CHAPTER 8 : MITIGATION MEASURES

8.1 INTRODUCTION

This chapter shall examine the mitigation measures to counter the impacts proposed in previous chapter. These mitigation measures can be carried out either through practical innovation or management practices. As for the Project under study, there are a few areas where engineering innovations are of relevance. However, cost benefits analysis need to be taken into consideration in evaluation of alternatives.

This chapter also shall discuss proposed mitigating measures to be adopted where practicable by the Project Proponent in order to minimise or eliminate potential significant impacts identified. All potential impacts of concern for every activity were identified and predicted in previous chapter. If the impacts are potentially significant, detailed discussion and formulation of mitigation measures are presented in this section.

8.2 ADHERENCE TO DOE GUIDELINES

8.2.1 Relevant Guidelines

The requirements and specifications stipulated in the following documents shall be adhered to:

i. Guidance Document for addressing soil erosion and sediment control aspect in EIA Report.
ii. Guidance Document for the preparation of Land Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2).
iii. Urban Stormwater Management Manual (MASMA) published by Department of Irrigation and Drainage Malaysia in 2000 (Revised version 2012).
iv. Other relevant guidelines and guidance documents issued by the DOE pertaining to environmental-related system and management as per **Appendix 1-G**.

8.3 MITIGATION MEASURES FOR SITE PREPARATION

8.3.1 Pre-Planning Stage

The main activities during this phase would include project planning, surveying, ESCP, soil investigation studies and sampling of rivers water, air, noise and vibration with very minimal impact on the site. No mitigation measures are required.

8.3.2 Mitigation Measure during Pre-Logging Planning

i. Planning and alignment of skid trails should be directed away from streams and located on ridges. Uphill skidding disperses skid trail run-off and should be encouraged, whilst downhill skidding if necessary must minimize earth works and facilitate drainage.

ii. Skid trails design should minimise skidding distance to only 50 m, avoiding steep slopes and stream crossing.

iii. Apart from the delineation of sensitive areas, the logging contract may also need to include the prohibition of log extraction during very wet periods to minimise the risk of soil rutting and compaction.

iv. There is a need to combine the information on the positions of the trees to be harvested with the characteristics of the terrain to derive the most economical, yet least damaging extraction technique. This process may be facilitated by integrating remotely sensed data and the use of a Geographical Information System.

v. The various conditions specified in the agreement should be monitored and supervised by the state Forestry Department. Provision for penalties must be implemented where conditions are not met.

vi. Log landing should be located in such a way as to minimise contribution of runoff and sediment to streams. They may need to be 'ripped' after completion of the operation to promote their recolonisation.

8.3.3 Mitigation Measure During Logging Planning

Inventory and Tree Marking

Pre-Felling inventory is to be carried out according to the procedures laid done by the Forestry Department (Fieldwork Inventory Before Felling, 1986). Inventory should be at 10% intensity using systematic line plots. Inventory should proceed at least 6-12 months before logging. All trees of 15 cm DBH and greater only within the inventory plots need to be measured. Tree marking operations must be done systematically and direction recorded. Trees to be felled must be tagged and carry the Forest Department marking numbers, and seed trees marked for retention should all be shown in the stock map. Trees can be marked for felling on slopes > 35° if the extraction method does not involve skidders and felling is done across the slope.

Road Construction and Skidding

All road should be carefully designed according to the proposals of The Forestry Department (Forest Road Specification 1988) with cross drains at intervals. The roads should not have long unbroken stretches running downslope. Cross drains should be constructed on roads and skid trails at a spacing of 30m or less with a minimum slope angle of 30°. It should be designed to disperse, rather than concentrate, runoff. Any culverts must be carefully designed to avoid scour on their down-slope sides. Where road cut are made, they should be at an angle of less than 20° which will give a stable slope and not lead to further sliding or slipping.

Where possible, roads should be constructed against the sunlight in order to speed up the drying process of road surface after a heavy downpour. Any haulage tracks made to remove the trees should be blocked off by bulldozing simple earth barriers across the roads at intervals. On slopes up to 30° one barrier every 20 m should be sufficient. One steeper slopes barriers should be at every 15 m. The

earth barriers should be covered with loose plant debris, such as bark on branches with foliage to protect then against raindrop splash erosion.

Road gradient should be less than 10° and the road density (including skid roads) should be minimised to not more than 6% of working area. The gradient of skid trails should not exceed 20° except for short skidding. Blading is not permitted for skid trail construction on < 15° slope. Skidding should not occur on slopes > 35°. Tractors should be used on a reverse down trail operation to avoid soil disturbance and trees damage. Landings (matau) are to be located on ridge or widened road areas, with slope of 2°-3°, size < 0.2 ha and minimum in number. The appropriate areal extent of landing should not be more than 4% of working areas. The compacted surface of any haulage tracks and abandoned roads should be broken up to encourage any runoff to infiltrate rather than run over the ground surface.

Logging Machines

It is unrealistic to expect logging companies to revert to the original damage-limiting methods of manual or animal-based timber extraction, but it is certainly possible to demand the minimum use of heavy equipment. Where soils are clayey or wet, smaller machines should be used to reduce damage caused through destruction of vegetation and compaction of surfaces. Machinery should be limited at any one time and the areas worked. The ratio is 1:1:2 chainsaw, crawler tractors and skidders for a minimum working area. If alternatives like skyline technique are considered uneconomical and the use of wheeled or tracked vehicle unavoidable, then at least overall machine size should be restricted where possible. In addition, the use of winch rope system should be encouraged to avoid heavy machine having to gain access to every individual log. Logs may then be winched uphill (preferably with the leading end lifted off the ground to prevent it from ploughing into the soil) by the machine on the ridge.

Combined haulage of several logs at the same time is encourage to reduce the number of vehicle passes in moderately flat terrain. In steeper terrain, use of tracked rather than rubber-tyre vehicle is preferred. The benefit of reduced type pressure should be considered to reduce 'rutting' and compaction of road surface.

Felling

Wherever possible, felling should be in the direction of the nearest skid track, which reduce the short distance transportation. All marked trees to be felled within 10° of felling direction. Damage trees >20 cm DBH should be cross-cut and the pieces removed. Smaller trees should be felled first to avoid damage from big trees. Felling cut to be as close as possible to the ground to avoid timber wastage. Felled timber should be transported as soon as possible to avoid damage and obstruction to skidding operations. No felling should be permitted during rainy season. There should be no logging on forested area above 1000 m elevation unless approved by the EIA committee.

8.3.4 Post-Logging Assessment

A post-felling inventory, as outlined by the Forestry Department (Field Work Inventory Guidelines After Felling, 1986) should be done within 6 months after the logging operation ceases to assess the residual stocking and regeneration status. Erosion should be controlled at the source where areas are disturbed, by early re-vegetation. Terracing, composting, mulching and fertilizing should be used where appropriate, to initiate growth on rehabilitated or reforested sites.

8.3.4.1Progress in Implementation of Reduced Impact Logging

The progress in implementation of Reduced Impact Logging can be categorise below:

i. Relevant Forest Policy and Legislation

- Among the earliest efforts taken by the Forestry Department, Penisular Malaysia to address this commitment has been the enforcement of the various forestry enactments and ordinances by the State since the early 1990s and the formulation of an interim national forestry policy in 1952.

ii. Availability Environmental Management Prescriptions and Assessment

- The forest management and harvesting plans, various regulations and guidelines with special emphasis on environmental conservation measures for forest harvesting had also been adopted. They include the ‘Forest Harvesting Guidelines’, ‘Forest Engineering Plan’ and the ‘Forest Road Specifications’.

iii. Strengthening Procedures in Forest Harvesting Operation

- In terms of forest harvesting, Peninsular Malaysia has pioneered a number of practices aiming at reducing logging damage on the forest stand. They including tree marking for felling, timber tagging for identification and log directional felling to reduce the negative impact of logging on the residual stand. Currently, for Peninsular Malaysia, the guidelines to carry out the activities of reduced impact logging can be found in various documents of the Department, as well as directives given by the Director of the State Forest Department and District Forest Officer on actions to be taken in the field with regards to reduced impact logging. These guidelines are as follows:
  a. Field Guide for Pre-Felling Forest Inventory;
  b. Guidelines for the Implementation of Tree Marking using Timber Tagging;
  c. Guidelines for the preparation of a Forest Harvesting Plan as elaborated in the Code of Practice for Harvesting of Natural Inland Forest, 1997;
  d. Forest Roads Specification (Feeder Road and Skid Trail) for Peninsular Malaysia, 1999; and

e. Field Guide for Post-Felling Forest Inventory.

iv. Intensified Research on Reduced Impact Logging

- It is increasingly being realised that environmentally, socially and economically sound timber harvesting is one fundamental aspect of wise forest use. Hence, in recent years, research into reduced impact logging and low impact logging harvesting technologies as a systematic approach to planning, implementing, monitoring and evaluating forest harvesting had been intensified.

v. Enhancement on Capacity Building

- Training of field operator and supervisors has been identified as the key to achieving sustainable forest management practices.

vi. Active Involvement of Private Sector

- Besides the government's efforts, the private sector has also contributed to the improvement of forest harvesting technologies.

