CHAPTER 8

MITIGATION MEASURES

8.1 MITIGATION AND ABATEMENT MEASURES

8.1.1 Adherence to DOE Guidelines

Project proponent must be assessed adherence to DOE guidelines in implementing the best available technologies (BAT) or any practical practices for applying the appropriate P2M2 approach. This practices must be implement during both development and operation phase. The requirements and specifications stipulated in the following documents issued by the DOE shall be adhered to:

1. Guidance Document for addressing soil erosion and sediment control aspect in EIA Report.
2. Guidance Document for the preparation of Land Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2).
3. Urban Stormwater Management Manual (MASMA) published by Department of Irrigation and Drainage Malaysia in 2000 (Revised version 2012).
4. Forestry Manual, Department of Forestry Malaysia, 2005.
5. Other relevant guidelines and guidance documents issued by the DOE pertaining to environmental-related system and management.

8.1.2 Proposed Mitigation Measures

All of the BMPs in the LD-P2M2 on the site must be installed and maintained correctly. In order to prepare a comprehensive LD-P2M2, the guidelines below shall be followed. **Figure 8.1.1** shows the eight (8) components of generic guideline to minimize soil erosion and sediment issues for this site.

1	Minimizing Soil Erosion
2	Preserving Top Soil & Other Asset
3	Access Route & Site Management
4	Runoff Control & Management
5	Field Establishment & Erosion Control
6	Sediment Prevention Control
7	Slope Stabilization
8	Site Maintenance

Source: Guideline for Erosion and Sediment Control in Malaysia, 2010, DID

Figure 8.1.1: LD-P2M2 Principles

The LD-P2M2 tools must be inspected and maintained regularly in order to maintain their working effectiveness. The LD-P2M2 conceptual map is as presented in **Attachment 1.** The control measures focus on soil erosion and sedimentation (LD-P2M2) as shown below:

SOIL EROSION CONTROL MEASURES	SEDIMENT CONTROL MEASURES
• To protect the soil surface from rain and to divert runoff from an exposed area	• To maintain effluent water quality by capturing the eroded soil particles on the site before entering water courses

As part of the implementation of LD-P2M2, the environmental monitoring and audit programs must be carried out by the project proponent during the earthworks and construction phase to ensure environmental compliance in term of water quality. This environmental monitoring and audit programs must be carried out due to the effects of erosion and sedimentation.

The environmental monitoring and audit program should be conducted throughout the entire construction period. The monitoring works includes of field data collection, laboratory analysis, data interpretation, evaluation and assessment of the status of water quality, air quality and noise level which will assist in identifying any adverse impacts related to the project site. The persons who were experienced and qualified persons which is registered with the DOE will be carried out the audit to review the performance of the implementation of Best Management Practices (BMP's) and its maintenance records as well as to verify the results of the water quality assessment.

The stated objectives can be achieved and workable to carried out on site when the selection of the Best Management Practices was done in such a manner.

Table 8.1.1 describes the category and objectives of some of the selected BMP's. Any changes or modifications need to be carried out in a systematic manner where revision plans shall be issued to all relevant parties clearly indicating the changes.

Table 8.1.1: General BMP's Category and Objectives

BMP Category	BMP Objectives						
	Practice Good House Keeping	Contain Waste	Minimise Disturbed Area	Stabilised Disturbed Area	Protect Slope and Channel	Control Site Perimeter	Control Internal erosion
Site Planning Considerations							
Phasing			√				
Preservation of existing vegetation							
Vegetative Stabilization							
Planting Cover Crops				√	√		
Mulching and Stacking				√	√		
Physical Stabilization							
Dust Control	√		√	√		√	

BMP Category	BMP Objectives						
	Practice Good House Keeping	Contain Waste	Minimise Disturbed Area	Stabilised Disturbed Area	Protect Slope and Channel	Control Site Perimeter	Control Internal erosion
Temporary Waterway Crossing	√		√	√	√		
Construction Road Stabilization	√		√	√	√		
Construction Access Stabilization	√		√	√		√	
Diversion of Runoff							
Earth Bank	√				√	√	√
Diversion Channel					√	√	√
Flow Velocity Reduction							
Drainage outlet protection					√		
Sediment Filtering / Trapping							
Drainage Inlet Protection						√	√
Silt Trap							√

Source: MSMA 1st Edition

8.2 POLLUTION PREVENTION AND MITIGATION MEASURES (P2M2s)

The main purpose of having to establish the LDP2M2 is to minimise the extent of impact of erosion due to the logging activities especially during site clearing and earthwork activities and ensure issue is address at an early stage of planning. The recommended land disturbance pollution prevention and mitigation measures are as follows:

1. Scheduling and staging of development.
2. Implementation of Land Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2).

The Proposed Land Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2) for Stage 1 and Stage 2 and calculation for each structural measures are shown in

Appendix 11 and **Attachment 1 (Overall LDP2M2 Drawing)**. The detail report of LDP2M2 is also attached in **Appendix 11** with the summary of the report is described below:

8.2.1 LD-P2M2 Principles

1. Scheduled Site Meeting

A scheduled site meeting shall be conducted prior to start of any construction activity. The site meeting shall be attended by the Project Proponent, Project Environmental Officer, Project Contractors and/or Sub-Contractors to discuss in detail all the relevant scopes of work that have relevance to pollution prevention and mitigating measures. Proper minutes of meetings need to be documented to record work progress.

2. Construction Markers

Physical construction markers in the forms of fences, signs, tapes, flags or other similar marking device shall be constructed on site to show the limit of the followings:

- Drainage or waterways within the site
- Areas not to be disturbed
- Buffer areas
- Existing vegetation meant for temporary or permanent preservation and for protection
- The working area for earthwork should be kept as minimum as possible and restricted to areas as designed and approved.

Most notable development marker for this Project is the perimeter drain construct along the site boundary to keep the site safe from intruders but more importantly from stray animals which can damage the forest plantation trees. The perimeter drain will

thus be erected to provide site security against vandalism and animals finding their way into the site-premises. A typical perimeter drain proposed is as shown in **Plate 8.2.1.**

Signage for the stockpile area (excavated materials, biomass and construction waste) must also be provided to avoid encroachment and allow better management during the transportation of the waste to the designated disposal area.

A good soil protection involves the preservation of vegetation along the buffer areas or areas not to be disturbed.

Plate 8.2.1 Example Perimeter Drain at the Project Site

Plate 8.2.2: Pre-construction Action

3. Stabilized Entrance Point

Access to the project area will be using public paved road to unpaved road. The main and internal roads in the Project site shall be topped with crusher run to reduce soil erosion or at least the formation shall be made of gravel upon achieving the required level. The primary functions are to protect the sub-grade and reduce the amount of potential erosion from the open surface (**Plate 8.2.3**). Construction of the drainage and access road essentially takes place at around the same time. All the water from the road surface will enter the road side drain and will flow to the sediment trap (Catch Basin). The drain is one of the mitigation measures for road construction to minimize erosion and sedimentation. The construction of the temporary drainage systems to drain the site prior to the roads construction must be properly designed to retain the desirable water table as well as to firm up the ground for the road construction. The temporary drainage can be upgraded into permanent drains based on the final drainage design. **Plate 8.2.4** example of road side drain.

Plate 8.2.3: Example of Stabilized Access Road With Crusher Run to The Project Site

Plate 8.2.4: Example of Road Side Drain

4. Erosion Control

a) Minimizing Soil Erosion

Riparian Management Plan / Monitoring (RMP)

A Riparian Management System will provide baseline data on existing conditions, offer management strategies for invasive species, recommend specific treatment methods, identify important view sheds, and implement appropriate clearing/pruning strategies and techniques for the specified area. Typical components addressed in a Riparian Management Plan include: riparian vegetation, stream restoration, invasive species management, herbivory management, riparian view shed management and large woody debris management.

The objective of the Riparian Management Plan (RMP) is protecting, enhancing water quality and habitat by restricting construction activities and maintaining existing vegetation along the watercourse. Riparian zone is the area of land (including floodplains) adjacent to watercourses. Riparian vegetation plays a role in controlling erosion through its attributes of water interception, energy dissipation, and soil stabilization and infiltration enhancement. Soil erosion is also influenced by the ground cover vegetation, which filters storm water runoff to remove sediment, while deep-rooted species affect soil moisture and groundwater levels.

Riparian buffer zones of 10m left and right of the seasonal stream will be proposed for all the seasonal streams at the project site. This is to prevent the project proponent from disturbing the stream. All the disturbed river at project site with riparian buffer zone is 20m both side of the stream. Disturbed area shall be limited to keep soil erosion at its minimum and further, can be stabilized within short duration. All stream and river buffers must be maintained. This buffer may be covered with cut vegetation to act as a damper to erosion forces. Existing vegetation shall be maintained to the maximum extent to filter runoff and provide erosion protection. The buffer (**Plate 8.2.5**) shall be retained uniformly on both sides of the stream/river in the area covered by the project.

Plate 8.2.5: Example of Riparian Buffer Zone

Stream buffer shall be retained uniformly on both sides of the stream/river in the area covered by the Project. Due the project site is located in a Forest Reserve, the natural waterway reserves should be delineated as recommended by the Jabatan Perhutanan as tabulated in **Table 8.2.1.** The guideline is applied when the river affected by the project is not listed under *Warta Rezab Sungai Negeri Perak*.

Table 8.2.1: Riparian Buffer Zone

STREAM WIDTH (m)	MINIMUM WIDTH RESERVED (m)
More than 40	45 m from river bank
Between 20 - 40	40 m from river bank
Between 10 - 20	20 m from river bank
Less Than 10	10 m from river bank

Source: Manual Perhutanan Jilid III, Jabatan Perhutanan Semenanjung Malaysia (2005)

The riparian buffer zone post (**Plate 8.2.6**) must be erected at the proper place so that people will not disturb that reserved area.

