# Contents

1. **INTRODUCTION** 5  
2. **BACK GROUND INFORMATION** 6  
   2.1 Location 6  
   2.2 History and Ownership 6  
   2.3 Site Layout 6  
   2.4 Geology 7  
3. **REGULATORY FRAMEWORK** 9  
4. **QUARRY OPERATIONS** 10  
   4.1 Type of Explosive Utilized and Storage 10  
   4.2 Rehabilitation and Landscape Management 10  
5. **ENVIRONMENTAL EFFECTS** 11  
   5.1 Typical Blasting Problems and Solutions 11  
   5.2 Ground Vibrations 11  
   5.3 Air Blast 13  
   5.4 Fly-Rock 13  
   5.5 Excessive Dust 15  
6. **MONITORING AND RISK MITIGATION MEASURES** 17  
   6.1 Preparation of Appropriate Safe Blasting Design 17  
   6.2 Defining Limits of an Exclusion Zone 20  
   6.3 Relocating People 21  
   6.4 Preparation of Pre-Blasting Inspection Checklist 21  
   6.5 Preparation of Blast Management Template 22
6.6 Accident/Incident Handling and Reporting

6.7 Appropriate use of Personal Protective Equipment (PPE)

6.8 Consultation, Notification and Identification of Blasting Time

6.9 Clearance of the Site

6.10 Final Warning Notification

7. REPORTING

8. CONCLUSION

9. APPENDIX:

9.1 Checklists

9.2 Template

9.3 Accident/Incident Report Format

9.4 Map of Blasting Site
Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
</tr>
<tr>
<td>BMP</td>
<td>Blasting Management Plan</td>
</tr>
<tr>
<td>BMT</td>
<td>Blasting Management Template</td>
</tr>
<tr>
<td>CLC</td>
<td>Community Liaison Committee</td>
</tr>
</tbody>
</table>
1. Introduction

This report covers the blast management plan to be implemented by the joint party of the contractor, CHINA MCC17, and the supervision Consultants, AARVEE Jv.NET, to control and mitigate the problem caused by blasting activity in the Biftu quarry on the immediate local community.

Blasting activity is the main alarm for safety risk due to its potential damage to people, property and infrastructure due to ground vibration and outbreak noise and debris from the blasting activity on the vicinity of the blast. Among the complaints actively raised from the local community include noise disturbance, excessive ground vibration, and damage to property and fly rock and debris as well as dust pollution of the air immediately after the blast. Damage to private owned property in the form of claimed cracking of houses due to the ground vibration is the major complaint.

This report is the supplement report to the previously submitted dust management plan for the crusher site. The parties aim to resume blasting activity by implementing this safe blast management plan without undue risks and vibration damage to structure and the immediate local community.

Therefore the supervision consultant and the contractor have devised this blast management plan with clear procedures to be effectively implemented to consistently minimize/solve the problems henceforth.

A blast management plan (BMP) is a risk control plan used in explosive blasting. It aims to ensure blasts are well planned, protect people in the area and limit damage to the environment.
2. Back Ground Information

2.1 Location
The Biftu Blasting Quarry is located in the South-Western part of Ethiopia about 652 km from the capital Addis Ababa and about 39km from Mizan Town, specifically at km 39+100 LHS 500m. The quarry is used as crushed aggregates and masonry stone production source for the Mizan – Dima road upgrading project. The quarry is owned by MCC 17, the main contractor building the road project.

![Biftu(Gurafera) Blasting quarry site map](image)

2.2 History and Ownership
The quarry site was handed over to the contractor as part of the contract agreement by the Ethiopian Roads Authority in consultation with the local administrative office in 2014 at the commencement of the construction project. The total area of the quarry site handed over to the contractor is 1.8 hectares. The total production site in this area includes the stone production blasting area (the quarry), aggregate crusher facility and hot-mix asphalt processing plant.

2.3 Site Layout
As indicated in the site layout map below the total production facility includes the quarry, the aggregate crusher and asphalt plant. All these facilities are designed in such a way that they are located as practically close to each other as possible but as safely far away from one another as possible.
2.4 Geology

According to the Geologic Map of Ethiopia, the Geology of the area where the quarry site is located is composed of territiary colcanics and low-grade volcano sedimentary rocks of the Ashangi Group with Paleocene-Oligocene – Miocene of Alkili Olivin Basalt. Specifically the quarry material is composed of ridge forming, fractured, volcanic columnar basaltic rock.

