SABAH FORESTRY DEPARTMENT

DERAMAKOT FORESTRY DISTRICT
(DERAMAKOT FR-FMU 19A & TANGKULAP/SG. PINANGAH FR-FMU17A)

Standard Operating Procedures

Quarrying of Hard Rocks & Excavation of Gravel Pits

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1.0 BACKGROUND & PURPOSE

Sabah Forestry Department (SFD) has initiated a policy to pursue certification by meeting the requirements of Forest Stewardship Council (FSC) as well as national standards in its management system for Sabah. To ensure that the operations are in line with FSC requirements, SFD has developed a series of Guidelines for forest management in 2008 that has been adopted as management procedures for FMU 19A and FMU 17A.

The purpose of this procedure is to define the process for quarrying of hard rocks and excavation of gravel pits for the construction and maintenance of forest roads inside FMU 19A and FMU 17A, that comply with the requirements of the FSC Forest Management Standard.

2.0 SCOPE

The scope of this procedure is limited to **quarrying of hard rocks and excavation of gravel pits** within FMU 19A & 17A managed by SFD. The procedure is to ensure that the hard-rock workings and mining of gravel pits are carried out in an appropriate, effective and environmental friendly manner.

3.0 RESPONSIBILITIES

The following units are responsible for defining, developing, monitoring and rehabilitating sites for quarries and gravel pits:

The Head of the Harvest Planning Unit is responsible for:

- Determining available and suitable quarry sites.
- Mapping (1:5,000) and demarcation of quarry site.
- Pre-harvest planning if involved with tree felling to establish access road and clearing of quarry site.
- Prepare comprehensive harvest plan (CHP). Documentation and mapping of harvest trees and alignment of forest road leading to quarry site.

The Head of the Forest Road Unit is responsible for:

- Quarrying of hard rocks and gravel pit.
- Quantifying/assessing amount of gravel or rock aggregates require for distribution.
- Haulage of gravel or rock aggregates to forest road that requires immediate graveling.
- Distribution, shaping and compaction of rock aggregates and/or gravel on forest roads.

- Monitor to ensure quarrying is done within the demarcated site, if hard-rock working is contracted out to private companies.
- Safety at the work site.
- Mitigating spillages and leakages of diesel and other lubricants.

The Forest Officer (DFO) is responsible for:

- Evaluation of quarrying impacts and preparing mitigation measures.
- Conducting awareness programme and training.
- Monitoring and enforcing all mitigation measures.

4.0 DEFINITIONS

The definitions contain common terms used by FSC and SFD in the procedures for forest management.

FSC: Forest Stewardship Council, an international non-government organization who governance the Forest Management and Chain of Custody standard.

FMU: A clear defined forest area with mapped boundaries, managed by a single managerial body to a set of explicit objectives which are expressed in a self–contained multi-year management plan.

DFO: A District Forestry Officer of the Sabah Forestry Department assign to manage a Forest Management Unit (FMU).

CHP: Comprehensive Harvest Plan. A detail documentation and mapping of trees to be harvested including the alignment of all roads/routes for timber extraction.

5.0 INTRODUCTION

Forest roads connect the most remote parts of the forest. It is crucial to have a steady supply of rock aggregates and gravel to maintain these roads and ensure them usable all year round. Good forest roads facilitate management for timber harvesting, wildlife management, social engagement, fire control and a variety of nature based tourism activities.

Construction and maintenance of forest roads is very costly. Operating between distant places, that is procuring rock aggregates from quarry plants located outside the forest reserves and hauling them for distribution will only exacerbate the already high cost of forest road construction and maintenance.

Therefore, it is appropriate that hard rock quarries and gravel pits should be identified in close proximity to the management areas within the FMU.

This procedure for quarrying of hard rocks and excavation of gravel pits serves to identify potential negative impacts on the operation and define means to mitigate these impacts. Quarrying of hard rocks and excavation of gravel pits in FMU 19A and FMU 17A is temporary (3 – 4 months), but will be re-used if the need arises.

6.0 DEVELOPMENT AND REHABILITATION PROCESS

There are three stages of development, rehabilitation and/or reclamation process:

1. **Planning**
   - Identify, inspect and determine resource suitability of preferred site.
   - Design the operation plan and determine end land use.
   - Layout and demarcate active work areas.

2. **Operations**
   - Prepare pit/quarry for extraction.
   - Follow pit and quarry operating procedures.
   - Ensure site is secured when not in use.

3. **Reclamation**
   - Pit/Quarry closure: temporary or permanent?
   - Site clean-up, re-filling or re-grade as required.
   - Drainage and erosion control, replace overburden and re-vegetation.

6.1 Defining the Site Requirements

Hard rock quarries and gravel pits can basically be defined as those areas which are not possible to excavate the quarry without some degree of primary fragmentation of the rock. This primary fragmentation is necessary to reduce the rock mass to a particle size that can be dug from a loose pile. This can be achieved by drilling and blasting in most circumstances, but depending on the degree of weathering and fracturing of the rock mass, it might be achieved by 'ripping' using a bulldozer, 'rock pecker' and excavator.