Plate 8.2.6: Example of Riparian Reserved

The RMP must be included in the Environmental Management Plan (EMP); it is to determine whether the Riparian Management Plan are being met. Several methods

include visual status (photos) before and after at all affected tributaries. The river buffer zone is presented in LD-P2M2 conceptual map, which is attached at **Attachment 1**.

b) Preserving Top Soil and Other Assets

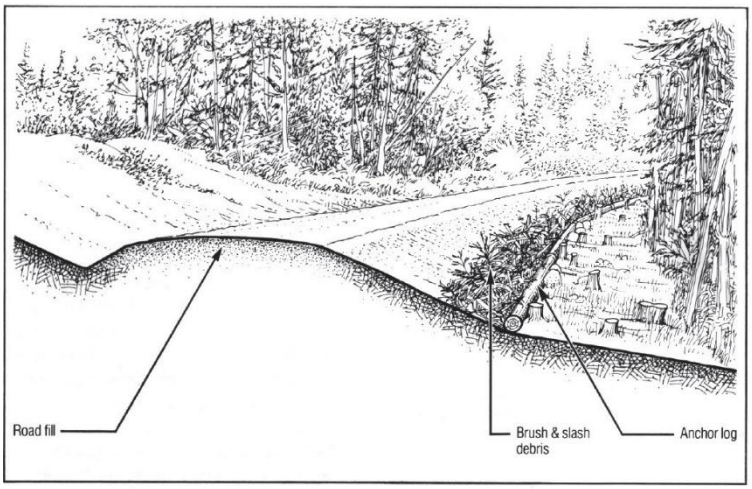
Sensitive ecological areas shall be demarcated and preserved within a development site such as natural spring and unusual rock outcrops. All excavated top soil shall be stockpiled, protected from erosion and later used for revegetation. The PP shall identify, protect and transplant the vegetation of high ecological or social value if required.

The vegetation on the steep slopes and along the river banks will be retained to act as buffer strip to retard any possible erosion potential. Remaining site clearing within the anticipated development area will be carried out once the internal access road is made available. Currently, the project site is accessible using the existing roads that have been used during the logging period previously. The site clearing will be conducted once all the erosion and sediment control measures are in place.

The biomass assessed to be generated during land clearance clearly infers the abundance of vegetation potential resource for erosion and sediment control measure. Slash or chipping of woody and vegetation branches would be initiated appropriately for the use of Brush Barrier (Sediment/Runoff Control BMPs) or Mulch (Erosion Control BMPs). However, chipping needs to deploy Chipping Machine of which might be costly but slashing can be done by general workers manually. **Figure 8.2.1.** illustrate the slash used for Sediment/Runoff Control, while **Plate 8.2.7 and Plate 8.2.8** shows the photograph of the use of Brush Barrier BMPs and Mulching BMPs implemented locally in Selangor State.

As soon as possible after felling of any residual trees, any woody materials shall be stacked and used as a natural biomass for erosion control. Large branches and trunks

have to be cut to shorter lengths to facilitate stacking. Stacking of debris and biomass from land clearing works **(Plate 8.2.10)** can function as a natural filter to surface runoff before discharging into any waterway. This also allows decomposition of debris, creating an ecosystem for soil organisms to proliferate and nutrient re-cycling within.



Brush barrier placed at toe of fill to intercept runoff and sediment (Ontario MNR, 1990).

Figure 8.2.1: Illustration of Brush Barrier BMPs use for Runoff/Sediment Control

Brush Barrier may serve as sediment barrier- good for sheet flow similar to silt fence.

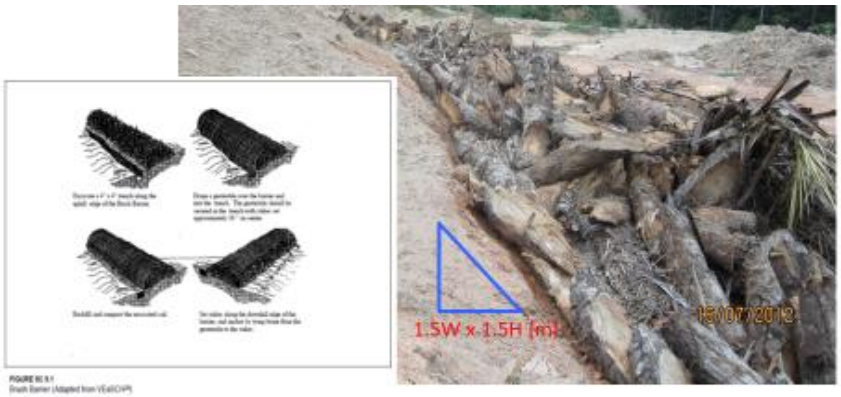


Plate 8.2.7: Example of Brush Barrier BMPs (biomass) application locally in a land development project

Plate 8.2.8: Mulching BMPs application locally in a land development project

Site clearance activity shall also practice in stages. Critical areas that prone to erosion or existing vegetated and stable areas that can be used to temporarily act as buffer strip should be retained temporarily and can be attended later whenever permissible. It is understandable many contractor reluctant to adopt the method as it may cost additional cost and logistic to re-visit the area or simply double handling. However, the practice will assist greatly in minimizing the erosion risk and in the bigger picture, the cost for remediation is completely avoid should the problem arise.

Sensitive ecological areas shall be demarcated and preserved within a site clearing activities site such as natural spring and unusual rock outcrops. All excavated top soil shall be stockpiled, protect from erosion and later used for revegetation. Identified, protected and transplanted the vegetation of high ecological or social value if required. **Plate 8.2.9** shows the example of preserved area.

Plate 8.2.9: Example of Preservation of Top Soil Area at Project Site

Plate 8.2.10: Example of Biomass Stacking at the Project Site

Biomass Disposal Area

Unsuitable material and biomass disposal area shall be provided at the Project site during site clearing activities. Material such as boulder rocks will need to be firstly stockpiled for further use such as check dam material. Biomass such as brush, tree

branches and trunks will be reused and stack at barren area for zero cost erosion control. After clearing work, biomass will be gathered from the site and moved close to the road to be lifted on trucks. Temporary internal access road is used to transport the biomass to the designated area.

Cover Crops

Mucuna bracteata has been found suitable with the ability to prevent growth of other weeds. The high growth rate of this plant suppresses other weeds while the symbiosis process in the root nodules of these plants is able to fix atmospheric nitrogen. Others than that, the cover crop also helps to reduce root disease, increase organic material, improves the soil condition and decrease maintenance costs. This cover crop should be planted after site clearing in order to reduce the soil erosion potential (**Plate 8.2.11**).

Plate 8.2.11: Example of Leguminous Cover Crops (LCC)

Geotextile

Geotextiles are an ideal protection from erosion of earth embankments by wave action, currents or repeated drawdown. A layer of geotextiles can be placed so as to prevent

leaching of fine material. They can be used for rock beaching or as mattress structures. They can even easily be placed under water.

Geotextiles also offer erosion control solutions - they're often used to firm up soil surfaces. The geotextile can help protect the surface from the eroding effects of wind and rain. It can also help reinforce soil, for example, along embankments that would otherwise face a greater likelihood of erosion and degradation.

Geotextile is proposed to be used as a river bank protection to reduce soil erosion on the river bank surface when the river receives discharge water from sediment basin and sediment trap outlet.

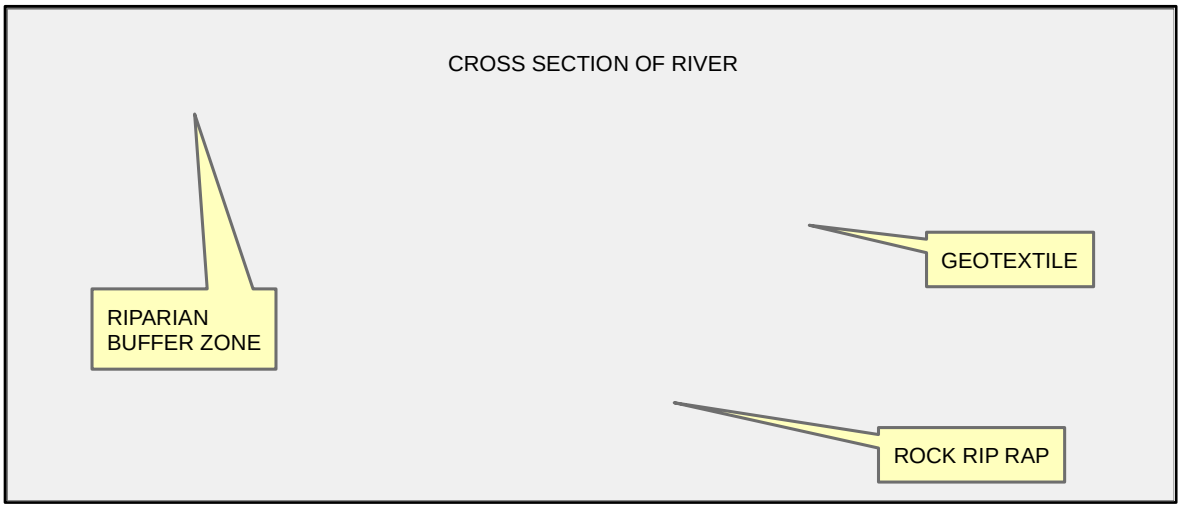


Figure 8.2.2: Illustration of Erosion Control at River Bank

c) Site Management

Spray the unpaved road in the project site with water to reduce the dust pollution during dry periods. **(Plate 8.2.12)**

Plate 8.2.12: Example of Water Browser is used to reduce the dust pollution during construction

5. Runoff Control & Management

- Runoff management is a process to control the direction, volume and velocity of the transported medium and safely convey storm water so that its potential to cause erosion is reduced. They help to direct storm water away from exposed soils.
- Transport control should direct the flow to areas where the sediment can be trapped and removed. This will decrease the amount of runoff, detain runoff to reduce its velocity and divert runoff from erodible areas. The runoff control and management that can be applied in development sites are earth drain and culvert.

a. Perimeter Control

- Placed below areas where sheet flows discharge from the site.
- Perimeter Drain is to be provided to divert off site runoff around the construction site to stabilized area**.**

Water move across the road surface laterally or longitudinally. Lateral drainage is achieved by crowning or by in- or out- sloping of road surfaces (**Figure 8.2.3**) and (**Figure 8.2.3).** Longitudinal water movement is intercepted by dips or cross drains. These drainage features become important on steep grades or on unpaved roads where ruts may channel water longitudinally on the road surface.