8.4 MITIGATION MEASURE PLANTING ACTIVITIES

8.4.1 Mitigation Measure during Planting Stage

From the identification and study of impacts in previous chapter, the potentially significant environmental issues are found related to:

- Forest Road Engineering
- Road Monitoring & Maintenance During and After Completion of Planting Operation
- Waterway Crossing.
- Soil erosion, sedimentation and loss of topsoil.
- Water pollution (agriculture fertilizer) and degradation of water quality.
- Air Pollution from spraying of agrochemicals.
- Vibration from machinery.

- Wastes disposal.
- Loss of flora, fauna and habitats.
- Traffic and transportation.
- Employment or business opportunities.
- Socio economic development.
- Rehabilitation and abandonment.

8.4.1.1Forest Road Engineering

Building forest roads involves clearing vegetation and cutting and moving of soil in order to develop structures that are capable of supporting heavy vehicles transporting materials and supplies and other machineries during weather conditions as:

- Minimise soil erosion associated with roads and thereby reduce sedimentation in streams;
- Utilize natural drainage system; and
- Avoid passing through areas of cultural, religious, any landscape significance.

8.4.1.2Road Monitoring and Maintenance During and After Completion of Planting Operation

- Road surface, roadside ditches, cross drains and stream crossings will be properly maintained;
- All roads considered essential for management or protection of the forests will continue to be maintained (see **Figure 8.1**, example of poorly constructed road and well drained and maintained road);
- Road surface will be made free of stagnant water, non-holes and other damages at all times;
- The contactors will ensure that all side ditches and water exit points function at all times;

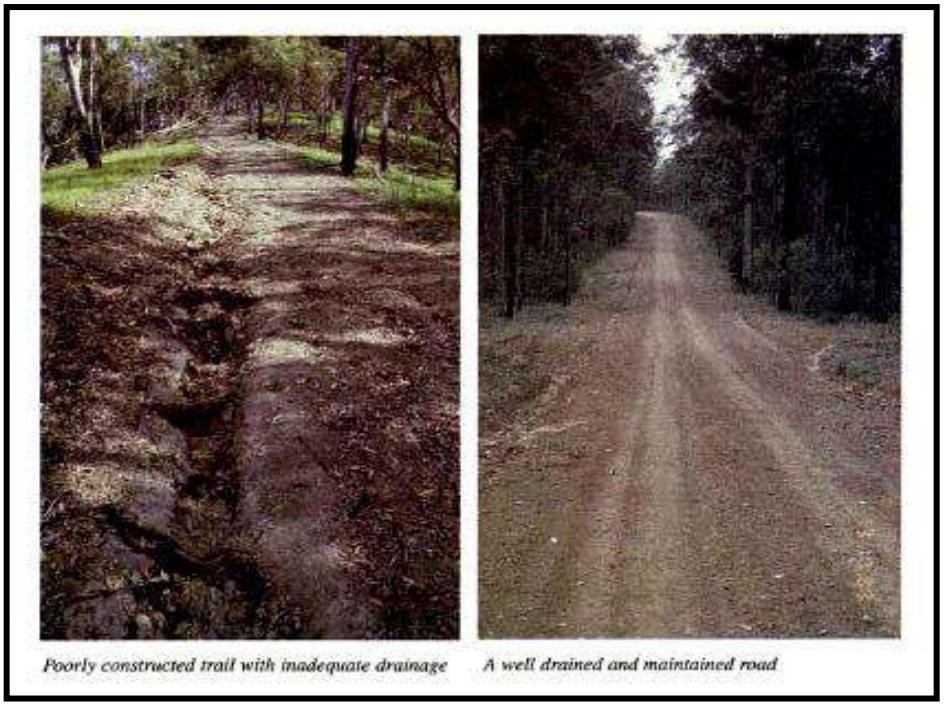

Figure 8.1 : Example of Poorly Constructed Road and Well Drained and Maintained Road

8.4.1.3Soil Erosion and Siltation Mitigation Measures

The estimated soil losses for the worst-case scenario were based on the assumptions that the vegetation was cleared and the soil left exposed for an extended period. However, it must be recognised that the worst-case scenario is only hypothetical, and the situation is most unlikely to happen.

Firstly, the clearing and earthworks are minimal with the only concern is during the construction of haulage road to the hilltop and preparation of forest plantation site. Then forest plantation activities shall be carried out within the working area. Even if the site were abandoned halfway through the site preparation stage, the cleared area would soon be colonized and covered by the pioneer vegetation.

If the project is progressing as planned, there will be no soil or loose materials to erode along the hill slope as the area shall be retained as green-belting. The preparation of forest plantation benches could trap any run-off from the upper riser slope by the next lower bench.

Nevertheless, potential soil erosion is a concern and can be damaging to the environment if it is not handled properly. However, for the relatively flat land shall only impose impact of siltation rather than erosion. The following mitigation measures of development concept should adopted to minimize the environmental disturbance and hence soil erosion.

They include the staging of the project development, particularly for activity such as land clearing and earthworks will preserve the existing vegetation on the areas, which are not immediately affected by land development. This reduced the size of the area;

- Exposed to the elements of water erosion at any one time, and because development of the smaller area can be completed more quickly, the actual exposure time of any particular area is also minimized. As compared to a cleared area, keeping the area vegetated would reduce the potential soil loss.

- Once an area has been cleared of its natural vegetation, every attempt should be made to revegetate the area as soon as possible. The development should establish cover crop as soon as possible. The development should establish cover crop as soon as possible at any exposed areas, which need not be further, worked or used for day-to-day operation of the project. Once a cover of leguminous creepers or grasses is well established.

- A combination of cover crop and terracing/platforming would reduce the potential erosion hazard even further. Where an exposed slope with soil materials is more than 10 m long, the development should terrace the slope at 3-5 m interval. In comparison to a bare 30° slope with a length of 50 m platforming at 10 m interval and the establishment of cover crop in the Project Area, for example, would reduce the estimated soil loss by a factor of approximately 300.

- In order to reduce the potential for surface water runoff and sediment delivery into streams, all compacted and bare soil areas on locations along roads and skid trails, logs landing, cut and fill

banks, within the ditch line area will be re-vegetated with indigenous plant species.

- To reduce the potential for sediment delivery into streams and blockages of waterway crossing and bridges, the running surface of permanent roads and drainage facilities will be continuously re-contoured and re-surfaced.

- The benches or platform should be constructed with a very slight reverse gradient sloping towards the hillside. By doing so, any run-off with or without eroded soil particles from the upper riser slope would be trapped by the next lower bench. This would further reduce the net soil loss from a slope and hence the actual sediment delivery to the valley floor and/ or waterway.

- More erosion prone development activities like site clearing and removal of overburden should be scheduled for the drier period of the year when the rainfall erosive would be lower. If this activity could be completed and any exposed sited properly prepared and stabilize before the wetter season return, the potential soil loss would be substantially reduced.

- All filled areas must be firmly consolidated and compacted to reduce the presence of loose soil materials, which are more erodible.

- Larger and/ or stepper cut or fill batters may be terraced and provided with appropriate drainage installation to discharge the runoff.

- The control of surface runoff is an important element in reducing the erosion hazard. Water should be directed down cut batters over solid rock, through U-shaped culvert pipes or over riprap installation.

- Suitable silt traps/sedimentation ponds are proposed to filter the runoff before it is discharged into the stream downstream of the

site. The runoff from the project site, particularly from the hill top should be directed to this trap/pond before it is discharged into the nearest stream.

Sediment retention pond to trap sediment, which is likely to be issued for the development, should be used preferably during the initial preparation phase of the Project. Controls may then be required progressively as the Project develops. However sufficient measures should be in place at all times to ensure that the sediment or other water-borne pollutants do not escape from the site.