The geology of the quarry material has a bearing on the economy and safety of the production. Because of the fractured and columnar nature of the rock it needs less mass of explosive to produce appreciable quantity of rock. The blasted material is also easily reduced into small sizes which is suitable for the crusher. However, it may also be susceptible to fly-rock accident while the ground vibration would be lesser because of lesser need of explosive. With good blast design all safety issues can be addressed to suit the nature of the rock.
Geologic Map of the Area
3. Regulatory Framework

We could not find any regulatory framework in a national as well as local level concerning quarry management in the country. However, relevant regulations prepared for developed countries have been consulted in the preparation of this report. The local need and expectation is also taken into consideration at every step of the preparation and implementation of this plan through regular consultation with the Community, CLC, the Financier and the Client as well as ‘Woreda’ and ‘Zonal’ administrative bodies.

The Contractor has got blasting permission from Ethiopia National Intelligence and Security Service and the Office has approved the Contractor Blaster who has experience and qualification for the work.

A qualified and experienced blasting foreman will be used for the blasting operations that would be responsible: for ensuring each blast has been safely designed, proper safety measures were taken, advance notice has been given immediately before the blast and the exclusion Zone is clear of all people and animals.
4. Quarry Operations
The quarry operations include clearing of the site by removing plants, debris and other unwanted contamination and extraction of the stone by using explosive blasting technique. The blasted and extracted stones are transported to a crusher site for further processing into desired stone aggregates of different size and composition. The location of the stone quarry and the crusher site is within the same production area about 200m apart.

4.1 Type of Explosive Utilized and Storage
An explosive can be defined as any material or device which can produce a sudden outburst of gas, applying a high impulsive loading to the surrounding medium. Chemical explosives are normally used in mining. In this project the contractor is using a detonating explosive namely Ammonium, Nitrate Fuel-Oil (ANFO).

Detonating Explosives are also called High Explosives and are characterized by a super-acoustic reaction rate and produce high blast-hole pressure.

Safe storage of the blasting chemical and accessories is very important as part of risk management in quarrying operation. To this end the chemicals used for blasting are stored in a safe location far away from human and animal habitation with the clearance and direct involvement of the Federal Security Office. The license to purchase, own, store and use has also been properly cleared by the office. The storage is located at km 38+000 LHS 600m.

Blasting operations on site need to be carefully controlled to avoid undesirable consequences, which could include:-

- Risk of damage on structures by ground vibration
- Noise and risk of damage from debris or fly rock

To address all safety issues a proper blast design is carried out and operation is carried out in a manner that addresses the concern and complaints from the community and all other concerned parties.

The community will be advised of impending blasts and appropriate actions will be taken to preserve the safety and amenity of the general public and to address any complaints in a competent and timely manner.

4.2 Rehabilitation and Landscape Management
As part of the ESIA the site quarry operation is also subjected to rehabilitation of quarry areas through filling up of excavations using overburden soil, replanting of the area with appropriate indigenous species of trees, draining of swamps and standing water.
5. Environmental Effects

5.1 Typical Blasting Problems and Solutions
Some of the problems caused by poor blasting design include unlimited ground vibration, air blast, flying rock, noise and excessive dust.

5.2 Ground Vibrations
Using explosives to break rock generates air and ground borne vibrations which may have detrimental effects on nearby structures if the necessary blast design and management procedures are not strictly followed.

In this particular project, most of the complaints received from the local community are attributable to ground vibration from blasting. Hence, this blast management plan aims to decrease and possibly eliminate such complaints by implementing a work procedure which guarantees all the loop holes leading to undesirably excessive ground vibration are avoided at all times of blasting operations.

Part of the excessive ground vibration was created because of the excessive use of explosive mass and depth of hole employed in the previous blasting operations. The contractor used up to 19m of depth of hole and about 95kg of explosive with no benching used, holes dug into flat ground and blasting of the ground rather than the benches in a sort of trench blasting, which might have created excessive ground vibration. This BMP is expected to help in strictly controlling the amount of explosive, depth of hole and number of holes blasted at a time and more importantly the blasting of benches rather than flat ground with appreciable decrease in ground vibration.

Hence, a blast design procedure has been implemented in line with acceptable blasting technical literature and guidelines and in close consultation with the responsible qualified and experienced blast foreman.