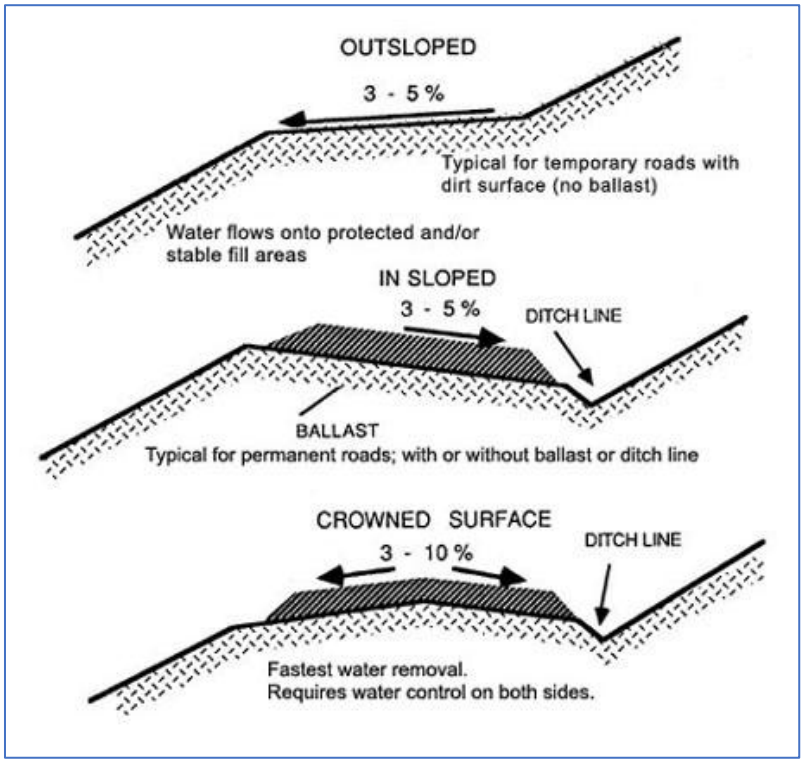


Figure 8.2.3: Road construction grading patterns used to control surface drainage

Ditches and berms serve two primary functions on upland roads: (1) they intercept surface run-off before it reaches erodible areas, such as fill slopes, and (2) they carry run-off and sediment to properly designed settling basins during peak flow events (when circumstances warrant the use of settling basins). Ditches and berms are commonly located at the top of cut and fill slopes and adjacent to the roadway, although mid slope berms may be useful in controlling sediment on cut and fill slopes before erosion control cover has been established.

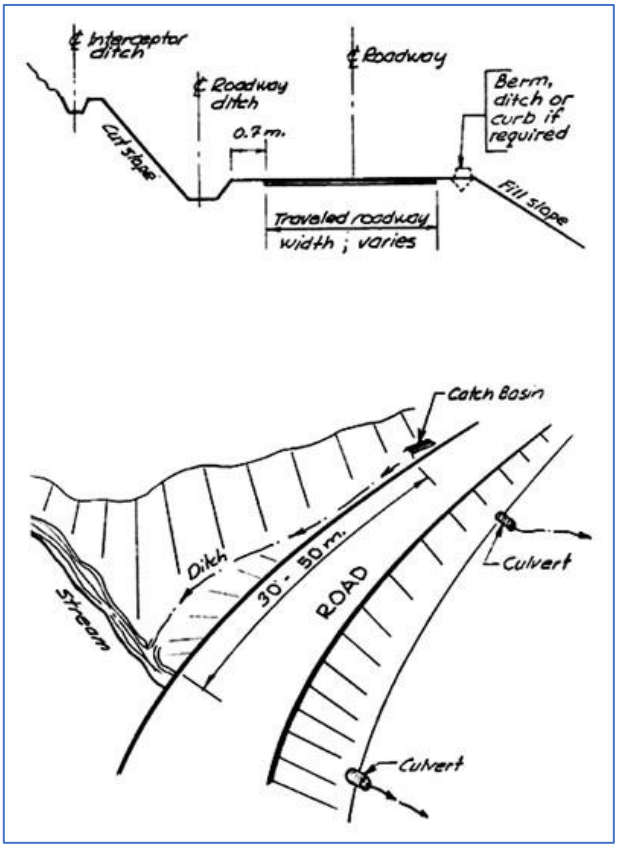


Figure 8.2.4: Road construction grading patterns used to control surface drainage

A series of rock check dam constructed in the temporary earth channel or drainage ditch to reduce the velocity of concentrated stormwater flows, encourage sediment dropout, reduce scour and channel erosion.

b. Earth Drain

The stages and sequences of constructing temporary earth drains will follow the progressive works advancement during site clearing as well as establishment of conveyance channel provision for sediment-laden runoff control measures which will be explained later in general site clearing sub-chapter below.

At the first phase of construction, the temporary earth drain will be built beside the temporary access and discharge to a temporary sediment trap and basin. After that, the temporary earth drain will be built beside the second temporary access during the second phase. Typical temporary earth drain is shown in **Figure 8.2.5**.

Temporary drains are also planned and designed to the best applicable to be constructed that match or coincide with the permanent drainage lines. This will reduce the extent of soil disturbance and double handling as well as saving cost and time duration involve. Invariably, permanent drainage lines will be constructed once entire platforms preparation were totally completed due to design constraint to achieve the required level and establish exact positive drainage lines while its preferable to be constructed and made operable at earliest possible so as reducing the erosion potential using the earth drains.

Drawing of proposed temporary earth drain is shown in **Appendix 11 (Drawing No: LDP2M2 Liput Raya).**

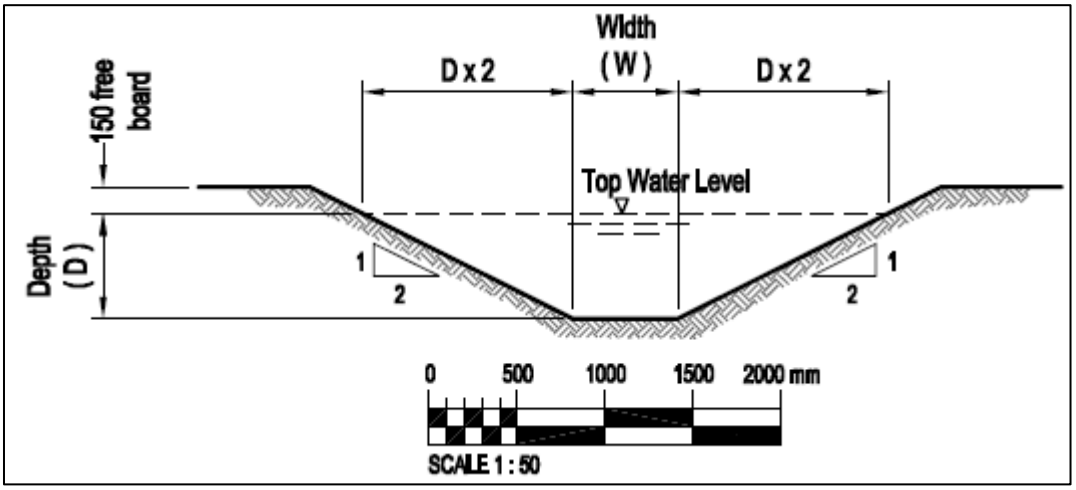


Figure 8.2.5: Typical of Earth Drain

Temporary earth drains function as storm conveyance channels constructed either to divert runoff around slopes or to convey runoff to additional sediment control BMPs prior to discharge of runoff from a site. There are few sizes of temporary earth drain designed to channel the surface runoff on site based on the catchment areas (**Table 8.2.2**)

Table 8.2.2: Sizing of Temporary Earth Drain

Type	Base Width (W) (mm)	Depth (D) (mm)
ED1	450	600
ED2	2000	1000

Source: LD-P2M2 Plan

c. Check dam

Check dam **(Plate 8.2.13)** will be used to reduce the effective slope of the channel, therefore reducing scour and channel erosion by reducing flow velocity and increasing residence time within the channel, allowing sediment to settle. The proposed check dam is proposed to be placed inside the temporary earth drains and major drains once it is constructed. Drawing of proposed check dam is shown in **Appendix 11 (Drawing No: CD/Liput Raya/).**

Plate 8.2.13: Example of Check Dam

d. Temporary or Permanent Waterway Crossing (Bridge/Culvert)

Temporary or Permanent Watercourse Crossing **(Plate 8.2.14)** such as culvert and bridge shall be constructed. The surface of the filling material (if earth is used) on the inlet and outlet end of the culvert or abutment of the both sides of the culvert shall be covered with appropriate materials such as rocks, Rolled Erosion Products (RECPs) and plastic sheeting or turf. Drawing of proposed water ways crossing is shown in **Appendix 11 (Drawing No: LDP2M2 Liput Raya.**)

Plate 8.2.14: Example of Culvert

6. Sediment Prevention Control

Storm water runoff is the principal cause of soil erosion. Proper storm water handling for erosion control can be accomplished by one combination of the following ways which are reduction and detention of the runoff, interception and diversion of runoff. Under the construction, the following are proposed as measures to minimize and mitigate erosion and sedimentation as well as other environmental issues:

Table 8.2.3: Sediment Control Facilities

SEDIMENT BASIN
• A sediment basin (**Plate 8.2.15**) is a temporary pond built on a construction site to capture eroded or disturbed soil that is washed off during rain storms, and protect the water quality of a nearby stream, river, lake, or bay where constructed by excavation or by erecting an earthen embankment across a low area or drainage swale. Sediment basins are larger than sediment traps, but the construction approach is similar. • It is typically consisting of an impoundment, a dam, a riser pipe outlet, and an emergency spillway. Usually, sediment basins have more spillway protection because of their larger flows. Most have risers and outlet pipes rather than rock spillways to handle the larger flows. Sediment basins are often designed to serve later as storm water treatment ponds. Before the runoff is discharge, the sediment-laden soil settles in the pond. • The proposed sediment basin at project site will be used as a temporary detention pond for flood control at downstream project. The riser pipe outlet will be used as an outlet control structure.