Generally, silt trap should have an energy dissipater at its entry so that the energy of inflowing water is reduced before it enters the body of the basin. It may otherwise flow directly across the basin and discharge from the outlet with little sediment settlement occurring. At the exit side, the discharge should be designed to similarly ensure that the energy of overflows is dissipated so that they do not scour. The silt trap should have adequate depth (minimum one meter) to ensure that there is capacity on the floor for sediment to collect without risk of that sediment being remobilised during high flows. It is recommended that the sump volume should be more than the estimated peak discharge from the contributing catchment for one in 10 years storm.

If a silt trap is to work effectively, the accumulated sediment shall be removed when it occupies a certain percentage of the basin volume. Upon removal, this sediment should be transported to a suitable disposal site where it cannot be remobilized to pollute rivers. The level of soil erosion risk can be further reduced if the following practices are adopted:

Sensible scheduling of activities

More critical development activities such as site clearing and earthworks should be undertaken during a dry spell, or as much as possible, are scheduled for the drier period of the year.

Minimise soil disturbance

Wherever possible, soil disturbance should be minimised. Particularly in the case of haulage road construction, disturbance could be reduced by minimizing cut and fill operations. Where cut and fill operation are unavoidable, the cut slopes should have a safe angle of repose, be approximately benched if it is a long slope, and be cover cropped immediately after the earthworks. The filled area should be properly compact and cover cropped as soon as possible

Control of surface runoff

The control of surface runoff is an important element in reducing the soil erosion hazard. The appropriate drainage system should be installed to lead the runoff from upper slopes without causing too much soil erosion, especially scouring and mass movement due to slope failure. Water should be directed down batters over solid rock, through U-shaped culvert pipes or riprap installation.

Retention of hill vegetation

This does not reduce soil erosion but the vegetation buffer would act as a filter and decrease the net delivery of silt during runoff flow from the upper hill area to the lower areas and finally into the earth drains and silt traps before being discharged into natural watercourses.

(Source: savebukitgasing.wordpress.com, April 2008)

Figure 8.2 : Slope Failure at Hutan Pendidikan Bukit Gasing

8.4.1.4Sedimentation Mitigation Measure

The problem to be deal here is the potential sediment pollution. To ensure that the water discharged from the Project area is in an acceptable standard, the following steps should be taken;

Stormwater management system

In order to have a sustainable operation, the forest plantation is planned to have a well- designed network of drainage, which is designed in such a way to minimize soil erosion from the run-off on the forest plantation area. The permanent stormwater management system shall consist of silt trap and interceptor/earth drains within the project site.

Effort is made to ensure that all drain gradient is on a minimum slope elevation to prevent water rush. All drains are designed to take all maximum water run-off and at the same time control the water flow speed. The drains are discharged into the dedicated areas, which will flow into the stream within the project area and eventually end up in the river.

Roads are constructed with a curve profile and side drains. The service/haul road to the top is designed to have a berm on the open side with a drain on the cliff side directing the water to the bottom. In this arrangement, the discharged water is directed into a retention pond to stabilize the water speed before it will be discharged.

Erosion and sediment control plan

The design of erosion and sediment control for the proposed of forest plantation area is based on the following consideration;

- The critical areas within the project site that may have potential soil erosion and sedimentation process during pre-bulk grading (development) stage such as the temporary source of erosion caused by the initial site clearing and earthwork activities and areas that involve with the logging activities;

- Critical areas within the project site that may have potential soil erosion and sedimentation during post-bulk grading (operational) stage;

- The exposed overburden materials that temporarily at the overburden dumping area for future rehabilitation work;

- The proposed mitigation measures taken from the soil erosion in **Item 8.2.3** shall be implemented to ensure source for the siltation is controlled. Proper implementation of the mitigation will greatly reduce the impact of siltation from the Project area. The details conceptual ESCP for the proposed project is presented in **Appendix 8-A**.

- Installation and maintenance of silt traps and sediment basins – Through proper design of the internal drainage system and the water features, the water from the area can be ‘treated’ first before it is discharged. The sedimentation ponds shall treat silt and suspended solid, can also help to aerate the water thereby increasing the content of dissolved oxygen to a level that will

satisfy the BOD requirement. Vegetation planted in and around the ponds and on waterways will also have beneficial effects. Plants around the ponds and on the slopes will act as a buffer and help to trap or filter out some of the suspended sediment load from the runoff.

- Maintenance of drainage system shall be regularly carried out. Re-design or add on number of drainages shall be considered from time to time viewing to the current situation;

- The staging of the Project will help to reduce potential soil erosion and the resultant sediment pollution;

- Monitoring of water quality – The project Proponent must also monitor the water quality at the point of discharge from the Project site to ensure that the water is of an acceptable quality.

8.4.1.5Mitigation Measure Relating to Hydrological Regime

A number of measures have been devised to reduce and to mitigate impact of Project activities on surface water and groundwater. Riparian reserves/ buffer strips will be designated around perennial and intermittent streams and wet areas. These reserves will be laid along all streams in the Project site. The main purpose of the reserves is to protect the quality and health of the aquatic ecosystem and its dependent community and species.

Forest contractors and their workers will not be allowed to leave unwanted logs in stream channels where they will interfere with the hydrological cycle by obstructing and regulating flow and lead to the formation of debris dams, so further destabilizing the stream channel and causing diversion in water flows.

Some of the measures are as follows:

- Redirect storm water around working area using drains, collection and diversion ditches.
- Provide wastewater treatment system such as sedimentation pond for collection and treatment of site runoff.

- Cease operation during period of high rainfall.
- Reduce site runoff by grassing soil and overburden mound through progressive restoration.
- Minimise exposed area at any one time to prevent immediate increase peak discharge rate and storm-flow by accumulating water in sedimentation pond and gradually discharged it.
- Buffer zone around the boundary with natural vegetation to be retained will act as riparian buffer to surrounding.
- Final plantation floor shall have level temporary accumulate water during heavy rainfall.
- Wastes and scheduled wastes shall be collected and treated in proper manner to prevent water clogging and impact on quality of water.
- Monitoring of water quality at point of discharges from the Project site to ensure an acceptable quality.

Most potential problems can be deal by good design of water control system. This shall integrate various requirements and optimize cost-effectiveness of the system. Control of erosion and runoff can be achieved by vegetating surfaces and terracing.

Furthermore, drainage also forms important part of successful forest plantation operation. Development of site drainage plan is an essential step that shall focus on restricting amount of extraneous water entering working area, limiting area exposed to erosion and also managing runoff leaving the site. However, even if all available mitigation measures were employed, some degree of sedimentation of watercourses may still occur. This issue can be considered as potential residual impacts where require monitoring works.

Agriculture Fertilizers and Chemicals

- Crops need fertilizers and chemicals to grow better. However, it should be strictly prohibited not to apply the fertilizers and chemicals during the local wet season. It is because they can be washed through the soil by rain, to end up in the water body especially the nearest river. Hence, this bad practice will pollute

the environment, especially the river/stream water and reduce the quality of water.

- It also recommended that the fertilizers and chemicals should not be applied on rainy days, particularly in fields that are close to natural streams. The Plantation Management should closely supervise and regulate the method, dosage and frequency of application of fertilizers and chemicals, to maintain cost effectiveness and minimize wastage and environmental pollution.

- For fertilizers, the dosage should be split to minimize losses for example split the annual dosage into 3-4 applications.

- Ring weeding is recommended in order to keep the basin area free from the weed growth. This practice is important for the young trees, the roots of which are to be kept from competition from weed.

- Chemicals for pest and disease control should only be applied when the outbreak is the application would be necessary, judicial usage of the right chemicals at the correct concentration should be practiced.

- Fertilizers should be stored in a proper place, closed and secure storage place in order to protect the products from the weather such as sun, rain, etc. and to reduce the risk of theft. A good storage facility and house-keeping practices are always important ensure a safe workplace.

Runoff Surface Water and Drainage

As discussed earlier, runoff surface water as a result of rain demands much attention when designing forest plantation operations. Most potential problems can be dealt with by good design of the water system. This should integrate the various requirements and optimize the cost- effectiveness of the system. Control of erosion and run-off could be achieved by a number of elements and uses a number of tools. These include:

- Vegetating surfaces
- Mulching
- Roughening/ridging of surfaces
- Terracing and low gradient

Drainage forms an important part of successful forest plantation operation. Too much will make the haul road slippery thus making it dangerous for the lorry to pass. All drainage runs must be designed for anticipated flows and be in such a position and depth that they are capable of receiving outfalls from under drainage, which may be installed.

