlife has been discuss in the previous section. Other potential impact that may generate because of the conversion activity is spread out of disease that may affect the human health such as malaria, which commonly occurred. Malaria causes about 350-500 million infections in humans and approximately one to three million deaths annually and this represents at least one death every 30 seconds.

The vast majority of cases occur in children that under the age of 5 years, pregnant women are also especially vulnerable. Despite efforts to reduce transmission and increase treatment, there has been little change in which areas are at risk of this disease. Malaria is not just a disease commonly associated with poverty, but is also a cause of poverty and a major hindrance to economic development. The disease has been associated with major negative economic effects on regions where it is widespread. Symptoms of malaria include fever, shivering, arthralgia (joint pain), vomiting, anaemia caused by haemolysis, haemoglobinuria, and convulsions as well as the feeling of tingling in the skin. This disease can very fast to be spread out and become a major outbreak when it appear in certain community area.

A part of that there is also another common disease may occur in any development especially when water pollution which commonly known as cholera. In is a severe diarrhoea disease cause by the bacterium Vibrio cholera. Transmission to humans is by ingesting contaminated water or food. The major reservoir for cholera was long assumed humans but some evidence suggests that it is the aquatic environment. Vibrio cholera produces cholera toxin, an enterotoxin, whose action on the mucosal epithelium lining of the small intestine is responsible for the characteristic massive diarrhoea of the disease. In its most severe forms, cholera is one of the most rapidly fatal illnesses known.

A healthy person may become hypotensive within an hour of the onset of symptoms and may die within 2-3 hours if no treatment is provided. More commonly, the disease progresses from the first liquid stool to shock in 4-12 hours, with death following in 18 hours to several days without rehydration treatment. Symptoms include those of general GI tract (stomach) upset and massive watery diarrhoea. Symptoms may also include terrible muscle and stomach cramps, vomiting and fever in early stages. In a later stage, the diarrhoea becomes “rice water stool” (almost clear with flecks of white) and ruptured capillaries may turn the skin błack and blue with sunken eyes and cheeks with blue lips.

Symptoms are cause by massive body fluid loss induced by the enterotoxins that Vibrio cholera produces. The body is tricked into releasing massive amounts of fluid into the small intestine which shows up in up to 20 litres (or 20% of body weight) of liquid diarrhoea in an adult and massive dehydration. Radical dehydration can bring death within a day through collapse of the circulatory system. Cholera can be gruesome and quick with drastic effects on its potential victims. This disease is also can very fast to be spread out and become a major outbreak when it appears in certain community area. **Table 7.19** highlighted generally on some human disease that normally being spread out through polluted water.

Table 7.19 : Some Human Diseases Transmitted by Polluted Water

Disease	Infectious Agent	Type of Organism	Symptoms
Cholera	Vibrio	Bacterium	Severe diarrhea, vomiting, fluid loss of as much as 20 quarts per day causes cramps and collapse
Dysentery	Shigella dysenteriae	Bacterium	Infection of the colon causes painful diarrhea with mucus and blood in the stools, abdominal pain
Enteritis	Clostridium perfringens, other bacteria	Bacterium	Inflammation of the small intestine causes general discomfort, loss of appetite, abdominal cramps and diarrhea
Typhoid	Salmonella typhi	Bacterium	Early symptoms include headache, loss of energy, fever, later, a pink rash appears along with (sometimes) haemorrhaging in the intestines
Infectious hepatitis	Hipatitis virus A	Virus	Inflammation of liver causes jaundice, fever, head ache. Nausea, vomiting, severe loss of appetite; aching in the muscles occurs
Poliomyelitis	Poliovirus	Virus	Early symptoms include sore throat, fever diarrhea and aching in limbs and back; when infection

			spreads to spinal cord, paralysis and atrophy of muscles
Amoebic dysentery	Entamoeba histolytica	Amoeba	Infection of the colon causes painful diarrhea with mucus and blood in the stools, abdominal pain
Schistosomiasis	Schistosoma sp.	Fluke	Tropical disorder of the liver and bladder causes blood in urine, diarrhea, weakness, lack of energy, repeated attacks of abdominal pain.
Ancylostomiasis	Ancylostoma sp.	Hookworm	Severe anemia, sometimes symptoms of bronchitis

7.13 POTENTIAL IMPACTS FROM ABANDONMENT PHASE

The proposed project could be abandon at any time due to financial, social, political problems or the occurrence of natural disasters or wars within or outside of the country. Abandonment at these stages would be significant on the biological environment due to unnecessary loss of habitat, flora and fauna. Likewise, the project proponent would incur heavy losses, as significant investment would have already gone into the project. Impacts at these stages are the loss of topsoil, forest cover and in – situ biodiversity.