Plate 8.2.15: Sediment Basin

LOCATION OF SEDIMENT BASIN		
NAME	LONGITUDE	LATITUDE
SB1	101° 33' 27.725" E	3° 55' 47.828" N
SB2	101° 33' 29.090" E	3° 55' 47.547" N
SB3	101° 32' 36.560" E	3° 55' 48.364" N
SB4	101° 32' 37.581" E	3° 55' 48.472" N
SB5	101° 32' 42.912" E	3° 55' 47.275" N
SB6	101° 32' 41.653" E	3° 55' 47.436" N
SB7	101° 32' 57.067" E	3° 55' 35.321" N
SB8	101° 33' 33.441" E	3° 55' 44.274" N
SB9	101° 34' 0.396" E	3° 56' 1.072" N
SB10	101° 33' 16.931" E	3° 56' 3.197" N
SB11	101° 33' 40.531" E	3° 55' 56.899" N
SB12	101° 33' 0.822" E	3° 56' 3.739" N

Source: LDP2M2 Drawing

SEDIMENT TRAP

- A sediment trap that was formed by excavation and/or construction of an earthen embankment is known as a small temporary ponding area and usually made with a gravel outlet. **Plate 8.2.16** shows the example of sediment trap and **Plate 8.2.17** shows the example of sediment basin at valley area.

- The purpose of sediment trap is to detain the runoff from disturbed areas for long enough period of time. This is because to allow for a majority of the coarse suspended soil particles in the runoff to settle out. It was constructed as a first step in any land disturbance activity. It must be maintained until the area is permanently protected against erosion by vegetation and/or structures.

Plate 8.2.16: Sediment Trap

LOCATION OF SEDIMENT TRAP		
NAME	LONGITUDE	LATITUDE
ST1	E101° 32' 42.771"	N3° 56' 13.629"
ST2	E101° 32' 44.793"	N3° 56' 13.291"
ST3	E101° 32' 53.644"	N3° 56' 11.974"
ST4	E101° 32' 55.632"	N3° 56' 11.678"
ST5	E101° 33' 19.617"	N3° 56' 15.129"
ST6	E101° 33' 25.394"	N3° 56' 13.227"
ST7	E101° 33' 44.170"	N3° 56' 6.898"
ST8	E101° 32' 6.168"	N3° 55' 21.251"
ST9	E101° 32' 7.350"	N3° 55' 21.347"
ST10	E101° 32' 20.741"	N3° 55' 24.746"
ST11	E101° 32' 58.333"	N3° 55' 30.839"
ST12	E101° 32' 47.849"	N3° 55' 50.190"
ST13	E101° 33' 6.073"	N3° 55' 52.743"
ST14	E101° 33' 7.980"	N3° 55' 52.226"
ST15	E101° 33' 14.589"	N3° 55' 50.526"
ST16	E101° 33' 15.695"	N3° 55' 50.299"
ST17	E101° 33' 20.603"	N3° 55' 49.291"
ST18	E101° 33' 22.056"	N3° 55' 48.992"
ST19	E101° 33' 24.072"	N3° 55' 38.108"
ST20	E101° 33' 38.516"	N3° 55' 45.611"
ST21	E101° 32' 17.986"	N3° 55' 36.182"
ST22	E101° 32' 19.716"	N3° 55' 36.165"
ST23	E101° 33' 2.485"	N3° 56' 3.582"
ST24	E101° 33' 48.157"	N3° 55' 51.997"
ST25	E101° 33' 46.522"	N3° 55' 52.390"
ST26	E101° 33' 9.058"	N3° 56' 2.962"
ST27	E101° 33' 14.008"	N3° 56' 2.409"
ST28	E101° 33' 7.409"	N3° 56' 3.118"
ST29	E101° 33' 43.847"	N3° 55' 58.249"
ST30	E101° 32' 45.915"	N3° 56' 20.195"
ST31	E101° 32' 47.278"	N3° 56' 20.099"
ST32	E101° 32' 55.682"	N3° 56' 16.716"
ST33	E101° 32' 57.146"	N3° 56' 16.181"
ST34	E101° 33' 5.821"	N3° 56' 13.242"
ST35	E101° 33' 6.752"	N3° 56' 12.563"
ST36	E101° 33' 12.116"	N3° 56' 8.659"
ST37	E101° 33' 12.787"	N3° 56' 7.667"
ST38	E101° 33' 16.117"	N3° 56' 4.084"
ST39	E101° 33' 16.020"	N3° 56' 2.139"

LOCATION OF SEDIMENT TRAP		
NAME	LONGITUDE	LATITUDE
ST40	E101° 33' 41.769"	N3° 55' 56.516"
ST41	E101° 33' 50.370"	N3° 55' 54.086"
ST42	E101° 33' 51.521"	N3° 55' 53.817"
ST43	E101° 33' 26.520"	N3° 55' 44.298"
ST44	E101° 33' 27.913"	N3° 55' 44.176"
ST45	E101° 33' 32.282"	N3° 55' 44.227"
ST46	E101° 32' 42.149"	N3° 55' 50.183"
ST47	E101° 32' 40.640"	N3° 55' 50.324"
ST48	E101° 32' 37.028"	N3° 55' 50.391"
ST49	E101° 32' 35.696"	N3° 55' 50.415"
ST50	E101° 32' 21.165"	N3° 55' 32.164"
ST51	E101° 32' 19.353"	N3° 55' 31.565"
ST52	E101° 32' 55.925"	N3° 55' 34.698"
ST53	E101° 33' 57.423"	N3° 55' 59.202"
ST54	E101° 33' 32.369"	N3° 55' 46.874"
ST55	E101° 32' 7.393"	N3° 55' 18.728"
ST56	E101° 32' 8.801"	N3° 55' 18.603"
ST57	E101° 32' 24.321"	N3° 55' 23.511"
ST58	E101° 32' 24.408"	N3° 55' 24.688"
ST59	E101° 32' 20.322"	N3° 55' 26.251"
ST60	E101° 33' 17.949"	N3° 55' 30.983"
ST61	E101° 33' 30.480"	N3° 55' 33.269"
ST62	E101° 34' 15.183"	N3° 56' 0.562"
ST63	E101° 33' 39.086"	N3° 55' 54.355"
ST64	E101° 33' 37.596"	N3° 55' 54.792"
ST65	E101° 33' 22.681"	N3° 55' 33.031"
ST66	E101° 33' 19.022"	N3° 55' 31.378"
ST67	E101° 33' 27.725"	N3° 55' 47.828"
ST68	E101° 33' 29.090"	N3° 55' 47.547"

Plate 8.2.17 Example of Sediment basin at valley area

Sediment markers **(Plate 8.2.18)** make it easy to determine when the sediment depth is between 3 and 6 feet and needs to be removed. A vertical silt marker shall be installed for the purpose of measuring the depth of accumulated sediment to facilitate maintenance program. Sediment trap and basins are required and to be maintained until the site area is permanently protected against erosion. All sediment trap and basin must be constructed inclusive of the riser pipe which will be connected to the final discharge point.

Plate 8.2.18 Sediment Marker

7. <u>Stockpile Management</u>

The stockpile area shall be located at a minimum 30m away from any nearby waterways. Sufficient drainage networks surrounding the stockpile must be provided and channeled to a sediment trap and basin for sediment control. Low bunds can also be constructed to protect the stockpiles from runoff.

8.2.2 Site Maintenance

A maintenance programme shall be prepared to include plans for the removal and disposal of unwanted sediments, the repair of structural damages, and improvement or modification of BMP's. Regular inspection should also be planned before and after each storm event for on a fixed interval. The project proponent shall construct and maintain all the LD-P2M2 tools. All necessary temporary drainage shall be provided for keeping the site and other areas free of standing water. Final discharge from the logging activities site shall comply with ambient standards for TSS (50 mg/L and below (DOE, 1996)).

The success and key to control erosion and sedimentation and its proposed LDP2M2 lie on effective inspection and maintenance to ensure that the proposed measures operating as intended design for.

Inspection should be undertaken;

- During any storm event where rainfall may exceeds the capacity of sediment basin and any permanent water quality structures
- After any storm event especially with substantial runoff
- Weekly as a routine
- Before site closure and other time where site may be left unattended for more than 3 days
- All the BMP's at site every time the amount of precipitation more than 12.55 mm. The rain gauge model installed on site to measure the precipitation.

The inspection shall cover the followings activities but not limited to;

- Inspection of catch drains, earth banks and initiate cleaning if necessary
- Inspection of any damage and required restoration
- Removal of stockpile material or sediment if necessary
- Determine any new erosion and sedimentation control measures that may be necessary

Maintenance work should be carried out based on the site inspection done. This work must be carried out immediately by the construction team and may comprise of the followings;

- Sediment Trap shall be regularly desilted and the sediment shall be disposed off site in compliance with local regulations at designated disposal area. The interval of desilting shall depend on the rain conditions but the accumulated sediment shall not allow to be filled by more than

2/3 of its depth. Debris or construction waste material washed into the silt trap must be removed immediately to prevent blockage and damage to the bund wall.

- Sediment accumulated at the silt fence shall be removed manually. Sediment shall be temporary placed on site before being removed off site as above. Any damage to the fence must be repaired immediately and construction debris washed onto the fence removed.
- Any erosion to the temporary earth drain shall be repaired. Sediment build up shall be removed and ensure sediment laden runoff flow to the silt trap or sediment control measures.
- Accumulated sediment at the check dam shall be removed once its reach 1/3 of its height. Any damage shall be repaired immediately.
- Stabilized Access shall be kept in proper order. Gravel/crusher run shall be regularly reinstated.

Record of the work carried out shall be kept and maintenance Log shall be regularly updated.

8.2.3 Best Management Practices (BMPs)

The selection of the Best Management Practices shall be done in such a manner that the stated objectives can be achieved and workable to be carried out on site. A number of the proposed best management practices at Project site is shown in **Table 8.2.4**.

Table 8.2.4: Number of Best Management Practices (BMPs)

No.	Types of BMP	Number of Proposed BMP (Development)	Number of Proposed BMP (Operation)
1.	Sediment Trap	68	19
2.	Sediment Basin	10	7
3.	Temporary or Permanent Waterway Crossing (Culvert/Bridge)	31	31

Source: LD-P2M2 Drawing

The implementation of the LD-P2M2 Plan in **Appendix 11** shall be carried out throughout the project implementation stages and some BMP's may become permanent as part of the project design. Any changes or modifications need to be carried out in a systematic manner where revision plans shall be issued to all relevant parties clearly indicating the changes.