This blast design takes the nature of the geology of the quarry rock which is as mentioned above columnar and fractured ridge forming basaltic rock with a need to low energy blasting. Hence, the amount of explosive has been decreased appreciably to decrease the blast ground vibration which is made about 6.5kg of explosive per meter of blast hole. Moreover, the utilization of the bench technique of quarry operation is expected to help in avoiding excessive ground vibration avoiding the practice of trenches blasting. The depth of the blast hole is also related to the ground vibration and hence the depth of hole is also decreased to a maximum of 8m in line with the blast design guideline. The depth of the blast hole is measured by the number of drilling rods used. One drill rod is 3m long. The depth of the blast hole in our case is synonymous with the height of the bench and hence it can easily be ascertained by measuring the bench height.
Hence, the contractor will submit an activity request format prepared for the purpose to the supervising engineer before any blasting operation is allowed. The supervisor will record all observations on the pre-blast checklist which includes the following information which is expected to ensure excessive ground vibration is not produced.

**Action to be taken**

- Utilize three (3) holes per blast, or use a delay system with a maximum of three holes blasted at a time. The spacing of the holes will depend on the burden width as described under section 6.1 blasting design.

- Limit the depth of holes to 8m to minimize the shock. One drill rod is 3m long, so we will check the depth by checking number of rod used for drilling and measuring the left over from the third drilled rod.

- Only utilize 6.5kg of explosive for every meter of blast hole, which is for a stemming length of 4m about 26kg for every hole and 78kg for the total of 3 holes per each blasting operation. The density of the explosive is 812.5 kg/m3 and the rod diameter is 101mm, so the weight of explosive per meter is 6.5kg.

- Use of adequate stemming, a delay detonation system, and drilling and whole loading to ensure that the required blast design is implemented.

- Review of monitoring results and modification of the blast design, if necessary.
5.3 Air Blast
An Air-blast occurs when the explosive energy reaches the free face and is transferred into the air as a wave due to poor blasting management.

Appropriate checklists are prepared to insure that air blast is not created during the blasting operations and unless the required conditions to avoid air blast are not met before the blasting operation then the activity will be canceled by the supervising engineer.

The following practices should be followed to control and manage excessive air blasts:

- Sufficient stemming length will always be used which must be at least 0.7 times the Burden, but in this particular project a stemming length always greater than the burden will be used to minimize fly rock.
- Angular, crushed rock of appropriate size distribution in relation to the blast-hole diameter will be used as the suitable good quality stemming material to be used during blasting. A sand size of dia 4-9 mm ideal for stemming material will be used
- Engineer will always check the free faces for excessive fractures from the back break and for the presence of voids and mud seams before blasting
- Blasting will be suspend at all times when there is adverse weather like foggy or heavy rain due to safety concern.

5.4 Fly-Rock
Fly-rocks are rocks which are propelled beyond the blast area during rock blasting. Fly-rocks present a dangerous situation to the blasting workers during rock blasting as well as to any close
by person and structure; therefore it is always important to secure the blast area and apply solutions that prevent and control fly-rock incidences during blasting.

The supervising engineer will check if the following preconditions are met before any blasting operation.

Action to be taken to control fly-rock

- Optimum explosive charge is chosen to reduce fly rock
- Adjust stemming height to reduce fly rock. Normally stemming height should be equal to the burden, or the minimum distance to the free space. We shall use a stemming height of always more than the burden to reduce fly rock. Increased stemming gives less fly rock but an increased number of boulders and vice versa
- Using sufficient burden width of not less than 35 times the hole diameter, namely 3.5m or more
- The limit of evacuation distance and shooter/bullet point set not less than 500m from outside circumference of the blast areas. And, no one will remains within the defined area.
- Frequently check the rise of the powder column which prevents overloading due to loss of powder in cracks and holes. Overloading causes the release of excessive energy which results in a mismatch between the strength of the rock being blasted and the increased explosive energy. In other words, by increasing the depth of sand for stemming and loosening it will help to minimize the fly-rocks.
- Blasting resulting in fly-rocks due to insufficient burden.
- The presence of rocks on the top of the bench also causes fly-rocks during blasting as these rocks are propelled beyond the blast area, hence it is necessary to ensure that the top of all benches are clean and free of rocks
5.5 Excessive Dust

Rock blasting creates dust as the rock fragments are disturbed due to the explosive energy; the dust can be very intense if the blasted rock contains silica. In this particular project the blast quarry does not contain loose silica. Dust is dangerous and harmful to workers who come in contact with it on a regular basis. Dust can cause short term illnesses and long term illnesses like Silicosis and that is why it is very important for engineers to be well equipped in managing and controlling dust at a blasting site.