Drainage measures to protect the working area or associated disturbed areas and sediment retention measures to trap sediment, which is likely to issue from these areas, should be installed preferably during the development phase before planting of tree commences. However, sufficient measures are in place at all times to ensure sediments or other water –borne pollutant does not escape from the site.

The working area and the haulage road should be adequately drained with intermittent channels so that operational and storage areas are maintained as dry practical and more erosion which may disrupt access or generate unmanageable quantities of sediment is controlled. The collected run-off together with any other excess water from disturbed areas of the site should be directed into a sediment sump or pond prior to discharge away from the site or the pond.

If the discharge of runoff from the above sources increases flows in receiving drainage line down the slope, erosion control may be required within that drainage line to mitigate the damage, which the increased flows can otherwise cause. Generally, however, it will be sufficient to dissipate the energy of flows where they enter receiving drainage line so they do not cause localized erosion at that point.

Water Quality Standard

The pertinent regulations, which have a direct bearing on discharges from the Project, are the Environmental Quality (Sewage) Regulation,

2009. It controls the discharge of domestic effluent into the inland water and onto land' including those from the Project. This regulation defines parameter limits for two standard controlling discharge of effluent to inland water; i.e. Standard A for discharge to water supply catchment areas and standard B for discharge to other inland waters.

Guidelines for acceptable effluent discharge into a municipal sewage system are included for consideration by Sewage authorities in regulating wastewater discharges from pants. Pollutant parameters and their respective values included Standard A and B of the Regulations is presented in **Table 8.1**.

In addition, the DOE's Guidelines on Prevention and Control of Soil Erosion and Siltation explicitly states that "No person shall permit effluent water to pass beyond his control containing Suspended Solid (SS) matter in excess of 50 mg/l to inland waters within catchment areas and 100 mg/l for discharge to any other inland waters". However other standards may be allowed under certain circumstances.

Table 8.1 : Acceptable Conditions of Sewage Discharge (Standards A and B)

Parameter	Unit	Standards	
		A	B
Temperature	°C	40	40
pH Value	-	6.0 – 9.0	5.5 – 9.0
BOD5 at 20C	mg/l	20	50
COD	mg/l	120	200
Suspended Solids	mg/l	50	100
Oil and Grease	mg/l	5.0	10.0
Ammonical Nitrogen (enclosed water body)	mg/l	5.0	5.0
Ammonical Nitrogen (river)	mg/l	10.0	20.0
Nitrate – Nitrogen (river)	mg/l	20.0	50.0
Nitrate – Nitrogen (enclosed water body)	mg/l	10.0	10.0
Phosphorus (enclosed water body)	mg/l	5.0	10.0

8.4.1.6Slope Stability Mitigation Measure

Stabilisation of slopes is one aspect which needs to be taken into consideration in the Project for safety reason and also for post land use. In order to do that, the following mitigation measures shall be incorporated in the operation to enhance slope stability of the area.

- Develop refine modelling studies (geological terrain mapping) to predict the suitability of the proposed project in the affected area, geo-hazard and conducting field monitoring methods.

- Erosion and siltation control devices to be implemented besides streams before site clearing activity.

- Planting vegetation to control surface water infiltration to reduce seepage forces.

- Changing the slope geometry to decrease the driving forces or increase the resisting force by reducing inclination, height and adding weight to the toe.

- Providing detention for increasing the resisting forces by implementing concrete pedestals, ground anchors, soils nails and retaining walls.

- Installing interceptor trench drain, blanket drains and sub-horizontal drains to control internal seepage by reducing the driving forces and increase material strength.

8.4.1.7Mitigation Measure Related to Air Pollution

One method of suppressing the dust emissions is to keep the soil moist at all stages of the logging and planting stages (if any). Furthermore, dust emission can be controlled based on the following techniques:

- Exposed soil areas, holing materials, terracing and haul roads shall be dampened with water during dry ambient conditions. The

minimum number of wet suppression units to be provided must be specified in operation contract clauses;

- Before work commences, the contractor will prepare a dust control strategy in agreement with regulatory requirement;

- Vehicle speed restrictions shall be imposed to reduce dust generation and dispersion;

- During the transport of potentially dusty materials to/from the site shall be of an appropriate design to ensure load containment, transport vehicles shall not be overloaded;

- All lorry utilized to transport potentially dusty materials to/from the site shall be of an appropriate design to ensure load containment; transport vehicles shall not be overloaded;

- Provide mechanisms to slow down the speed of running vehicles going downhill by building bunds and other mechanisms;

- Improve surface grade of main roads. Stop all engines from running when not in use, as they will emit noise and air pollution.

Spraying of Agrochemicals

- Agrochemicals should only be used when absolutely necessary.

- Workers involved in spraying activities must be equipped with appropriate protective gears such as mask, gloves, long sleeve clothes and long pants by the contractors concerned, to minimize the direct contact.

- Proper safety and operational spraying procedure must be instructed to the workers.

- Spraying is forbidden on rainy and windy days. Frequency, dosage and timing of chemical application must be closely monitored.

- Only approved chemicals registered under the Pesticides Act 1974 with the Pesticide Board of Malaysia should be used.

- Use of sensible biological control with no known side-effect wherever and whenever possible to reduce use of pesticides and other poisons,

8.4.1.8Mitigation Measure Related to Noise

Implementation of quieter machinery and working method shall be the main thrust of mitigation measures to be implemented to abate relevant noise issue pertaining to the Project operation.

i. Low noise equipment shall be used in the operation.

ii. Transportation and machinery that may be intermittent shall be throttled to minimum.

iii. Silencers or mufflers on equipment shall be utilized and properly maintained during the operation.

iv. If operation noise does become an issue, additional measures such as avoiding simultaneous noisy activities shall be done.

v. Workers shall be provided with suitable safety apparels such as ear plugs to prevent the impact on their ears. The wearing shall be made mandatory.

vi. If any complaints are received, it shall be investigated promptly with remedial measures implemented as appropriate. Complaints, investigations and corrective actions shall be documented.

vii. Monitoring of ambient noise quality shall be regularly done at Project site and nearby adjacent interests.

viii. Other measures for the equipment which may be given consideration during the Project operation shall include the followings:

- Air compressors - Low-noise compressor shall be used and/or it shall be housed within appropriate enclosure.
- Pumps - Pump or gearbox noise levels shall be reduced using insulation or enclosure.
- Diesel engines - Noise level can be reduced by enclosure of unit.
- Electric motors - Low noise or silenced designs of motors shall be specified.

8.4.1.9Mitigation Measure Related to Solid and Hazardous Wastes

Even the project site shall not have problem in discharging the wastes, as precaution, the following mitigation measures are proposed and shall be implemented wherever practicable:

Cut Vegetation

- Large stumps, small branches and other organic materials shall be disposed of via mulching/composting in a suitable area within the Project site.
- Open burning shall be prohibited.

Excavated Materials

- Surplus excavated materials and inert wastes shall be reused on site as structural fill, landscaping, erosion control and restoration features wherever applicable.

General Refuse

- General refuse generated on-site shall be stored in enclosed bins separate from hazardous wastes.
- General wastes shall be kept segregated and reused or recycled wherever possible. Appropriate areas for wastes shall be

designed. Waste should be collected on a daily basis by reputable contractors for disposal by appropriates methods at appropriate sites.

- Solid wastes generated from the Project site is expected to be minimal. Thus, the disposal of solid waste from the Project is not expected to be problem.

- Any extra dumping will utilise local dump site at local council dump site.

Waste management

- A comprehensive waste management plan must be prepared by the contractor before starting the work, detailing all waste tires and quantities which are expected to be generated and detailing means of minimizing, storing, transporting and disposing of wastes. The plan must be approved before the work commences.

- Waste is to be stored in appropriate design and marked areas.

- Reuse of waste materials shall be taken place wherever possible (e.g. drums and containers shall be returned to the supplier for reuse), thus avoiding disposal (generally only with limited reprocessing).

- Recovery and recycling shall take place wherever possible, thus avoiding disposal.

- Schedules waste must be treated and disposed of according to relevant laws, guidelines and best practice.

- In the event of inappropriate or inadequate disposal of waste generated as a result of the construction activities, the contractor shall bear the full liability for any further clean-up costs.

Hazardous wastes

All hazardous wastes must be managed in accordance to the Environmental Quality (Scheduled Wastes) Regulations, 2005. Wherever possible, these wastes shall be recycled. Any wastes generated shall be stored, transported, treated and disposed at prescribed premises by contractor registered under DOE. Appropriate manner of handling the said wastes will reduce the associated impacts.