8.2.4 Self-regulation via the Establishment of Environmental Performance Monitoring Committee (EPMC) and Performance Monitoring Documentation

The project proponent shall "establish a project Environmental Performance Monitoring Committee (EPMC) to monitor the environmental performance and effectiveness of pollution prevention and mitigation measures (P2M2s), and status of regulatory compliance of the project", as stipulated in the DOE's *Guidance Document for the Preparation of the Document on Land Disturbing Pollution Prevention and Mitigation Measures (LD-P2M2)*

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8.3 WASTE MANAGEMENT

a. Biomass Wastes

Mitigation measures and benefits

MITIGATION MEASURES	BENEFITS
• Apply zero burning method during land preparation. • Felled trees must be cut into small pieces and piled in between planting rows and left to rot or being use for stacking to act to hold the soil and reduce erosion. • Signage "No Burning" shall be erected at places that can be seen by workers. • The remaining non-marketable trees are useful as building material for temporary bridges or for a foundation in road development. • Using air burner for vegetative waste. • Biomass also can be cut into small pieces and then then it can have buried in the trenches at toe slope. • Biomass must be cut into small pieces or will be shredded and then sell to factory to converted into chipping board.	• Zero burning method improves nutrient cycling, soil fertility and maintains soil moisture. • Reduce inorganic fertilizers consumption. • Minimize risk of water pollution through leaching or surface wash of nutrients. • Reduce management cost and faster plantation development. • Increase economic and sustain ecology. • Air burner is a pollution control device which is an efficient burn that significantly reduces combustion time and smoke generation. Besides that it helps in reducing the trucking impact on the roads and traffic.

b. Solid Wastes

Mitigation measures and benefits

MITIGATION MEASURES	BENEFITS
• Contractors shall provide garbage bins to collect solid wastes. • Solid waste segregated by the waste type. • Implement recycling campaign at the base camp where workers can segregate the recyclable wastes into PET bottles, glass, bottles, and other waste (mixed wastes) (**Plate 8.3.1**). The collection of recyclable materials can be brought to the collection centre.  **Plate 8.3.1: Example of Recycling Bins** • Composting is recommended to dispose food wastes from worker camp. • Non-degradable wastes such as plastics, food containers, drink cans, glass and bottles must be disposed at an approved landfill site. • The non-degradable wastes also can be sold to recycle premises. • Wastes are prohibited from being discharged into river systems. • Contractors should notify workers not to burn the solid waste.	• Composting will help to improve soil fertility. • Recycling will help to sustain the environment. • Recycling will help to increase workers economy.

c. Scheduled Wastes

Mitigation measures and benefits

MITIGATION MEASURES
Containers of Agrochemicals and Fertilizers • All Scheduled Waste handling procedures must parallel with the Environmental Quality (Scheduled Waste) Regulations 2005 especially for Regulation 3, 8, 10, 11 and 12. • All empty containers must be labeled as Scheduled Wastes. • Proper storage area must be built to store empty agrochemical and fertilizer containers and must be kept away from heat to prevent explosion. • The storage area should be equipped with firefighting and other emergency response equipment as well as spill kit and comply fully with the requirements of the Fire and Rescue Department of Malaysia. Clear signage must be placed at appropriate area to reduce risks of explosions. • A storage facility must be built in proper condition and sheltered. The designated area should not be located at areas that has the potential to be flooded or close to the edge of hill or slopes. The pesticides should be stored at a minimum distance of 90 meters from surface water bodies and 30 meters from base camp based on “Garis Panduan Akta Racun Perosak”. • The entire storage area must be fenced-in and regarded as restricted area. Adequate signage should be put up clearly and visible with the word “DANGER” and “SCHEDULED WASTES STORAGE”. • Empty containers are prohibited from being disposed into river system and onto ground. Use only eco-friendly and/or organic fertilizer and biological control for pest management. • According to *Skim Amalan Ladang Baik Malaysia (SALM)* adopted by the Department of Agriculture, the pesticide container (high density polyethylene (HDPE)), poly bag, fertilizer bottles and others should be recycled. The pesticide container can be cleaned by the method of triple rinsing (**Figure 8.3.1**). • The floor of the storage area and loading and unloading area must be covered with concrete or any suitable lining material, free of cracks and gaps. **Scheduled Waste (Lubricant Oil)** • A proper container must be selected to store the scheduled waste according to their characteristics of the waste (**Plate 8.3.2**). • Label all containers as Scheduled Waste with clear label according to the type of waste (**Figure 8.3.2**). • Lubricant oil must be stored in containers which are compatible with the Schedules Waste to be stored, durable, and able to prevent spillage or leakage. • The containers shall always be closed during storage. • Scheduled Wastes generated may be stored for 180 days or less and the quantity must not exceed 20 metric tonnes. • All Scheduled Waste must be disposed off at a licensed premise. • The Project proponent must refer to the Guidelines for Packaging, Labeling and

Storage of Scheduled Waste in Malaysia as published by the Department of Environment (Refer **Appendix 12**).

BENEFITS

- Environmental friendly fertilizers and pest control can sustain the ecology and economic. Proper storage and disposal of empty containers avoid soil and water contamination.
- Proper storage and disposal of empty containers avoid soil and water contamination.
- Reduce cost of forest plantation management.
- Avoid spillage and contamination to soil and water

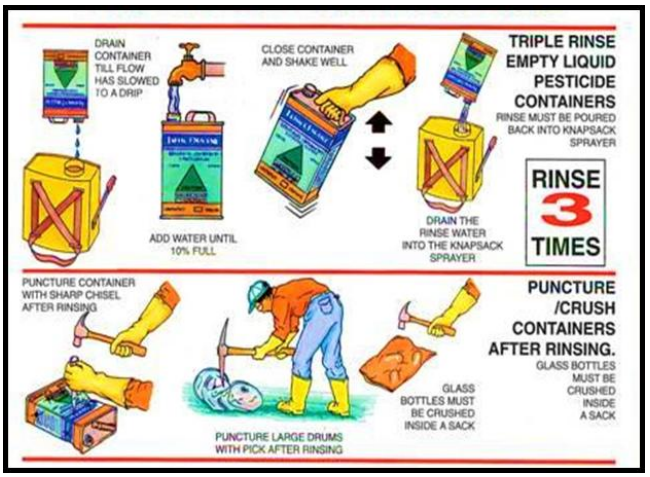


Figure 8.3.1: Safe Handling of Pesticide Containers

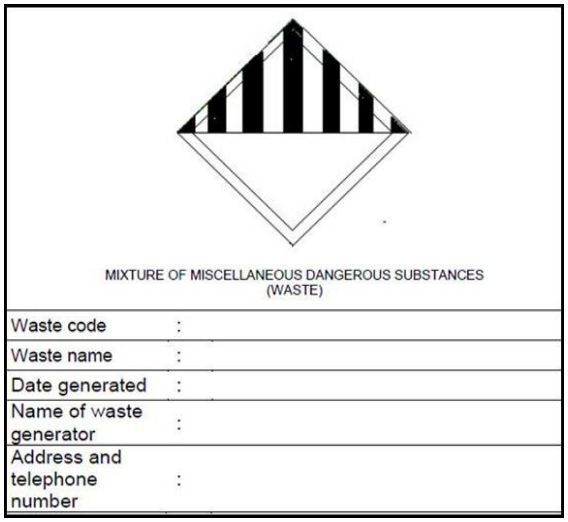
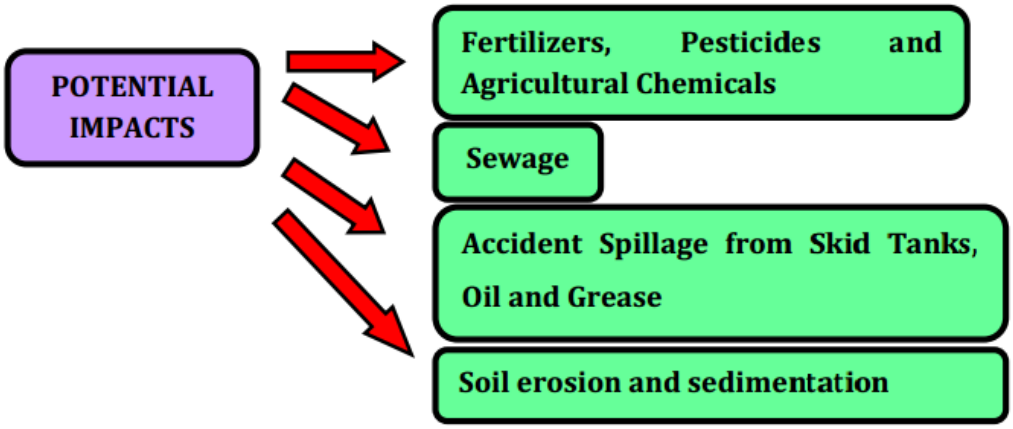


Figure 8.3.2: Example of Label for Scheduled Wastes Container

Plate 8.3.2: Example of Bunghole Plastic Drum (Left) and Open Top Steel Drum with Cover and Clamp (Right)

8.4 WATER POLLUTION

Three significant potential water pollution impacts have been identified with respect to the development of this project.



a. Fertilizers, Pesticides and Agricultural Chemicals

Mitigation Measures

- Fertilizers and agrochemical such as pesticides and weedicides must not be applied during the rainy days and monsoon season. Materials applied during the rainy days and monsoon season are likely to get washed or leached out, diminishing the

beneficial effects of the application to the target site and at the same instance heightening the probability of polluting the environment especially the surrounding stream water.

- Workers must use fertilizers and agrochemicals following the prescribed dosage and should be split to minimize losses e.g. split the annual dosage into 3-4 applications.
- Plantation Management should closely supervise and regulate the method, dosage and frequency of fertilizers and agrochemicals application, so as to maintain cost effectiveness and minimize wastage and prevent environmental pollution.
- Apply weedicides while weeds are in the early growth stage for effective control. This may reduce the dosage of weedicides use at each application.
- Chemicals for pest and disease control should only be applied when the outbreak is severe. If the chemical application is necessary, the usage of appropriate chemicals with sufficient amount should be practiced at the plantation area.
- Mulching, grow cover crops and intercrops practiced as recommended to minimize weeds growth besides to maintain soil fertility.
- The entire storage area should be surrounded by a concrete dike or other equivalent structure designed to contain any spillage of the waste under the worst case scenario. The capacity of the containment should be 110% of the largest container stored in the storage area.
- Any surface water run-off should be channelled to a proper drainage system to avoid the water from entering the storage area.
- Provide a material safety data sheet (MSDS) to employees who may be exposed to hazardous substances in use or dangerous pesticides and herbicides handled or stored. The MSDS will provide all the information related to the safety and health manner, methods to control risks, etc.
- Use environment-friendly insecticides or pesticides. Insecticides or pesticides are only resorted to in outbreak situations where natural enemy pressure is no longer sufficient to manage the pest population. Once the situation is within control, natural controls will be reactivated.

b. Sewage

Mitigation Measures

- The project proponent shall ensure that contractors provide proper sanitary toilets (**Plate 8.4.1**), bathing facilities and proper piping system from the kitchen to channel the sewage water into the septic tank. It is recommended that the workers' quarters and offices are equipped with standardized septic tank for sewage treatment system. Sewage and grey effluents are strictly prohibited from discharged directly to the river systems. These facilities must be maintained by the contractors.