In order to control dust from rock blasting, the following action will be applied:

- Spraying with clean water before blasting
- Dust aprons will always be lowered during drilling
- Blast foreman shall not use fine material from previous drilling operations as stemming material
- Sufficient material is used for stemming. We use crushed rock sand for stemming.
- Assessing the weather condition of the day to ensure that wind speed and wind direction does not enhance dust emission from the mine site
Are all Ground Vibration safe limits in place?

Are all Air Blast safety measures in place?

Are all Fly Rock safety measurements in place?

Are all safety measurements in place against excessive dust?
6. Monitoring and Risk Mitigation Measures

Blasting measures will be taken to reduce the extent of high risk coming out from blasting activities through implementing the following mitigation measures:

- Defining of limits of an Exclusion Zone, within which persons or property may be at risk, in this case 500m from the circumference of the blasting operation
- Relocating of all people living within the exclusion zone, and compensation paid for crops and property within that zone
- Preparation of blast management template
- Appropriate use of personal protective equipment (PPE)
- Preparation of appropriate safe blasting design
- Identification and notification of blasting time
- Pre-blasting inspection
- Clearance of the site, and verification that it is clear immediately before the time of blasting
- Final warning notification to community surrounding the site immediately before the time of blasting
- Consultation and handling of complaints from local community

6.1 Preparation of Appropriate Safe Blasting Design

Proper blast design is the most important tool to prevent blasting problems including fly-rock. A qualified and experienced blaster optimizes the balance between rock properties, explosive energy distribution, and explosive energy confinement to reduce the consequences. The most logical approach is to adjust energy distribution and confinement suitable for the rock properties, including geological abnormality. Such optimization would improve fragmentation and minimize blasting problems such as fly rock, ground vibration, and airblast.

Blast design is undertaken for each and every blast in order to maximize the blast efficiency, minimize the dust, fume, ground vibration and air blast, and ensure compliance with site specific blasting conditions. To minimize the consecutive risk upcoming from poor blasting design on people who live around the vicinity of blasting site implementing the under listed design and monitoring mitigation measures will be ensured:

- minimize and limit the weight of explosives used per blast holes
- limit the number of holes per one blast
- limit and decrease the depth of the hole to minimize the shock ground vibration

A typical blast design clearly indicates the diameter of hole, the depth of hole, the slope, the burden, the spacing, the type and amount of charge used, the stemming height, the hole arrangement and type of detonating to be used among other things.

The following diagram shows the basic concepts used in blast design.

![Diagram showing blast design concepts](image)

The following rule of thumb is usually used in a proper blast design:

- $V =$ Burden 25 to 35 times Hole Diameter.
- $E =$ Spacing 1 to 1.5 times Burden.
- $K =$ Bench height 2 to 4.5 times Burden.
- $U =$ Sub drilling 0.2 to 0.5 times burden.
- $h_0 =$ Stemming 0.7 to 1.0 times Burden.

Specific needs of the project demand the manipulation and optimization of the above rule of thumb to cater for specific constraints and requirements in this particular project. A number of combinations of the above requirements can be used to successfully meet the specific needs of any project but with certain requirements to minimize undue side effects or to cater for specific criteria.

Hence, the following design is found sufficient and appropriate for this project.

Hole Diameter, $D = 100\text{mm} =$ that is the actual diameter of our core drill rod.
Burden, \( V = 35 \times 100 = 3500 \text{mm}, \) or about 3.5m (to minimize fly rock)

Spacing, \( E = 1.25 \times 3500 = 4375 \text{mm} \) (or about 4.5m)

Bench Height, \( K = 2 \times 3500 = 7000 \text{mm} \) (8m is decided considering bench height)

Sub drilling, \( U = 0.2 \times 3500 = 700 \text{mm} \) (or 70cm) we use a lower value to avoid ground vibration

Stemming, \( h_o = 1.15 \times 3500 = 4000 \text{mm} \) (or 4m) this helps in reducing fly rock