The potential for environmental damage from improper use of these materials shall be very clearly understood and the following guidelines shall be implemented:

- Proponent must aware that oily residues such as spent lubricating oil (SW305) and spent hydraulic oil (SW306) are classified as scheduled wastes under the Environmental Quality (Scheduled Waste) Regulations 2005.

- Hazardous waste materials shall be stored in a secure area located at least 100 meter from watercourses and on-site drainage channels.

- Provision of a weather shelter over the storage area is an appropriate measure to prevent accumulation of rainwater within the bund.

- All hazardous wastes must be kept in proper containers, labelled appropriately and stored properly.

- The storage area shall be elevated at least 6 inches from ground level and shall not be subject to flooding. The floor of storage area must be covered with concrete or any suitable lining material. A concrete dyke or other equivalent structure shall surround the entire storage site and the dyke shall be designed to contain the wastes under worst spillage condition (110% of capacity of largest container). The dyke area shall be graded to a sump. There shall not be any opening in dyke that may allow wastes to leave the site or surface water run-off from entering the storage site.

- There shall be a sidewall and roof to protect waste containers from weather.

- At the entrance to storage site, a signboard shall be set up with word “BAHAYA” and “DANGER”, painted with a letter size of 30 cm on a bright yellow background.

- All wastes storage drums shall be labelled according to Third Schedule of Environmental Quality (Schedule Waste) Regulations 2005.

- Material Safety Data Sheets (MSDS) shall be maintained for all materials.

- The change-out of lubrication oils from construction equipment and vehicles on the site shall be controlled. Spent lubrication oil is classified as hazardous wastes and shall be handled and disposed in accordance with regulatory requirements.

- Relevant government authorities shall be immediately informed of any accidental spills of fuel, oil, or other hazardous materials. Any such spills shall be cleaned to the satisfaction of these authorities. The resultant recovered material shall be appropriately disposed as hazardous wastes.

- In the event of any pollution to watercourses occurring as a result of operation activities, the Proponent shall bear the full liability for any clean-up and restoration costs.

8.4.1.10 Mitigation Measure Related to Fuel Oil Storage

The potential of environmental damage for improper use of these materials should be very clearly understood by users the following guideline should be implemented:

- Fuel tanks and storage areas shall be sited on bund enclosure provided with drip collection devices and capable containing 110% of the largest tank inventory to maximize the chances of containing spills.

- Fuel and other hazardous materials (e.g. lube oil etc.) shall be stored in a secure area (enclosure with hard-standing base) located at least 100 meters from the watercourse and on-site drainage channels. Material Safety Data Sheets (MSDS) shall be maintained for all materials.

- These dyke bunds shall be built of impermeable material such as concrete or other approved impervious lining.
- Fuel storage in dumps shall be set back 50 meter from any water body and located on relatively flat land.

- Run-offs from tank area to be routed through oil trap prior to discharge to external drains.

- Regardless of their size or contents all fuel containers shall be handled carefully.

- All containers, full or empty shall be handled with care, since drums with broken seals often contain some fuel. In addition to potential pollution, such drums may, in case of lighter hydrocarbon products, contain fumes, which may be explosive.

- Transportation and storage of fuel and lubricants shall be in properly constructed containers of an approved design.

- Refuelling activities shall not be conducted within 100 meters of watercourses or on-site drainage channels.

- Dedicated maintenance and refuelling areas shall be identified and provided with bund hard standing with provision of oil trap and oil interceptor.

8.4.1.11 Mitigation Measure Related to Sewage and Wastewater Discharge

The design of the sanitary wastewater at the operating site is handled by the septic tank, the system is expected to consist of collection and sludge thickening/dewatering stages. The system shall ensure the quality of effluent and facilities complies with the limits specified under the Environmental Quality (sewage) Regulation, 2009, if discharged.

Provision of proper managed of available sanitary facilities for the workforce is necessary to ensure that associated impacts are negligible. Some of these are as follows:

- Workers shall be provided with adequate sanitation facilities.
- At least 2 toilets shall be provided for every 15 workers.

- The waste shall be properly stored and managed to minimize contaminated run-off and avoid from flowing to the water body.

8.4.1.12 Mitigation Measure on Traffic and Transportation

Mitigation measures to deal with impacts generated by traffic are related to air and noise pollution. These have been elaborated in other sections of this report. However, for easy reference the following basic measures are relevant:

- In order to minimize dust dispersion during transportation, road spraying shall be undertaken regularly during dry spells.

- Good planning and coordination will reduce the frequency of delivery and therefore the number of trips. Transportation activities should as far as possible to be restricted to daylight hours but outside the peak traffic periods.

- The project proponent shall install clear speed limit and warning signs beside the road approaching to work site areas.

- The speed limit of trucks community areas shall be restricted to 30 km/h.

- To minimise traffic congestion and accidents, material transportation shall be avoided during the peak hours 7.00 am until 9.00 am.

- The project proponent shall develop specific transport/traffic safety plans to include vehicle routine policy laws and regulations, briefing and training, vehicle maintenance and operational procedures, training and safe driving techniques.

- The project proponent shall keep and maintain records of any transportation accidents with the history and details of causes for further planning of prevention measures.
- Prior entering paved road, lorry shall undergo tires cleaning process or water trough to ensure soils and fugitive dust are not scattered on public road.

- Vehicles conveying product materials shall be covered to effectively contain the materials to prevent spillage that may cause accidents. Any material spills on paved road shall be cleaned.

- Vehicles conveying product materials and equipment must not exceed the permissible tonnage to prevent formation of cracks and potholes on paved road.

- Proper maintenance of lorry can reduce vehicular smoke emission.

8.4.1.13 Mitigating Measures for Socio-Economy

- The project proponent, contractors as well as sub-contractors for the project must educate or made known to their workers of the local customs and respect the local people.

- Care must be taken to keep the temporary houses tidy and clean at all times. Security measures must also be taken by the respective parties to ensure that nobody can come in and out from the project site as they like.

- A designated security guard shall be employed to undertake a proper security system at the project site. A part of that the project proponent shall imposed a restricted no hunting exercise within or surrounding the proposed project site to all the workers and parties involved in rubber forest plantation activity. Any event of illegal hunting activity shall report to the respective government agencies such as Police, Department of Forestry, Department of Wildife and DOE Negeri Perak. The project proponent shall develop a proper safety and security system for the project site area as to prevent workers from creating a problem with nearby local communities.
- The use of legal workers shall become a mandatory policy for all the plantation industry. The project proponent has to make sure that this government policy shall be fulfilled at all time. Avoid using the illegal foreign workers which may possibly create lots of issue either from the safety, security, health and other socio economic problem. Regular communication and also consultation shall be made and maintained with respective government agencies (Custom, Police and Department of Immigration) for new update rule and guidelines. All of the legal foreign workers shall free from any health and disease problem as well as any other criminal records that may potentially create an outbreak within the proposed project site and surrounding area. Any issue pertaining to the foreign workers shall be officially made known to the respective government agencies as to avoid issue become uncontrolled thus may affecting the nearby local community.

- The project proponent shall also undertake an extra precaution and more effort needs to be enhance in maintaining the health care of the workers as well as any other parties involved in the project site area. All worker quarters (if any) shall be constructed

together with a proper sanitary and sewerage system. Avoid direct discharge of sewage into the nearby waterbody. Any possible disease occur in the proposed project site area shall be treated and controlled immediately as per guidelines stated in the Destruction of Disease-Bearing Insects Act and Regulations (Act154), 1982 and Prevention and Control of Infectious Disease Act and Regulations (Act 342), 1989. Regular communication with the Department of Health, Kuala Kangsar shall be developed and maintained especially during any outbreak within or surrounding the proposed project site area. Immediate action and notification shall be made to respective government agency if there is an outbreak of disease occur within the proposed project site and surrounding area.

- The project proponent is suggested to take an extra effort to know surrounding community. This is perhaps the most important and simplest action can be taken. People are more open to discussion with individuals they know. Be neighbourly and a good listener. As a result, the surrounding community will be more likely to come to the project proponent with a complaint instead of reporting to the government authority or enforcement agency. Try understanding their viewpoint as non-farm community living in a farming community, which have the right to enjoy their property without the nuisance of flies, odour and dust.

- The project proponent is recommended to be active in the community. Educate the public by supporting agricultural education activities and outreach programs. Be active with the local government, promoting pro-agriculture public opinion, legislation and regulation. Get to know the local representatives and community decision makers and keep them informed about the business operation of the project site.