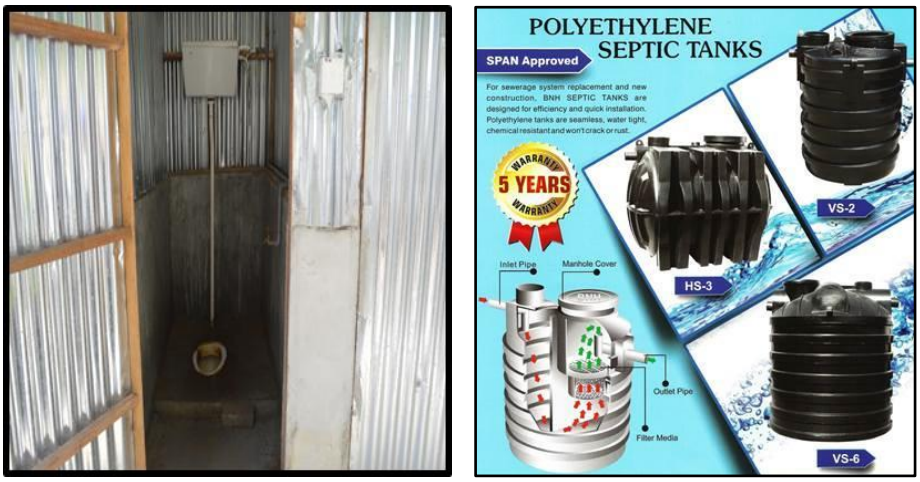


Plate 8.4.1: Example of Portable Toilet & Septic Tank

- Contractors are responsible to explain to the workers with regards to maintaining proper sanitation and cleanliness in the base camp to prevent diseases occurrence and transmission.
- The toilet facility with septic tank must be provided by project proponent and contractors. It shall comply with requirement from Health Department and National Water Services Commission (SPAN).
- If subjected, all regulations stipulated in the Environmental Quality (Sewage) Regulations 2009. The important sewage regulations that need to be concerned as follow:

REGULATION	DESCRIPTION
Regulation 12	Prohibition against sewage through by-pass
Regulation 14	Prohibition against discharge of sludge into inland waters or Malaysian waters
Regulation 15	Restriction on the disposal of sludge onto land

Penalty: Fine not exceeding one hundred thousand ringgit or to a term of imprisonment for a period not exceeding 5 years or to both and to a further fine not exceeding one thousand ringgit a day for every day that offence is continued after the notice by the Director General requiring him to cease the act specified in the notice has been serve upon him.

c. Accident Spillage from Skid Tanks, Oil and Grease

Mitigation Measures

- Used oil and grease and lubricants from machineries or other equipment should NOT be disposed into the river, water channel nearby or ground. Used oil must be stored in container and managed as scheduled waste and disposed only at the licensed facility.
- To avoid oil and grease leakage, regular maintenance of the vehicles is necessary.
- The workshop for vehicles and equipment maintenance area must be built with concrete floor which free of cracks and gaps. Storage area of bulk tanks must be covered with concrete floor and equipped with containment wall as preventive measures of fuel spillage. Drainage system around the workshop area must be equipped with oil and grease trap.
- Skid/storage tanks (**Plate 8.4.2**), if any, must be located on stable ground which not prone to flood phenomenon with bunding and sited at least 50 m away from the waterway. Used oil must be kept in proper containers to avoid leakage and contaminate groundwater.

Plate 8.4.2: Example of Skid/Storage Tank on Stable Ground

- Development of containment bund must be accommodating at least 110% of the contents of the largest tank of fuel tank that been used at the Project site. The pumping facilities to pump in the oil spillage shall be provided. The design of skid tank is shown in **Figure 8.4.1.**
- The fuel skid tanks in the storage yard must be properly constructed and fitted with bunds following the DOE guidelines.

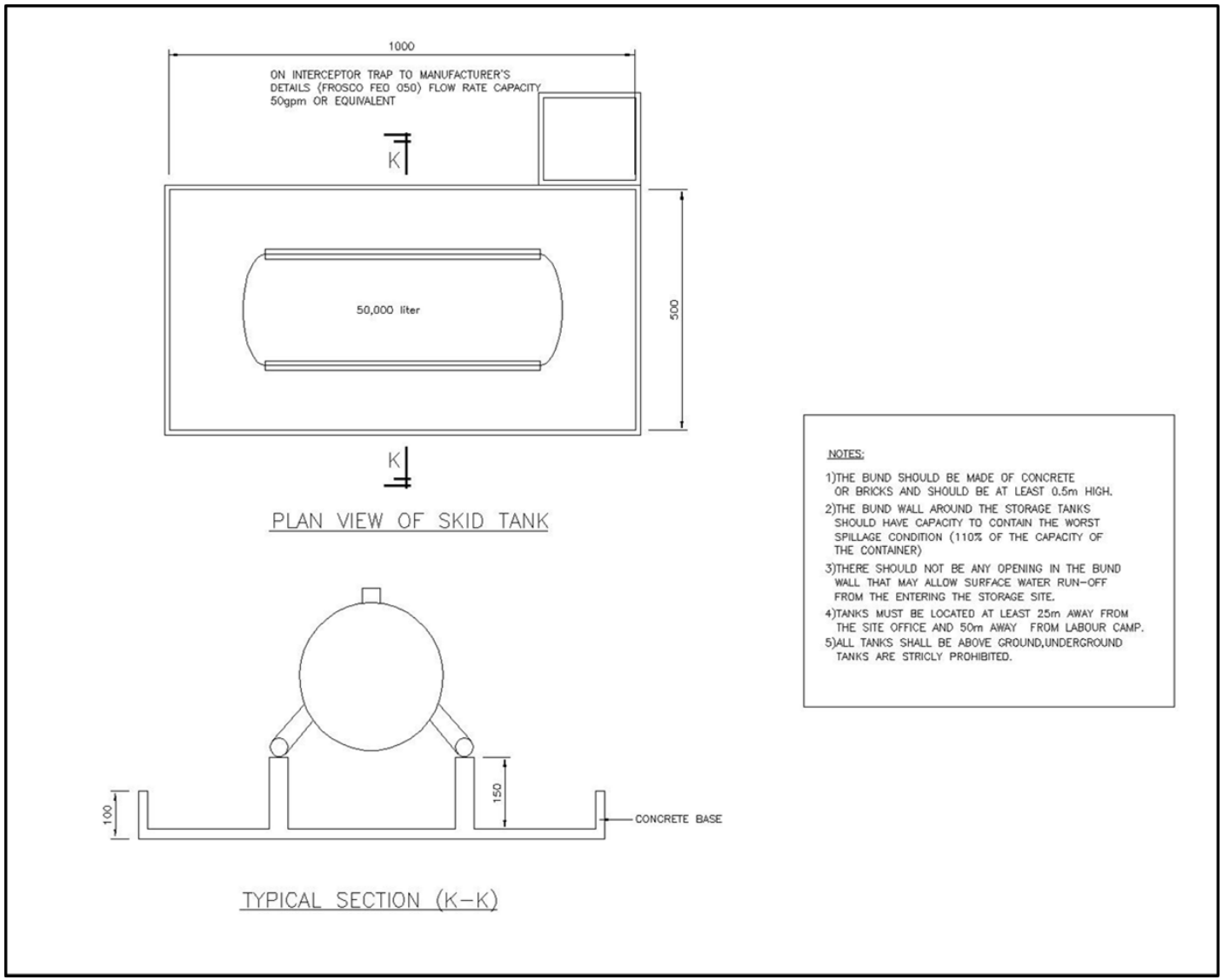


Figure 8.4.1: The Design of Skid Tank

8.5 AIR POLLUTION

Mitigation Measures

- Reducing the dispersion of dust from unsealed road by limiting the vehicles speed. Temporary road humps / speed bumps should be installed at the road system in the project site.
- Maintain the sealed road with crusher run or gravel to protect the earth surface from precipitation and dry weather.
- Vehicles should be regularly serviced and maintained to reduce undesirable emissions.
- Open burning is strictly prohibited under the *Environmental Quality Act, 1974, Section 29A (1).* Notwithstanding anything to the contrary contained in this act, no person shall allow or cause open burning on any premises.
- Workers are strictly prohibited to carry out open burning at site. Any incidents must be reported and the offender must be fined.
- The usage of generator set in the site has to comply with the *Environmental Quality (Clean Air) Regulations 2014, Regulations No. 5.* Written notification must be forwarded to the DOE**.**
- The mitigation measures for agrochemical, fertilizers and etc. as mentioned in Subchapter **8.3.2.3(a)** must follow effectively. Workers involved in spraying activities must be equipped with appropriate protective gears such as mask, glove, long sleeve clothes, long pant to minimize the direct impacts.
- Use sensible biological control in managing forest plantation to reduce use of pesticides and other poisons. With less use of pesticides, the insect predators can be allowed to breed. Insect predators can be found throughout plants, including the parts below ground, as well as in nearby shrubs and trees. Some species may play an important role in the suppression of some pests.
- Where applicable, the Project proponent shall adopt Best Management Practices (BMPs) for control of fugitive dusts/aerosols as suggested in **Table 8.5.1.**

Table 8.5.1: Best Management Practices for Control of Fugitive Dust

BEST MANAGEMENT PRACTICE (where applicable)	**DESCRIPTION**
Apply dust suppression measures when required 	Even if the regular schedule is thrown off, it may be a one-time occurrence, or the schedule may need adjusting to more frequent application intervals.
Clean up those dusty spills immediately 	Don't wait for the next scheduled housekeeping - the mess will just get bigger and will take longer to mitigate.
Pave haul roads and storage areas 	Heavy vehicles pulverize the surface material and create a constant source of dust. If wholesale paving is too costly, pave just the entrance and exit to minimize carryout, and gravel the remainder to reduce the amount of surface silt.
Water or/and sweep often 	Ensure that vehicle traffic is not picking up dust for wind action and carryout. Fewer treatments are necessary in cool, wet weather. "Reasonable dust control measures" are required by some local fugitive dust rules, as are an adequate water supply and keeping dust control equipment in good working order.