Those stages impacts include build - up of vegetative debris associated with re – logging and land cleaning, risk of wild fires and invasion of pioneer species, sedimentation and siltation as well as loss of employment and business opportunities. In addition, recently rebuilt roads could also provide access to a wave of illegal hunters and loggers into the area. If foreign workers were not repatriated properly, potential conflicts and disputes between local and foreign workers may be possible. All these would have negative impacts to the environment.

If the project were abandoned during the operation stage, the whole area would be left with monoculture species thriving in the area. The impacts would be the loss of biodiversity and genetic resources as

well as a different ecosystem without many of its former environmental functions. Cleaning and felling will only take place when an alternative development plan is identified for the site. Although the possibility of abandonment problem of the proposed project activity is very unlikely however, there has to be a contingency plan setup by the project proponent in the event of this happening in abnormal circumstances such as economic turn down, economic collapse or a poor market situation, riots or other unpredicted calamities. The abandonment situation could take place at any stage of the project. In addition, the abandonment activities may create a potential impact to several aspect of environment such as aesthetic, water quality and socio – economic.

7.13.1 Aesthetic

Abandonment of project may result in aesthetic and security problems at the proposed project area. The aesthetic of the landforms will be affected as large area of cleared but undeveloped land will be visible. Security system of the project area will also be affected. The potential adverse environmental impacts include indirect long – term impacts on aesthetic. The impact could be significant if no adequate measures being undertaken by the project proponent.

7.13.2 Water Quality

Abandonment of project site would result in increase in water turbidity and siltation. Soil erosion would be accelerated from exposed areas due to the unfinished site clearing and earthworks. The potential adverse environmental impacts include indirectly long – term impacts on water quality. The impact could be significant if no site rehabilitation measures are in places.

7.13.3 Socio – Economics

The abandonment of the project will also create socio – economic impacts to the general populace. The labour force or workers would have to be retrenched or re – deployed and this will result in an

increase in social problems associated with unemployment issue. The impact could be significant as the number of plantation workers and employee population are large and normally very difficult to be absorbed in other kind of employment.

7.14 RESIDUAL IMPACT

Residual impacts can be divided into residual adverse impacts and residual beneficial impacts. Residual adverse impacts are negative impacts, which remain even after mitigation because of circumstances beyond the control of the Proponent or the relevant authorities. Residual beneficial impacts are favourable impacts that do not warrant any mitigation because they contribute positively to enhance the environment.

7.14.1 Impact Due to Air Quality

Even high care maintenance and controlled is carried out, the results is not totally achieved due to the nature and the efficiency of the operation can be seen from the impact at the surrounding after a period of time.

Detection of residual impacts by dust can be made by comparison of the previous surrounding area before the plant is installed and the condition after a period of time when the forest plantation is fully operated. If there is high dust contaminated on the leaves or trees at the area close-by, this means that, the Project implementation fail to prepare the environment mitigation measures that should be provided. The health of the workers and the surrounding residence are other means that can determine whether dust emission or the pollutant from the forest plantation activities has become residual impacts to the environment.

7.14.2 Impact Due to Noise

Noise problem is the impact that is hard to be prevented especially regarding the vehicle movement and logging activities. Complaints from the neighbouring interest will show that it was a residual impact to them. For the workers the impact more related to their health

aspect due to their hearing problem. However, noise shall be an issue of concerned as the noise level from the forest plantation site is below the Recommended Noise Level Guideline.

Furthermore to avoid any hearing impairment and loss, if the need arise, make it compulsory for workers to wear earplugs when going for inspection around the Project site.

7.14.3 Impact Due To Water Quality

This impact is not likely to occur if silt traps and drains constructed within the Project area are functioning as expected. It is also possible to occur if there is unreasonable attitude such as illegally release of wastewater or solid waste to the drainage and leakage/spillage of fuel or other hazardous material. If occurred, the impact will be tremendous because it is not only affected the water bodies nearby but also the downstream activities where the water flows. If dust emission problem occur, it will affect the water quality by the sedimentation of dust in the water, thus it may change the water characteristic.