In FMU 19A and FMU 17A, hard rock quarries and gravel pits normally include excavations in sedimentary, metamorphic and ultrabasic igneous rock types. Based on hardness and durability, metamorphic and ultrabasic igneous rocks are most suitable for forest road workings. Quarrying generally takes one of two forms:

1. Hill-side rock quarries – characterised by a general downward haulage of excavated material from the quarry area.
2. Gravel pits – a surface or roadside excavation for extracting gravel.

6.2 Operational Procedures

For quarrying of hard rocks, there are four stages in the extraction process:

- Soil and overburden removal;
- Primary (and secondary) fragmentation of the rock mass;
- Excavation and loading; and;
- Haulage to the forest roads that requires immediate graveling.

6.2.1 Soil and Overburden Removal

Overburden can be the soil or loose, unconsolidated material (clay, broken rock, gravel, etc.) overlying the hard rock. Most hard rock settings in FMU 19A and 17A are made of hard rock outcrops in areas of high relief and overburden is absent. If soil and overburden is present, remove and conserve as much of the soil and overburden as possible, and retain it in a condition suitable for re-use.

6.2.2 Fragmentation of Rock Mass

In FMU 19A and 17A, quarrying is on hill-side hard rocks and gravel pits only. There are no open-pit quarries and hard-rock workings do not involve any rock processing plant. Since most rock types in the area are generally highly weathered, the rock mass is already fractured extensively. Drilling and blasting are not required. Mechanical breakage is most suitable. The three forms of mechanical breakage are:

- 'Ripping' using a bulldozer fitted with a tooth at the rear (Photo 1). Ripping techniques is effective in short duration excavations (e.g. for construction and maintenance of forest roads). Ripping has major cost advantages over drilling and blasting, and avoids many of the environmental impacts associated with blasting.
- 'Rock pecker' (Photo 2). Rock peckers have a number of advantages in secondary breaking applications. They are efficient machines and can be used to accurately reduce block sizes in the rock pile. In addition, they can also be used in other works in the quarry, principally in scaling rock faces (to scrap or push off large hanging blocks that may pose safety hazards).
- Excavator (Photo 3). Besides breakage and loosening of rock mass, excavator can also load rock debris onto dump trucks.

Photo 1. Bulldozer fitted with tooth at rear for 'ripping'

Photo 2. Rock pecker

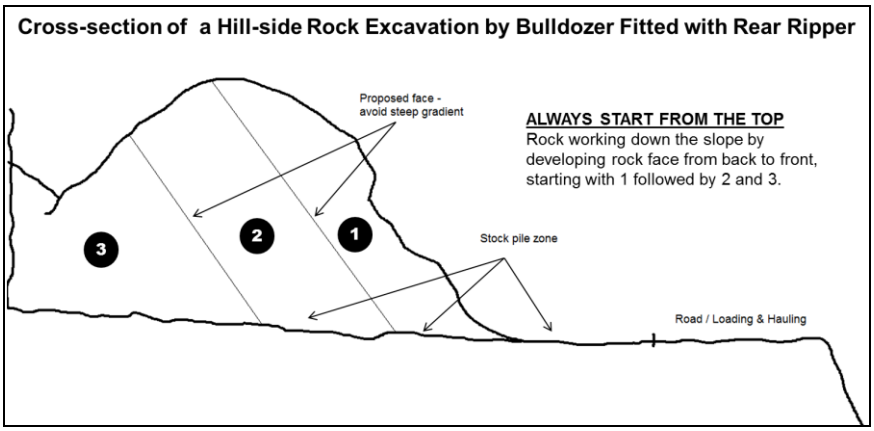
Photo 3. Excavator

6.2.2.1 Workings on Hill-Side Rock Quarry

Procedures for workings on a hill-side rock quarry depend on the three types of machineries used. They are:

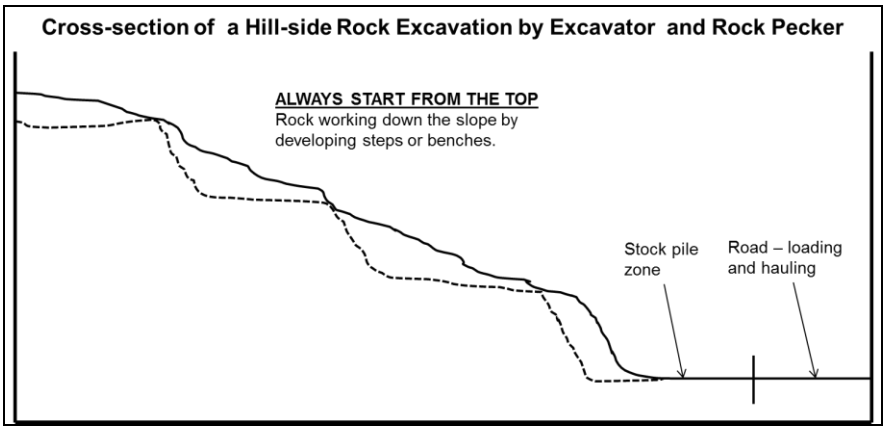
1. The ripper (bulldozer fitted with tooth at rear).
2. Excavator fitted with a multiple toothed bucket or shovel.
3. Rock pecker.