BEST MANAGEMENT PRACTICE (where applicable)	DESCRIPTION
Reduce speed 	Speed Limits on unpaved surfaces to 10 or 15 miles per hour (~15 or ~25 km per hour) for well-travelled areas and heavy vehicles, never to exceed 25 mph (~40 km/h) for any vehicle on any unpaved surface.
Prevent transport of dusty material offsite 	Rinsing vehicles before they leave the Project site and tightly cover loaded trucks.

Source: Modified and adapted from California Environmental Protection Agency (2007)

8.6 NOISE POLLUTION

Mitigation Measures

- Modifying existing old equipment with damping materials and mufflers.
- Work should be limited to daytime hours (0700 to 1900) only.
- Noise barriers such as existing vegetation at the boundary of the project site shall be maintained to minimize noise diffusion.
- Vehicles and machineries shall be regularly serviced and maintained.
- The supervisor for the project site must keep a log book to compile all complaints from the surrounding dwellers and address the issues immediately.
- Proper mitigation measures for the personnel likely to be exposed to high noise level like provision of Ear Protective Safety Equipment (ear plug & ear muff) **(Plate 8.6.1).**

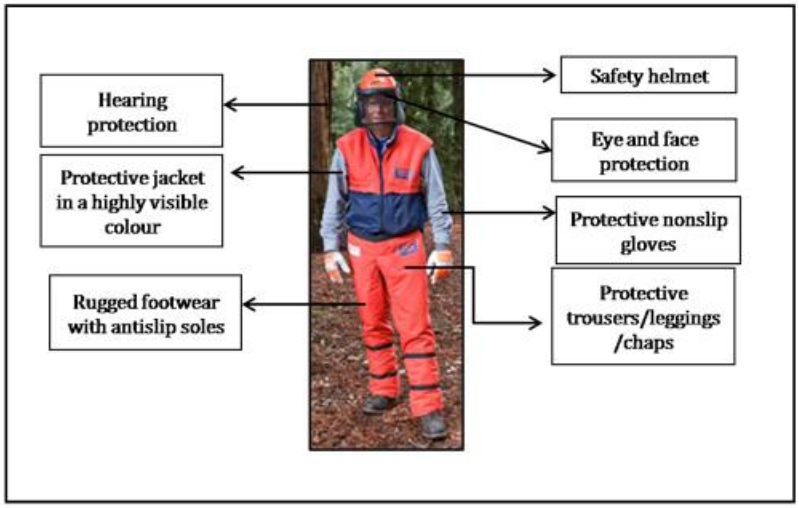


Plate 8.6.1: Proper Personal Protective Equipment (PPE) during Working Hours

8.7 FLORA AND FAUNA

a. Flora

Mitigation Measures

- Land preparation shall be done in stages follow the phase development as proposed in **Chapter 5**.
- Vegetative cover along rivers and streams must be retained to act as buffer zones to protect river banks and river ecosystems.
- Bare areas shall be stabilized and planted with cover crops after completion of land preparation works. The cover crop will help to maintain soil nutrient that needed by the crops and sustain soil moisture that plays an important role in the development of weather patterns and the production of precipitation.
- Start the land preparation near the existing roads and moving towards the forest areas as mentioned in **Chapter 5**.

b. Fauna

Mitigating Measures for Terrestrial Vertebrate Fauna

I. Mitigation Measures – Loss and Displacement of Fauna

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;

- Employ knowledgeable and experienced environmental officer to look into this matter. Among the responsibilities of this person is to ensure the facilitation of safe fauna escape and no or very minimal loss in fauna. Despite the fact that almost all of the habitat and vegetation had been cleared, the remaining or any further clearing works must be monitored. 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 (DWNP) 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.
- The clearing should be heading towards the remaining forest and habitats in the surroundings and must not be fragmented.

II. Prohibition of Wildlife Poaching and Trapping

- The contractors and workers must be prohibited from wildlife hunting and poaching. The Wildlife Conservation Act 2010 [Act 716] states that any person who commits an offence (illegal poaching and hunting) be liable to a fine and imprisonment for a term (**Plate 8.7.1**). Offences pertaining to totally protected species carry a mandatory jail term and a fine of up to RM 500 000 if convicted

Plate 8.7.1: Offence & Penalty for Wildlife Trapping or Hunting

- Access roads must be constructed for the purpose of the forest plantation development only. Unauthorized individuals shall prevent from using these roads to prevent illegal hunting and trapping.
- Place “No Hunting” and “No Trespassing” signage at appropriate locations that can be seen by the contractors and workers (**Plate 8.7.2**).

Plate 8.7.2: No Hunting Signage

Plate 8.7.3: Example of Warning Sign for Wildlife Poaching

- 24 hours surveillance at the entrance of the access road to the project site will prevent the intrusion by poachers and other intruders hunting or trapping of wildlife species (**Plate 8.7.4**).

Plate 8.7.4: Example of Permanent Guard House

- Any information related to illegal hunting and poaching should be reported to the contractors and/or the plantation management immediately and that information must be channeled to the relevant enforcement authority, e.g. Department of Wildlife and National Parks, Police Department and etc.
- A Wildlife Management Plan (WMP) needs to be established to counter potential negative impacts of the project. The proposed environmental monitoring and auditing program will ensure that environmental requirements are observed and abided by the project proponent.

- Wildlife Monitoring Team should be established to monitor the encroachment of wildlife (eg: Elephant, Sunbear , Tapir and etc.) with the cooperation of PERHILITAN.

Reporting to Department of Wildlife and National Park

- Any human-wildlife conflict occur on site should be reported to the Department of Wildlife and National Park (DWNP).
- Cooperate and seek advices with the DWNP on any plans involving the mitigation of encroachment by mammals (eg. Installations of LED light for mitigating elephant disruption)

Development of Ditch

The project proponent/plantation management shall seek advice from the PERHILITAN for the development of a ditch or fencing at the boundary of project site taking into account the most efficient protection measure and costs. The size of the trench is usually 3m x 2m. Once constructed, the ditch or any other structural control system shall be well maintained to ensure its' effectiveness.

Figure 8.7.1 shows the mitigation strategies for wildlife. **Plate 8.7.5** shows the example of animal trench to protect from wildlife encroachment.

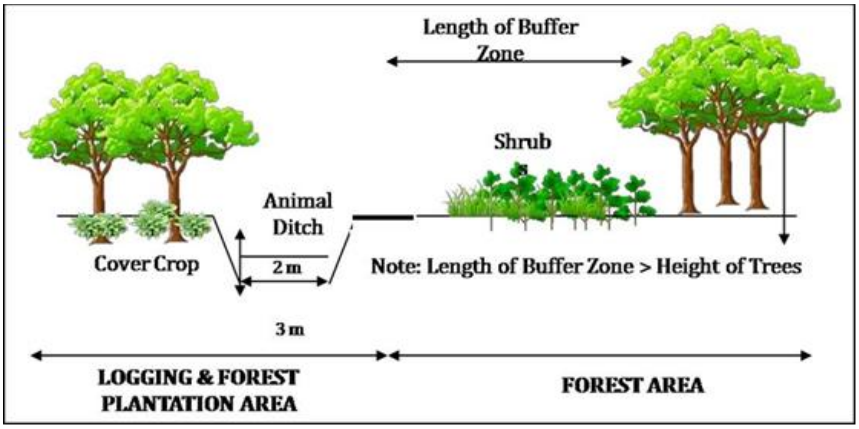


Figure 8.7.1: Ditch for Human-Wildlife Conflict Prevention

Plate 8.7.5: Example of Animal Trench

Avifauna

Mitigation Measures for avifauna

i. Incident Reporting

- If a tree containing an active nest of a specially protected species is felled, the incident should be informed and reported to the wildlife custodian, the Department of Wildlife and National Parks.
- In this case the advice on what practical steps might be possible should be sought in order to provide necessary aids to translocation by employing proper handling procedure.
- Furthermore, if the workers are able to see a suspicious individual, with a trap in hand and able to see his/her vehicles, attempt to get a license plate number and a description of the individual so that the authority will take an action regarding this matter.

ii. Signage on Prohibition of Bird Hunting or Trapping

A warning post must be erected in order to remind the poachers about the offense and the penalty they have to face if committed breaking the law. Proper signage on prohibition of bird hunting or trapping must be placed at suitable conspicuous locations for workers and contractors (**Figure 8.7.2**). Violators will be prosecuted if they break the law.

Figure 8.7.2: Example of No Hunting Sign

iii. Monitoring and Auditing Program

An Environmental Management Plan (EMP) is recommended to be established to counter the potential negative impacts described in the preceding paragraphs. The proposed environmental monitoring and auditing program in the EMP will ensure that environmental requirements are observed and abided by the project proponent.