- A proper security and safety system need to be planned and implemented by the project proponent as to ensure that the harvested rubber forest product is properly being collected and recorded in the log book during the transportation for trading

purposes. The log book shall be endorsed by the estate manager on daily basis.

- Unauthorised vehicle and workers are not allow to transport the harvested rubber forest product. The project proponent shall continuously implement the no hunting as well as no open burning exercise within or surrounding the proposed project site to all the workers and parties involved in rubber forest plantation activity.

- An announcement and acknowledgement shall be made on regular basis to all parties involve in the plantation activity on the matter. A proper signage on the matter shall be located at the strategy location for a reminder purposes. Instead of the above-mentioned proposed recommended there is also several appropriate more friendly mitigating measures as listed below that can be done by the project proponent as part of social obligation:
  - **Community Forest** - Implement tree farming project as part of Community Forestry Programme. Under this scheme, private land owners should be given subsidised planting material and free technical advice to enable them to establish wood lots in their idle land. Provide business opportunities to the local population particularly in the field of clearing and maintaining project external boundaries, and supplying plantation materials.

  - **Road Network** - Assist local community in providing road access to their villages. Ensure that road access is properly maintained at all times, particularly during rainy period.

  - **Employment** - Preference for employment should be given to local community. This will provide some opportunities tor the local people to participate in the development of the project, as well as providing them with an opportunity to earn extra income. In addition, their employment will prevent social resentment and conflicts, increase their positive feelings

towards the project, and create a sense of pride towards the development of the area.

- **Dialogue** - Set-up proper programme of public relations. Two-way communications through dialogue help both parties to understand each other, set a forum for understanding, and establish rapport. Conduct a proper public relation exercise involving local authorities (including District Office of Kuala Kangsar and Department of Forestry Perak). Information about the numerous benefits of the project and the associated environmental impacts should be made readily available to the public. Hold regular meetings/dialogues with affected population and their community leaders (including JKKK and Ketua Kampung/Tok Batin). The project proponent should explain to the villagers the nature of the project, the extent to which it will affect the villagers and the mitigation measures undertaken or to be taken by the project proponent.

8.4.1.14 Mitigating Measures for Ecology

8.4.1.14.1 Flora

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.

The nature of impact greatly depends on the nature of the proposed development to be carried out. It also depends on the stage of the development. Based on the development of the Project, clearing and removal of habitats and existing vegetation would be unavoidable. Mitigation measures recommended to be implement during the project development are as follow.

<u>Planning of Logging/ Forest Plantation Activities</u>

- Logging shall be conducted in stages (phases) to avoid massive clearance at one particular time.

- The Contractor and Sub-contractor shall carefully plan the schedule of work so that the time gap between logging and forest plantation is minimised.

Biomass Management

- Logging shall be carried out by Contractor with permit from Department of Forestry Perak.

- Felled trees and other biomass (tree stump, branches, bushes and shrubs) can be used as mulch at suitable area to avoid soil erosion at downstream.

- These biomass can also be shredded into smaller pieces or chips prior to removal and disposal off-site. Dumping of biomass along river/ stream area is not allowed.

Restriction of Open Burning

- Strictly no burning and any source that could cause spark and fire such as machines must be monitored. Signboards showing strictly no burning must be set up throughout the proposed project. Workers especially non-locals (foreigners) must be briefed before any work commence that strictly no burning is allowed. In case of non-compliance, the responsible worker(s) should be penalised and the fire must be put out immediately.

Allocation of Riparian Buffer Zone and BMPs

- Riparian buffer zone is recommended to be allocated particularly along streams bank (minimum of 20m).
- Best management practices (BMPs) shall be provided during site clearing/ site preparation stage to control the impacts of erosion and sedimentation particularly towards the streams and slope area. Silt trap, silt fence and wash basin will be provided at

designated location as specified in the Land Disturbing Pollution Prevention and Mitigating Measures (LD-P2M2) section.

Minimise Exposed Surfaces

- Exposed surfaces shall be turfed as soon as possible or covered with temporary stabilisation materials which may include cover crops, mulches, and other techniques to reduce or eliminate erosion until further development activities take place at that certain area.

Maintain Riparian Zone

- Maintain the vegetated buffer zone along the riparian zone of the streams (minimum of 20m).

- Remove any debris that may block the flow of the streams.

Maintain Slope Stability and Protection

- Cover crops along the slope also need to be maintained to adequate to protect the soil underneath.

8.4.1.14.2 Fauna

Forest and Habitat Loss and Degradation

- It is strongly urged that some original forest and habitat especially along rivers are preserved to serve as refuge/ habitat for some medium and small sized wildlife and fauna affected by the proposed project. The standard river buffer of 20-metre wide or according to the width of the river on each bank typically stipulated is only intended to reduce the impact of soil erosion. It may not be sufficient to serve as refuge or habitat for some small and medium sized wildlife and fauna.

- Additionally, the rivers within the proposed project are less than 20 metres wide that the maximum buffer provided would only be 20 metres. There are a presentation slides and journal

publication which discusses that riparian reserves in Malaysia usually consider for soil erosion and hydrology aspects, ignoring its importance for biodiversity.

- Although, they discuss more on riparian reserve in oil palm plantations, it's still deemed applicable to forest plantations which uses only one species, mainly rubber tree, or a few. **Figure 8.3** shows extracts from the slides file mentioning about riparian reserves and the minimum width. To provide refuge for the fauna to be affected in situ (within the original habitat), it's strongly recommended that a minimum of 50-metre wide along each river bank is preserved in petak 1A and 2A which are still well forested as shown in **Figure 8.4**. The 50-metre riparian reserve proposal is also considering;
  i. The status of the land in the proposed project is still a forest reserve involving a relatively large area of 1,600 hectares in total;
  ii. Plot petak 1B and 2B had been clear felled. Although some riparian reserves were noted in these plots, they are estimated of about 20-metre wide along selected river banks only.

- The area involved for the riparian preservation (may also be referred to biodiversity since other components would also be preserved namely flora, fungi and habitat including those of aquatic) is estimated to be about 244.1 hectares which is equivalent to 15.3 percent of the total project area of 1,600 hectares. All the area figures above were calculated using a GIS software – QGIS 2.18. However, the figure may differ to certain extent to what is actually on the ground especially involving the riparian reserve. This is because the actual river shape and length would be different than those seen on the map.

- Strictly no burning and any source that could cause spark and fire such as machines must be monitored. Signboards showing strictly no burning must be set up throughout the proposed project. Workers especially foreigners must be briefed before

any work commence that strictly no burning is allowed. In case of non-compliance, the responsible worker(s) should be penalised and the fire must be put out immediately.

- No littering and waste are properly disposed of in line with regulations. Siltation and sedimentation are strictly kept to absolute minimum.

Figure 8.3 : Extracts from A Slides File Mentioning About Riparian Reserves and The Minimum Width.