If a ripper (bulldozer fitted with a rear tooth) is used for breakage, the procedure for quarrying of hard rocks is as shown in Sketch 1.



Sketch 1. Ripping of hard rocks using a bulldozer

For the excavator and rock pecker, excavation of hard rocks is as depicted in Sketch 2.



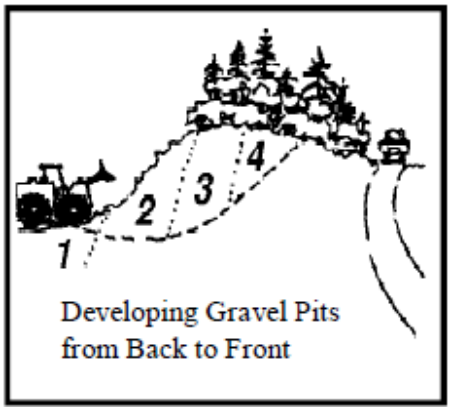
Sketch 2. Excavation of hard rocks using the excavator or rock pecker

Avoid creating steep rock faces because this will lead to falling off or detachment of loose rock masses resulting in injuries or fatalities. Workings of hard rocks should always be initiated from the top to the bottom of the slope.

6.2.2.2 Excavating Gravel Pits at Road Side

Gravel pits are usually located near forest roads. It provides easy access and availability of gravel material to immediately remedy ruts and potholes on forest roads. The appropriate machines use to excavate in gravel pits are the rubber-tired Skidder with shovel or the Backhoe.

Gravel pits should be developed from back to front, moving toward predominant viewer or vantage point as shown in Sketch 3.



Sketch 3. Excavation of gravel pits

In this illustration, Stage 1 has been completed, Stage 2 is in process, and Stages 3 and 4 will follow. Leaving the area adjacent to the road beyond Stage 4 untouched could result in no negative visual impact on the travel route.

6.2.3 Excavation and Loading

Once broken rock has been created in a pile (push by a bulldozer following 'ripping' or 'rock pecker'), rock aggregates are loaded onto dump trucks (tipper) using the excavator or rubber-tired skidder with shovel. They are no excavation plant involving hydraulic face shovels, hydraulic back acting excavators and wheel loading shovels.

6.2.4 Haulage

Dump trucks that can tip (Photo 4) are used for haulage of rock debris to forest roads that requires immediate graveling. Turns/corners on haul routes should be designed, wherever possible to be level, and all effort must be made to avoid 'turns-into-space' (i.e. where the outside of a turn is at a crest of a slope). Care and maintenance of haul routes are key areas in ensuring that efficiency is not compromised.

Photo 4. Tipper Dump Truck

7.0 SITE SAFETY

All quarry sites are considered workplaces and are subject to the Occupational Safety and Health procedures. Training on safety shall be provided prior to quarrying work. Safety and health issues to be considered are:

- Personal Protection Equipment (PPE) such as hard heads, safety boots, goggles and ear muffs
- First Aid
- Water for drinking and cleaning
- Scheduled wastes disposal

8.0 IMPACTS AND MITIGATION

SFD shall define the impacts that may have significant effect to the forest environment. These impacts are mostly negative. All identified impacts must be addressed through formal mitigation measures.

8.1 Impacts

Workings of rock quarries in FMU 19A and FMU 17A are temporary and does not require the development of permanent infrastructure such as living quarters and processing plants. Impacts are only confined to the following:

- Noise
- Dust

- Siltation of streams and river from surface run-offs.
- Ponding
- Aesthetics

8.2 Mitigations

Mitigation measures need to be identified to cushion these impacts. Mitigation to impacts of quarrying and excavating on hill-side hard rock outcrops and gravel pits are as follows:

Noise – In the absence of processing plants and stone crushers, the primary sources of noise are truck traffic and the heavy machines use for breakage, especially the rock peckers. Distance between the noise source and the recipient is an important factor in reducing noise impacts. Since most quarry sites are located at some distance away from the human population, noise is only confine to those working in the vicinity of the quarry. Wildlife will definitely be impacted by noise emanating from quarry sites. Wildlife, especially mammals and the avian will distance themselves from the noise by migrating to the surrounding forest areas.

Dust – Primary sources of dust are from truck traffic and from land areas stripped of vegetation. The basic method for controlling dust is water suppression.

Siltation of streams and rivers from surface run-offs – Divert all visible run-offs from quarry sites or gravel pits to the forest floor. No excavation in close proximity to watercourses (riparian).

Ponding – This usually happens at gravel pits where excavation goes below the water table. Site drainage measures will be required to protect local watercourses and to prevent uncontrolled run-off into the pit. For hard rock sites in particular, topography and space considerations often restrict the ability to form ponds. Water in ponds should be drained to the forest floor and filled up with the overburden material and rehabilitate upon completion of the excavation work.

Aesthetics – Visual impact is usually associated with gravel pits located at the forest road side which is highly visible to the traveler. Locate gravel pits out of the visible corridor as much as possible. Screen pits from travel routes using existing vegetation or landscape berms. Rehabilitate (reforest) pits upon completion of use.