The fixed conditions are hole diameter and bench height. The specific design for each blast shall be checked to ascertain whether it fulfils not only the above rule of thumb but also the following project specific requirements:

1. The stemming height shall always be greater than the burden to minimize fly rock
2. The burden shall not be less than 35 times the hole diameter
3. The column charge should be 40-100\% of the bottom charge
4. Dry sand dia 4-9 mm ideal for stemming material will be used

Moreover, the following guideline from trusted blasting cartridge and equipment supplier would be implemented in the project for optimum production and less side effects:

- Quality in drilling + blasting can give expected fragmentation, final contour and less vibrations
- Drilling \( \to \) Drill plan, length, dia, direction, deviation
- Charging \( \to \) Weaker explosives in contour + helpers
- Initiation \( \to \) Many small vibrations, less damage
- Good contour, small damage radius \( \to \) less reinforcement
- Avoid failures and interrupted detonations
Defining of limits of an exclusion zone within which persons or property may be at risk will be one of the first measures to be taken as a first and foremost step toward an effective blast management plan.

Exclusion zone is defined as the area within which no person and/or property is allowed to permanently settle or inhabit as long as the blasting activity is not permanently closed due to the safety risk and damage coming from explosive. The limit of the explosive zone has been set at a minimum of 500 meter radius from the circumference of the blasting site for a particular blasting operation. No blasting shall occur within 500m of privately owned property. For this reason, we have agreed with the Contractor to blast in the newly proposed blasting area, which is attached with this plan.
6.3 Relocating People

Relocating of people living within the exclusion zone, and compensation paid for crops and property within that zone will be implemented to ensure the blasting is safe to human and livestock as well as property near the blasting operation. Arrangement shall also be made for those people and property to be evacuated temporarily, for later resettlement of these people to their property after the quarry operation has been terminated or the end of the construction project. ERA and Local Administration have been discussing with the PAP’s within the buffer zone for the implementation.

The consultation meetings are being made with the local affected people and the local administration office to identify the need of the affected people and direct the compensation mechanism accordingly.

The actual surveying exclusion zone boundaries within 500m from the quarry circumference has been done in all directions of the blasting yard and the remaining PAP’s who live within the exclusion zone has been identified for compensation of their crops and any property within the zone for relocation. Currently about 18 individuals has been identified as living within this exclusion zone and arrangement is being made to resettle them elsewhere with consideration to the loss they suffered not only to their permanent property but also due to the lost opportunity during and after their resettlement, such as the yield they lost in their present farms and compounds and the number of seasons they will not be able to get their yield from their crops as livelihood restoration and assistance. ERA and SC have been working on the Livelihood restoration and vulnerable group assessment within the buffer zone.

The blasting operation shall not resume until all people within the exclusion zone has been evacuated, fully compensated and either temporarily or permanently resettled.

6.4 Preparation of Pre-Blasting Inspection Checklist

Pre-blast inspections are undertaken on a regular basis before every blasting operation using the prepared inspection checklist to ensure that no persons, property or livestock are at risk from blasting zone and sentries are posted on all access points to ensure that there is no possible access to the blasting exclusion zone prior to carrying out any blasting.

In this particular quarry operation there are two access points to the quarry site. One is the main access which is also the access point for all vehicles and personnel of the contractor. However, this is also used by the local people occasionally. The other access point is a foot-path only used by the local community who usually come to fetch water from nearby closed water well. Hence, sentries will be posted on both these two access points and this shall be inspected by the works inspector as part of the pre-blast inspection checklist. The completed pre-blast checklist will have been
signed by the Project Manager before it is presented to the Resident Engineer, who would give the final go-ahead by approving and signing the checklist.

Action to be taken

- Initial request to blast will be requested to the RE and the preparation for blast will be started when the RE approve the request.
- The contractor will notify the Engineer of the intent to blast through the RFI and the Engineer will check the pre-blast checklist for approval.
- The Pre-blast Checklist will be completed by the works inspector of the supervision consultant according to the hole and arrangement design and sign it with appropriate comments.
- The Project Manager of the Contractor will sign the Checklist
- The Resident Engineer of the supervising consultant will check and sign the pre-blast checklist.
- Adequately notify the blasting time to all local residents by loud speakers.
- Notify the blasting time to Biftu Woreda police office

6.5 Preparation of Blast Management Template

This guidance includes a template for a BMP that must be used for all blasting operations. For safe supervision BMT will be followed. The template has full information and description of all participants involved in the blasting activity including the time/date of blast the description of responsible experienced blaster and has full description of the name of company and specific blasting place to be blasted and the description of total weight and the no of holes to be blasted at a time.