8.8 SOCIO-ECONOMY

Mitigation Measures

a) Job Opportunities

The Project Proponent should sincerely approach local community heads and advertise to the community to encourage locals to participate in jobs suitable to locals' skills.

b) Management of Wildlife

Project proponent should follows as proposed by consultant in section for wild management. Awareness should be conduct to workers and locals on illegal and wildlife encroachment to make them aware of the laws and potential risks. Before conducting any actions, consultation from the Department of Wildlife and National Parks is essential before conduct any activities.

c) Orang Asli Roaming Area

Orang Asli roaming area covers the area of Bukit Slim Forest Reserve. The forest products could also be found at other adjacent forest areas where Orang Asli can find other sources

of petai, rattan and forest products. Their livelihood would not be totally destroyed and they can still find them in other areas beside the proposed project site. But the Orang Asli may have travel further distances. Further, Orang Asli is still a concern as the proposed project would destroy their roaming areas.

d) Flood

The project proponent needs to emphasize the importance of building a drainage system prior to starting the project. Implement mitigation measures and best management practices (BMP) (e.g., turfing, temporary earth drains, check dams, sandbags, sediment basin, sediment fence) on-site to control peak discharge to the water bodies and control erosion sediment removal at surface dumps following EMP, ESCP and MASMA guidelines. The proposed sediment basin at project site will be used as a temporary detention pond for flood control at downstream project.

e) Corporate Social Responsibility (CSR)

CSR is one of the approaches that help those affected people to be appreciated and improved their social wellbeing. Example of CSR can be community service such as gotong royong, tree planting and maintenance of access road (paved / tar road).

f) Public Engagement

Annual community meetings between the communities affected and project proponents need to be carried out. The project proponent should always update the progress or problem from developing the proposed project to prevent any misunderstanding and ensure the development of the proposed project can be operated smoothly.

g) Other mitigation measures

- The project site must also have demarcated boundary markers and fences to determine the working area and to avoid unnecessary trespassing from local people and wildlife that can cause incidents.
- Existing road condition needs to be upgraded by having proper signage and traffic guides.

- Suppose there is a case of disturbance from wildlife. In that case, the Department of Wildlife and National Park involvement is essential for any advice and suitable actions based on the management's inventory records.
- The Project Proponent must visually observe, monitor and control all the machinery used in the site preparation phase. The Project Proponent must also have time limits (8 am to 6 pm daily) to operate heavy machinery to minimize the noise annoyance, especially during the late evening.
- Project Proponent also needs to monitor air pollution i.e., fugitive dust generation that the proposed activities may cause. It may help the local people to live in a more comfortable condition during this phase.
- The Project Proponent and his contractors must observe the following aspects:
    - Workers must be given sufficient instructions, training, advice and information of good work procedures, work ethics, and code of conduct and safety rulings during working hours. The work/ base camps must be sited away nearby local settlement area.
    - The relationship between the worker and local people must also be monitored to avoid any problem generated by a poor understanding of local culture and values.

8.9 MITIGATION MEASURES DURING OPERATION PHASE

8.9.1 Soil Erosion

There are some recommended mitigation measures to be done during operation measures such as:

- Well established ground covers that have been planted during the development phase shall be maintained and function efficiently. Withered ground cover must be replanted to ensure there is no gap exposed the soil surface to the weather.
- All Erosion Control tools should be maintained regularly to ensure that they work efficiently.
- Vegetation along the rivers must be retained as buffers to trap eroded material from being carried away by runoff to enter the water bodies. Sedimentation will subsequently reduce the storage capacity of the river.
- Clear and proper signage must be placed at the river buffer zone to avoid the invasion of the reserve area that would destroy the vegetation cover along the river banks that acts to retain eroded material from enter the water body.
- The fertilizer and herbicide used shall comply the guidelines established by Department of Agriculture (DOA). It shall include the amount, method and timing for the usage of the fertilizer and herbicide. Inappropriate management of fertilizer and herbicide might possess harm and degradation toward the soil characteristics and water quality of the project site.
- Apply wood/branches chips as mulching material in the plantation area. Mulching is the application of materials on the ground surface to reduce soil temperature and conserve soil moisture to improve growth and yield of plants besides supplying varying amounts of plant nutrients as they decompose and finally can reduce the soil erosion.
- For the active road, the road system should be inspected at regular intervals, especially after heavy rainfall to detect problems and to schedule repairs. The debris should be cleared from the culverts, ditches, dips and other drainage structure to decrease clogging that can lead to washouts. The debris should be placed where it cannot be washed back into these structures or into open water.

8.9.2 Water Pollution

- A proper storage facility must be built to store agrochemicals and fertilizers from being exposed to the weather. It should be located distant from the water bodies. The containers must be properly labeled and secured to avoid any spillage.
- The chemicals container specification must follow the standard established by the Environmental Quality (Scheduled Wastes) Regulations 2005.
- In order to avoid the soil erosion risk in the project site, the ESCP establishment from the early stage of project implementation shall be well maintained and monitored efficiently at all time.
- The manuring process must be scheduled and application of fertilizers should be avoided during the rainy days.
- Chemicals for pest and disease control should only be applied when the outbreak is severe e.g. leaf blight caused by *Rhizoctoniasolani*. If the application is necessary, sufficient usage of the right chemicals at the correct concentration should be practiced.
- Biological control is highly recommended to be implemented in forest plantation. The characteristic of forest soils are basically low in the availability of nitrogen. Therefore, tree growth is often less than optimal, even in unmanaged ecosystems (Sharon G., 1980). Some flowering ground cover can be planted in the plantation area such as *Clitoria ternate*, *Desmodium triflorum*, *Cassia sp*. and etc. to promote the nitrogen fixation to the soil, pest and weed control. Furthermore, other cover crops can be used during this phase, hence, the used of fertilizers and agro chemicals can be reduced.

Plate 8.9.1: *Clitoria ternate*

Plate 8.9.2: *Desmodium triflorum*

Plate 8.9.3: *Cassia sp*.

- The growth of Leguminous Cover Crop (LCC) should be monitored regularly for preserving its function of retaining the soil and reducing the risk of the soil erosion. Therefore, it will eventually absorb the excessive amount of fertilizers and reduce the possibility of water pollution.

8.9.3 Waste Management (Sewage)

- The project proponent needs to provide the temporary toilet equipped with a septic tank. The toilets with septic tank must fulfilling the requirements of the Department of Health and National Water Services Commission (SPAN) that are maintained regularly to ensure their effectiveness.
- If subjected, project proponent and contractors shall comply with all the regulations that subjected to *Environmental Quality (Sewage) Regulations 2009*.
- The base camp operator has to maintain the toilets in accordance to the sound engineering practice for the treatment of sewage and ensure all the components of the sewage treatment systems are in good working condition.
- Wastewater collected from canteen kitchens from basins, sinks and floor drains should be discharged into foul sewers via grease traps capable of providing at least 20 minutes retention during peak flow.

8.9.4 Air Quality and Noise

- The using of agrochemicals if and only if it is absolutely necessary.
- The workers must be trained on proper safety on site and implementing the operational spraying procedures.
- The frequency, dosage and timing of chemicals application must be closely monitored. Spraying should be forbidden on rainy and windy days.
- Only approved chemicals registered under the Pesticides Act 1974 with the Pesticides Board of Malaysia should be used.
- Use sensible biological control with no known side-effects wherever and whenever possible to reduce the use of pesticides.
- 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 a direct contact (**Figure 8.9.1**).

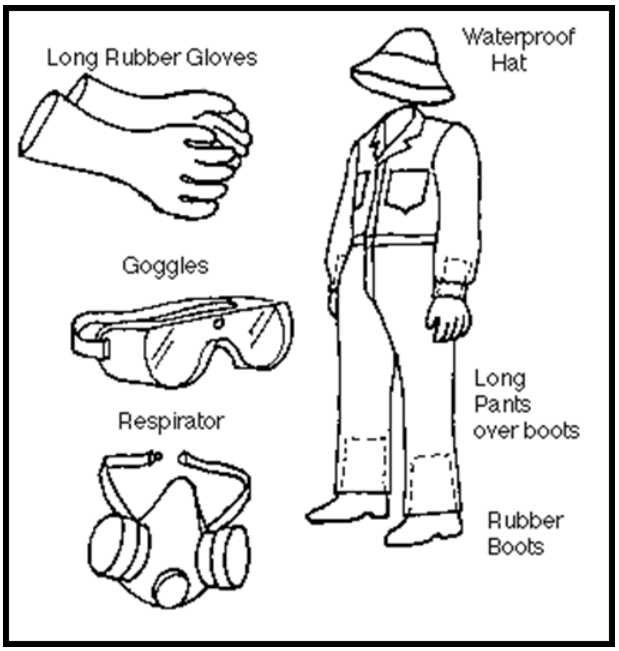


Figure 8.9.1: Example of Appropriate Protective Gears during Spraying Activities

8.9.5 Flora and Fauna

Mammals

- The newly planted seedlings need to be ditched properly in order to reduce trespassing by wildlife into the project site. The boundary of the project site and the forest edge shall be made clearly. The boundary shall be well maintained and managed. This is to ensure the forest plantation is free from animal encroachment.
- Workers and local folks must be prohibited from poaching and trapping of any wildlife species. Appropriate warning posts 'No Hunting' should be erected at the approach and at strategic locations along the access road to alert workers. These posts must be put in a good view; to enhance visibility, the color red must be applied to the posts.
- The forest plantation management should erect a guard post at the entrance to the project site. Permanent guard(s) should stand watch 24 hours to prevent hunters or trappers using the access road for hunting or trapping wildlife.
- Any information of illegal hunting or trapping of wildlife should be immediately reported to the plantation management and that information must be channeled to Department of Wildlife and National Parks. This is to enable swift action to be taken.
- A Wildlife Management Plan (WMP) needs to be established to encounter the potential negative impacts of the project, especially toward the wildlife management on the project site. The proposed environmental monitoring and auditing program will ensure that the environmental requirements are observed and abided by the project proponent.

Encourage Bird Diversity

The forest plantation can be characterized broadly by the different microhabitats found within and beyond their boundaries. The forest plantation management is encouraged to manage their plantation area to promote the biodiversity in the area. Some ways to encourage bird diversity in plantation are:

- Plant native flowering and fruit-bearing trees in waterways areas and around the office and quarters areas.

- Improve water quality in waterways.
- Apply moderate or reduce agrochemicals use. Encourage usage of biological control measures to control pests.
- Control illegal hunting or trapping activities in and around the plantation area.

Plate 8.9.4: Example of Signages Prohibition in Forest

8.10 PROJECT ABANDONMENT & REHABILITATION

During project abandonment and rehabilitation, the following mitigation measures shall be implemented:

- The project proponent must endeavor to vacant the project site in an environmentally responsible manner and prepare a Project Abandonment Plan for the main stages of development.
- Warning signs have to be installed at all abandoned sites to prevent unauthorized entry and encroachment by illegal squatters.
- All vehicles involved in the project development must be taken out of the sites.
- All environmental control measures (control of erosion, drainage disruptions, and accumulation of rotting biomass) must be initiated following the guidelines produced by the Department of Environment, and Department of Irrigation and Drainage.
- Provide regular inspection of the sites and take necessary measures to ensure their sanctity.