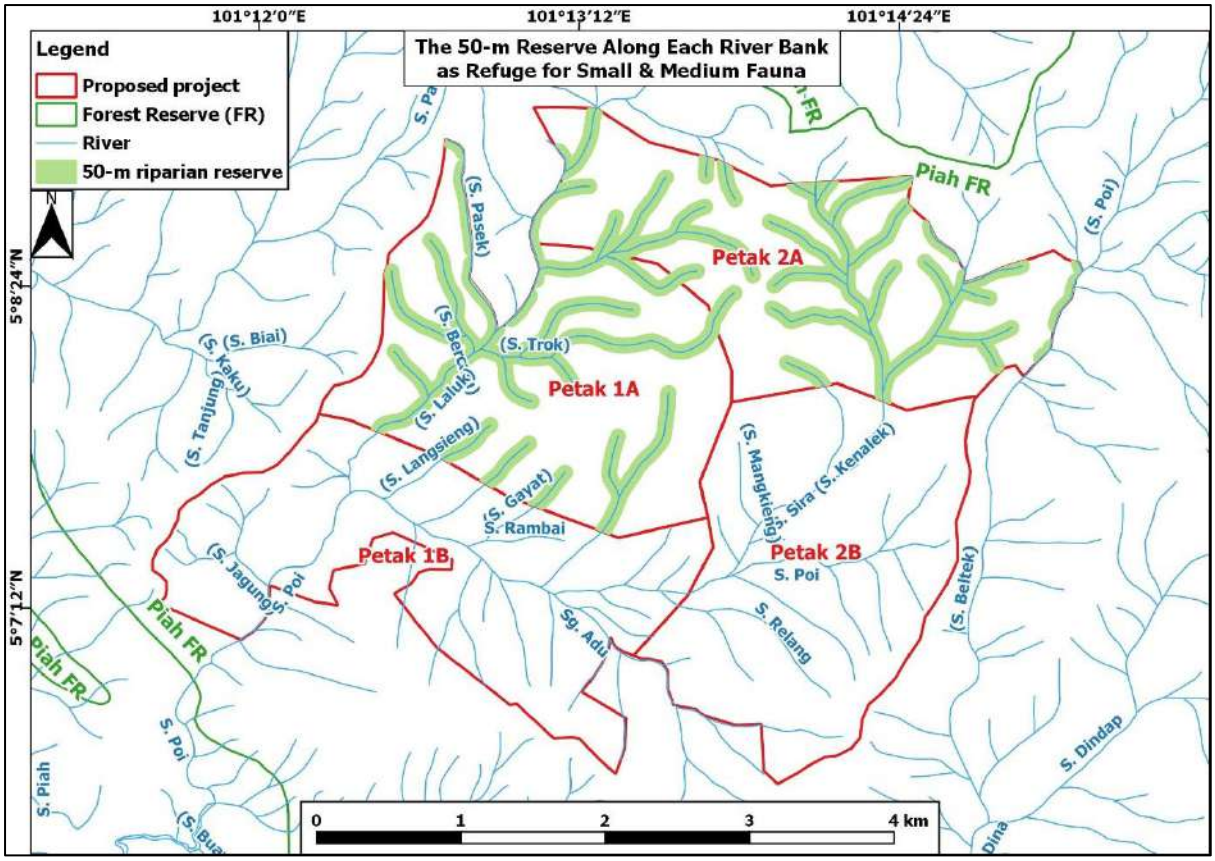

Figure 8.4 : The Proposed Minimum 50-Metre River Buffer on Each River Banks to Be Preserved As Refuge For Some Medium and Small Fauna.

Fauna Loss

As highlighted in impact section, many of the fauna recorded and expected were those of smaller and slow-moving ones which are often taken lightly compared to mega fauna. Some of them won't be able to make escape for factors mentioned above in the impact section. Without relocation effort for them, they are likely to sustain injury or die. Reptiles and amphibians are anticipated to be the most in need of rescue and relocation. As such, it is necessary to;

- The site clearing should be heading towards the remaining forest and habitats in the surroundings especially towards the north where there are forests within Piah Forest Reserve and Air Cepam Forest Reserve remaining. It must avoid towards the south where clear felling was conducted and villages of aborigines are present.

- Employ knowledgeable and experienced wildlife officer for wildlife and fauna management. Among the responsibilities of this person is to ensure the facilitation of safe fauna escape and no or very minimal loss in fauna. Any fauna which became trapped, disoriented, injured and having problem to make escape must be managed through rescue and relocation to suitable and secured habitats nearby. The appointed person is also to work closely with the authorities especially Department of Wildlife and National Parks locally known as Jabatan PERHILITAN. Active nests especially belonging to large raptors (bird of prey such as eagles) must be preserved temporarily until the young or chick develop and leave the nest.

Illegal Wildlife Hunting and Collecting

The project proponent and their contractors must;

- Strictly prohibit any workers and outsiders from hunting in any part of the project or the surrounding areas. **Figure 8.5** shows a sample signboard content showing the regulations related to wildlife that should be signposted at the site. Any non-adherence by workers and outsiders must be notified to the authority namely DWNP @ Jabatan PERHILITAN.

Figure 8.5 : A Sample Signboard Content Showing the Regulations Related to Wildlife.

Human Wildlife Conflict

- Strictly no harming or killing any wildlife or fauna that may cause conflict considering the conflict is due to the proposed project itself except in life threatening situations of which need to be notified to nearest Jabatan PERHILITAN office immediately. The nearest office is in Sungai Siput town with the following contact details:

  Pejabat PERHILITAN Daerah Sungai Siput
  Kompleks Pejabat PERHILITAN,
  Batu 3, Jalan Lintang
  31100 Sungai Siput (U),
  Perak.
  Tel: 05-597 4173.
  Fax: 05-597 4173.
  Email: dsungaisiput@wildlife.gov.my.

Alternatively, Jabatan PERHILITAN of Perak state may also be reached with the following contact details;

Jabatan Perlindungan Hidupan Liar Dan Taman Negara Negeri Perak,
Tingkat 3, Wisma Persekutuan,
Jalan Dato' Seri Ahmad Said,
Greentown,
30450 Ipoh,
Perak.
Tel: 05-243 6645
Fax: 05-243 6635.
E-mail: perak@wildlife.gov.my.

- Setting up and installing non-harmful deterrent such as ditch and electric fence for Asian Elephant and Wild Boar etc., which may raid on crop and damage properties.
- In case of human-wildlife conflict, collaboration with Jabatan PERHILITAN is necessary. Among the measures to reduce the conflict is to officially request DWNP to catch, trap and relocate the conflicting species. If the wildlife feeding on or damaging the crops, they should be dealt humanely with the advice and in compliance to regulations by the authorities. The appointed environmental or wildlife officer is also to work closely with the authorities in regard to human-wildlife conflict.

8.4.1.15 Mitigation Measure for Occupational Safety and Health

The project Proponent shall ensure that the health, safety and general welfare of the employees as stipulated under Occupational Safety and Health Act 1994 (ACT 514) are properly taken care of . Emphasis shall be placed on the enforcement of safety rules for workers, road safety regulations and proper and regular maintenance of machinery and vehicles.

The employer must provide information, instruction training and supervision as is necessary to guarantee the safety and health for its employees. First aid equipment must be readily accessible at all work sites, and training shall be provided to designated first aid personnel.

Safety on all phases of the work must be addressed fully right from the start. A safety committee must be organized together with a safety manual to cover all the areas of concern. Road design shall incorporate safety measures with respects to road gradient; bend radius, road width, etc. certain precautions must be exercised while driving the haulage lorry.

To mitigate against the worker – related impacts, the following measures are proposed to be adopted:

- Train workers to operate machinery properly so as to reduce dust generation.

- Only well maintained equipment shall be operated on-site and equipment should be serviced regularly during the operation.

- Ensure that the site is kept orderly and tidy with good working conditions.
- Workers shall be provided with adequate sanitation facilities. At least one latrine shall be provided for every 15 workers.
- Establish effective on-site safety procedures and emergency response plan.
- Provide sufficient training for pollution control safety measures first aid and fire-fighting.
- No employment of illegal immigrant workers is permitted.
- Establish a health surveillance system for workers.

The project proponent is to establish a public liability scheme for people and property in the vicinity of the Project area to cover the costs of compensation after an accident. Workers shall be provided with suitable Personal Protective Equipment (PPE) to ensure that their safety is protected while discharging their duties.

8.4.1.16 Mitigating Measures for Abandonment Phase

In case of abandonment, the project proponent will be responsible to ensure that the cessation of the project would be carried out in a responsible manner and a rehabilitation plan would be prepared to ensure the restoration of the environment and safe disposal of any waste remaining.

The purpose of the rehabilitation programme is to restore the project site to render it stable enough so as not to become a source of environmental repercussions in the future as well as minimising aesthetic and visual impacts.

It is also mean to prepare the area for other development of maintained as natural forest. However, the ability of reverting to the forest condition will depend on the stage when work on the project

stopped. Once land clearing started reverting to forest condition with the origin species will not be possible.

Artificial regeneration by planting with appropriate species will create a forest environment over a long period. Some of the rehabilitation programme proposed for this project development are listed as below. In case of abandonment, the following mitigation measures that have been listed below should be observed.

- Revegetation of cleared areas with fast growing indigenous shrubs and grass.
- Remove all wooden bridge or install blockage into all the logging roads to discourage hunting or unauthorized personnel from entering into the project area
- Remove all the base camps and workshops. All waste remaining must be disposed of safely
- Re – establish native vegetation to enable the formation of a new ecological equilibrium of the area.
- All remaining structure, machinery and equipment should be removed. Waste generated from the demolition of structure should be properly disposed of or buried.

Aesthetic

Aesthetic degradation occurs when large areas of forest are logged and cleared. In this respect, additional mitigation measures may be required in scenic areas or sites nearby tourism destinations. The leaving of appropriate buffer zones may be necessary. The following mitigation measures area recommended to carry out by the project proponent if the matters arise.