Therefore this template data’s will in advance be recorded by the responsible blast person signed and submitted with the checklist to the engineer. See attached the copy of the template in the appendices of this BMP.

6.6 Accident/Incident Handling and Reporting

In each blasting activity any accident will be recorded and a special report related to accident/Incident resulting from a specific blast will be prepared and sent to the ERA and the World Bank immediately after such events.

Accident report format is attached in the appendix
6.7 **Appropriate use of Personal Protective Equipment (PPE)**

All the required personal protective equipment (PPE) will be deployed for all local and foreign staff who participates in the blasting activities. These include glove, ear mask, and helmet.

The inspection of PPE will be monitored on the attached checklist

6.8 **Consultation, Notification and Identification of Blasting Time**

The community liaison committee and the Woreda will be consulted and the residents in the area should have to agree on the resumption of blasting before any blasting activity is started.

Before any blasting operation the Contractor should get permission from local police office and the blasting will be carried out in the presence of police. Besides, representatives from community liaison committee (CLC) and Engineer’s representative shall follow the blasting activity.

Consultation and discussions held usually with CLC from local community to solve and handle any complaints raised from the local community and revised the BMP to ensure the safety of risk free blasting activities. The BMP shall be updated as necessary to take into account safety improvements and the reasonable concerns expressed by the community. Any revisions to the BMP shall be subject to the clearance of ERA and the World Bank.

Blasting will be contained within the hours of 9am- 5pm, Monday to Saturday with maximum of four day per week subjected to agreement by the CLC and the local administration. Marketing days, public holidays and religious ceremonial days will be excluded from the schedule. The request for inspection would be submitted to the Resident Engineer 24hr before any blasting activities.

6.9 **Clearance of the Site**

Clearance of the site within the exclusion zone will be checked to ensure it is free and clear of any person, animals and property.

Before blasting the participants who are involve in the blasting activity together with the inspector and police officer will verify that the exclusion zone is cleared immediately before the final shooting.

6.10 **Final Warning Notification**

Notification procedure to the local community will be decided by discussion with the CLC. But, final warning notification to the community will be executed by possible means of communications such as announcing through loud speaker, employing flagmen and mounting posters in the nearby places.

Notification check list is attached in the appendix of this report.
7. Reporting

Reporting of all environmental and social issues relating to blasting activities are undertaken by environmentalist in a monthly basis as per our Environmental management Report. Likewise full summary of blasting monitoring will be prepared and reported by the Contractor and reviewed by the engineer.

All inspection check lists including accidents/incidents resulting from specific blast will be prepared and signed by inspector of works in every blasting day’s and approved by the resident engineer. And, it will be reported to the client and financer immediately after every blasting operation carried out within 24 hours.

8. Conclusion

It is hoped that with proper and diligent practice of the above formulated measures of this BMP the unwanted consequences of the blasting operation on the immediate local community can be avoided and the blasting operation can resume work with no future impediments. However, all parties concerned namely, the contractor, the supervising engineer and the representatives of the local community should work hand in hand to the completion of the project for a successful implementation of the plan to the satisfaction of all parties. The inspectors and engineers as well as blast foremen and employed workers in this blasting operation should be informed of the importance of this plan as well as the moral of safe operation with proper periodic training on the part of the consultant and the contractor for a continued success with manpower training in view.

The effectiveness of this plan will be evaluated through genuine and detailed post-blast reports outlining the success/failure of the implementation of the above procedures every time there is blasting operations.

The report shall include all checklists, templates and photographs showing the actual situation before and after the blast as well as the written and signed documents of satisfaction/dissatisfaction from the community representatives, CLC.
9. APPENDIX:-

9.1 Checklists

- Pre-Blast Checklist
- Blasting Environmental Checklist
- Drill and Blast Supervisor
- PPE
- Post-Blast Checklist
- Security Guard Checklist

9.2 Template

- Blast Design Explosives/charging
- Blasting Notification checklist
- Summary of the Blast
- Shot Firer

9.3 Accident/Incident Report Format

9.4 Map of Blasting Site