7.14.4 Occupational Safety and Health Impacts

The impacts shall be controlled from time to time with control measures such as supplying all the workers adequate safety gears (earplugs, safety shoes, respiratory masks, etc.) and its usage made mandatory. Workers exposed for long periods shall be sent for periodic medical check-up. Wastes generated at the Project site shall be stored, treated or disposed at approved dumpsite or within the forest plantation area. Good and safe working procedures shall also be implemented and maintained throughout the forest plantation operation.

7.14.5 Socio-Economic Impacts

In long-term aspect socio-economic is the most beneficial impact in residual impact. The employment provided by the Proponent may

increase the life standard of poor residents around that area. This employment opportunities also a contributor to the expected future employment from the structure plan of the area.

7.15 PROJECT EVALUATION

Based on impacts that have been discussed in this Chapter, most of the impacts occur during the site preparation and planting activity (development phase). Soil erosion and hydrology are the critical issues of the project development. However, with proper mitigation measure it will be able to control and minimise these impacts effectively.

The matrix used to identify potential environmental impacts that may occur during various stages of development. In this EIA study, the nature of environmental impacts is categorised into six classes according to level of significance and whether they are negative, positive or residual in nature. The completed matrix for the present DEIA study is shown in **Table 7.20**.

Table 7.20 : Impact Assessment Matrix

KEY

1. Potential significant impact, design solution identified.
2. Adverse impact, but insufficient information
3. Residual & significant adverse impact.
4. Significant environmental enhancement.
5. Potentially significant cumulative impact.

				Project Activities												
				Land clearing			Land preparation			Crop establishment				Crop management		
				Timber extraction	Clearing of vegetation	Disposal of debris	Construction of roads and bridges	Installation of drainage and culverts	Terracing	Nursery establishment	Preparation of planting holes	Planting of crops	Planting of cover crops, eg legume	Manuring/fertilizing	Weed control	Pest control
ENVIRONMENTAL COMPONENTS	PHYSIO-CHEMCICAL	Soil	Surface Erosion	1	1	1	1	1	1	1	1		4	1		
			Landslip	1	1	1	1	1	1	1	1	1	4			
			Slope Stability	1	1	1	1	1	1	2	1	1	4	2		
			Soil compaction	1	1	3	1	1	1	2	1	1	4			
			Soil fertility	2	3	3	1	1	1	4			4	4	5	5
		Hydrology	Water yield	4	4											
			Dry season flow	1	1	1				1	1	1				
			Storm flood /flood response	1	1	1	1	1	1	1	1					
		Water Quality	Sediment load	1	3	3	1	1	1	1	1		4	1		
			Turbidity	1	3	3	1	1	1	1	1		4	1	1	1
			Physical quality	1	3	3	1	1	1	1	1		4	1	1	1
			Chemical quality	1	1	1	1	1	1	1	1			5	5	5
			Biological quality	1	1	1	1	1	1	1	1			5	5	5
		Drainage	Channel morphology		1	1		1	1	1	1		4			
			Sedimentation	1	1	1	1	1	1	1	1		4	1		1
			Drainage pattern		1	1	1	1	1	1	1		4			
		Groundwater	Water Table recharge	2	2	2	1			1						
			Groundwater quality									4		5		2
			Aquifer characteristics													
			Existing uses		1	1			1	1		1	1			
		Atmosphere	Local climate	1	1	1	1					4	4	1		1
			Regional climate		1	1						1		1		1
			Air pollution (dust, smoke etc)	1	1	1	1					4	4	1		1
		Landuse	Adjacent land uses		1	1	1	1	1	1	1					
			Downstream land uses				1									
	BIOLOGICAL	Species & Population	Vegetation	1	1	1	1			1		1	4	1	1	
			Birds	1	1	1				1		4	4	1	1	
			Mammals	1	1	1	1			1		1	4	1	1	
			Reptiles/ amphibians	1	1	1	1			1		4	4	1	1	
			Invertebrates	1	1	1				1				1	1	
			Fish		1	1								1	1	
			Other aquatic life		1	1								1	1	
	HUMAN	Health & Safety	Domestic water supply	1	1	1		1	1		1	1		1	1	1
			Physical safety	1	1	1	1	1	1	1	1	1	1	1	1	1
		Social & Economic	Human settlement		1	1	4	4				4				
			Cultivation areas									4	4			
			Employment	4	4	4	4	4	4	4	4	4	4	4	4	4
		Aesthetic & Cultural	Wilderness	1	1	1	1									
			Visual quality	1	1	1	4	1	1	1	1	1	4			
			Cultural, historic. Burial site	2												