- All structures that cannot be made safe or cannot be assured to remain safe with time shall be demolished and dismantle.
- All plantation material, equipment and machinery shall be removed from project site as to avoid attraction from robbery problem.
- To clean – up the project site area from any land contaminated with hazardous material, schedule waste or oily wastes as

according to the guidelines a stated in the Environmental Quality Act, 1974

- Access to the project site area shall be properly fenced and closed, and appropriated warning and notice of abandonment signs shall displayed clearly at the entrance.
- Appropriate government authorities such as Department of Environment, Department of Forestry, Department of Wildlife, District Local Authority Office, Land Office, Police, etc. shall be officially informed of the closure.
- The project proponent shall station the security guard in order to carry out the regular inspection of the project site and shall take a necessary action to ascertain safety and security in the abandoned project site.
- Large exposed areas should re–vegetate with fast growing species such as legume. The re–vegetation should start immediately upon completion of each logging/ plantation phase, and not upon the final abandonment.
- Abandoned logging or plantation roads should be re–planted with high quality trees to improve ground conditions and to prevent unauthorized access.
- Consider the option to reuse the project site area for other purposes.

Water Quality

Re–turfing or put up a cover crops on the exposed areas and provide a proper drainage system in order to minimize potential soil erosion and flooding problem that may occur especially during wet season and heavy rainstorm events. All oil container shall properly seal and stored at the designed covered storage area with sufficient labelling system. The project proponent shall cover stored manure for nutrient retention and water quality protection. All stream crossings should be removed and area restored to near original conditions. A part of that any unstable area such as steep slopes should be stabilized/rehabilitated to minimize landslide and soil erosion.

Socio – Economics

A proper and comprehensive retrenchment programme shall be formulated to handle the large employee population. Such a plan shall be consistent with the existing labour laws to ensure that appropriate notices and compensations are provide to the affected workers. The project proponent shall also assist the employees for re–employment where necessary may be to the other plantation project nearby.

Summary of mitigating measures are as shown in **Table 8.2.**

Table 8.2 : Summary of Mitigation Measures

Potential impacts	Site Clearing Phase	Mitigation Measures
Soil erosion and Sedimentation	• Site Clearing	• Cover the exposed area with canvas before re-cultivation of plant process or other rehabilitation measures. • Site clearing will be run in stages. • Preserving the natural environment in the area that would not be disturbed by the activities. It will reduce the expose area from soil erosion. • Using the cut biomass (leaves, roots and branches) as a protective layer from soil erosion agent. • Avoid working during rainy season unless it is important and reasonable. • Preparing the silt trap that is big enough to give enough time for silt to sink. • Put together the irrigation system and check dam in the silt trap system. • Balanced terraces need to be carried out. But if more land need to be export, detailed steps need to be carried out. • Installation of the silt fence if needed. Silt fence is a temporary structure to trap the silt. • The silt trap pond must be excavated if the plant has covered the earth surface and other mitigation measures are found effective.
Degradation of the Surface Water Quality	• Site Clearing • Scheduled Solid Waste and Spilled Solid Waste • Effluent of untreated sewage	• Overland flow need to be controlled so that water catchment and local resident's point source would not be affected. • Measures to avoid erosion will be according to the MSMA's Malaysian JPS and guide line for soil erosion and sedimentation's mitigation that published by Department of Environment Malaysia. • Planting of pathways, cover crops and minimum steering will be used to maintain soil roughness to control erosion and reduce pesticide's movement in the soil into the water bodies.

		• Suitable irrigation system and pond will trap sediment from site clearing activities must be established according to contour and earth level. • Establish the buffer zone around the river, wells and sensitive areas. • Pesticides stock must be minimized by purchasing only the required quantity during the growth season. • Use suitable amount of fertilizers and distribute them equally on the soil during the good weather.
Hydrological Impacts	• Site Clearing	• Same mitigation measures as soil erosion and sedimentation issues.
Ecological Impacts	• Site Clearing • Road Construction of site clearing and pull alley • Machine Operation • Degradation of water and air quality • Trees Cutting	<u>Fauna</u> • Make sure there are no invasive species introduced to local forests intentionally or inadvertently. • Maintain the trees with the pores. • Shouting to scare away the wild animals such as monkey to avoid any injuries if they trespassed the project site. <u>Flora</u> • Supply the mud trap/silt trap, erosion dam and reservoir in all exposed slopes are important measures to reduce the negative effects to existing water bodies. • Forest workers must be trained and disciplined. • Exposed slopes will be covered with cover crops and forest trees immediately. • Biomass usage (branch, leaves and roots) that has been cut as a protection to protect the exposed soil from erosion agent. • Compactness of the road must be assured is minimum and their alignment must be identified first.

		• Oil, metal and other chemicals that brought into the forest must be operated carefully and controllably. The disposal of these substances must be watched to avoid unwanted accidents that can affect the forest negatively. • River reserve need to be at 5 m from tributaries of **Sg Piah, Sg Rombai, Sg Adu, Sg Poi and Sg Sira** to maintain the habitat which carry out important ecological function as a rich habitat supplier to flora and fauna. • When site clearing is done, the progressive land cover plant and planted timber latex will establish new habitat. • Site clearing activities will follow the phase and collection of biomass stock storage as shown in the project layout.
Soil erosion and sedimentation	• Site Clearing	• Same mitigation measures as the soil erosion and sedimentation during the site clearing phase
Degradation of Air Quality	• Uncontrolled pesticides and fertilizers	• Pesticides and fertilizers must be stored in the suitable area. • Every worker must be supplied with the suitable equipment during the pesticide's spraying process. The equipment must be returned after the work has been done. • Every worker must attend the proper training regarding the method of equipment's usage and substance that related with the project. • Pesticides and fertilizers control need to be observed by supervisor that has suitable qualification. • Any remain substances must be stored in fixed storage area. • Spillage must be cleared immediately.

Socio-Economy impacts	• Public Health and Security • Job Opportunity and Business	• Courage the public participation especially in the job opportunity at the proposed Project site. • Avoid misunderstanding with the foreign workers during the construction and operation phase and preparing the suitable house and recreational facilities. • Increase the public infrastructure to give benefits to public. • Business development and preserved the relationship with the project to trigger the economy activity within the local residents. • Preparing the training accommodation and technical development programme for the local labour team so that locals can involve in the project. • Increase the plantation sewage disposal system for health and security.
Solid waste and Biomass Impacts	• Office Usage • Site Clearing • Road construction * • Logging	• Solid waste cannot be burn in the site project area. • Implementing the 3R programme (reuse, reduce and recycle). • Supply the roro bin in the strategic location in the project area. • Effective solid waste collection in the project area. • Accumulated biomass waste will be disposed in the specified disposed area. • Biomass waste must be far from water sources. • Biomass stock storage must be established on the level ground and covered with the plant. • A set of irrigation system must be established surrounding the biomass stock storage to flow the overland flow into the nearby sediment basin.

Impact on health and occupational safety	• Site Clearing Activities • Planting Activities	• Workers should be given enough training in machinery and safety work procedure. • Workers should be prepared with suitable clothes, shoes and personal protective equipment (PPE) to protect staff from any injuries and harm in the workplace and make sure it is being used correctly. • The worker that joins harvesting activities or site clearing operation will be wearing the high visibility clothing. During dark hour, high visibility clothing with reflectance lines will be put on. • Gloves will be used when there are potential risk to be injured from chemicals, heat and abusive wound. • Usually the traffic volume in harvesting stage is higher than any other stages. That is why the traffic signage should be allocated in the strategic location in the proposed project location to avoid accident and traffic jam. • Establishment of occupational safety and health team (OSH).
Transport and traffic impact	• Transportation of equipment and machine. • Transportation of logs and seedlings	• Settling the speed limit of the road especially near the settlements. • No transport activity after 6 pm and before 6 am to reduce the risk to the public when the distance is poor and to provide a period of calm for the human and wildlife. • Transport activities will be stop during rainy day to reduce the accident risk and road destruction. • If any part of the road to the project site is damage by the transport vehicle, maintenance activity will be done immediately by the developer. • All public report will be investigated and proper measurement will be taken to solve the problem immediately.
Air quality impact and noise level	• Site clearing • Biomass elimination	Air

		• Site clearing operation and rubber forest plantation will be done stage by stage. It is to avoid all the area been clean in short time. • Rubber forest plantation operation will be plan properly so that soil will not expose in long-term. • Decrease activity that use fossil fuel. • Make sure machinery and equipment that been use in site were in good condition and not release smoke. • No open burning are allowed in or out the project site. • Tree stem should be sell to plywood factory and others to the charcoal producer. Balance of the wood waste include root should be cut into small size to facilitate the composition process. Noise • Noise monitoring inspection will be conducted quarterly if needed. • Ear cover will be given to the workers if needed.