DRAFT ENVIRONMENTAL IMPACT ASSESSMENT

OF

SOHMLUH LIMESTONE QUARRY

FOR

Production of 162478 TPA Limestone Minerals

At

Sohmluh, Elaka Wahlong (4.5 Ha.), Wahlong Sirdarship

District-East Khasi Hills, State- Meghalaya

Sponsor :

Shri Shembhalang K. Rymmai

At-Mawthang, Sohkhyllung

Dist-East Khasi Hills

State- Meghalaya

Prepared by :

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September, 2020

FOREWORD

Shri Shembhalang K. Rymmai is proposing to operate a Limestone mine for the production of 162478 TPA Limestone Minerals over an area of 4.5 Ha. is located in Sohmluh, Elaka Wahlong, East Khasi Hills District.

As per SEAC, Meghalaya 32nd Minutes of meeting held during July 21 to 22, 2020 TOR was issued Vide letter No. ML/SEIAA/MIN/EKH/P-41/2020/1482 dated 27th August, 2020, which formed the basis of preparation of draft EIA report.

With a view to assess the potential environmental impacts due to proposed activities, Shri Shembhalang K. Rymmai, Project Proponent has retained Indian Mine Planners & Consultants, Kolkata to undertake Environmental Impact Assessment studies for various environmental components, in order to identify the impacts and its mitigation measures. The report also envisages the prediction of the potential impacts due to the proposed activities.

The timely cooperation and assistance rendered by Shri Shembhalang K. Rymmai is gratefully acknowledged.

Authorised Signatory

Place: Kolkata **Indian Mine Planners & Consultants**

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1.0. INTRODUCTION

1.1. Preamble

Sohmluh Limestone Quarry project is for mining of limestone mineral by Semi mechanized opencast method with drilling and blasting. The applicant of the project is Shembhalang K. Rymmai. Shri Shembhalang K. Rymmai, owner of Sohmluh Limestone Quarry is the authorized signatory. The Government of Meghalaya has issued Letter of Intent for mining lease of limestone (minor mineral) mining in favour of Shri Shembhalang K. Rymmai on dated Shillong 23.03.2019 vide letter no. KH/8/ML/Limestone/68/7734 attached as **Annexure-2**. He has applied for an Environment Clearance after obtaining the necessary approval of the Mining Plan and Progressive Mine Closure Plan from the Directorate of Mineral Resources, Meghalaya vide letter no. DMR/MM/34/2019/28, Shillong dated the 02nd May 2019 attached as **Annexure-3**. The project area is of private land category. No forest area is involved. The mine will be in operation as per the Mining Plan approved by Director of Mineral Resources, Meghalaya vide letter DMR/MM/34/2019/28, Shillong dated the 03th April 2019. This EIA report is for production capacity up to 162478 TPA as per the pre-feasibility report. This is a new mining proposal. The owner of the mine carried out the mining of Limestone for supplying to consumers in producing lime The Limestone from the mines shall be utilised in the lime burning and construction activities.

The mine lease area is less than 50 Ha. hence project comes under Schedule no. 1 (a) Category "B" as per EIA Notification 2006. Mining will commence after obtaining EC and other statutory clearance. As per DMR Shillong Report No. DMR/MM/34/2019/1779, dated 24 January 2020 lease area comes under cluster. DMR Report is attached as **Annexure-4.** The details of lease within a distance of 500 m from the periphery of applied lease area is as follows-

Table- 1.1

S.N.	Approved Mining Plan	Area (hectares)	Mineral	Distance from the approved mining Plan of Sri Shembhalang K Rymmai (meters)
1	Sri Arjust Nongtraw	0.7162	Limestone	310
2	Youroin Enterprise	4.94	Limestone	183
3	Shri Jrop Singh Nongkhlaw	4.1	Limestone	380
4	Shri Debren Nongthraw	0.368	Limestone	302

1.2. General Information on Mining of Minerals

In India, the total resources of limestone of all categories and grades as per UNFC system as on 1.04.2010 are estimated at 184,935 million tonnes, of which 14,926 million tonnes (8%) are under reserve category and 170.009 million tonnes (92%) are under remaining resource category. Karnataka is the leading state having 28% of the total resources followed by Andhra Pradesh (20%), Rajasthan (12%), Gujarat (11%), Meghalaya (9%), Chhattisgarh (5%) and remaining 15% by other states. Gradewise, cement grade has leading share of about 69% followed by open hearth (SMS) & blast furnace (BF) grade (12%) and chemical grade (3%). Remaining 16% are others, not-known and unclassified grades. There were 717 reporting mines in 2013-14. Andhra Pradesh was the leading producing state accounting for (21%) of the total production of limestone, followed by Rajasthan (20%), Madhya Pradesh (13%), Tamil Nadu (9%), Gujarat, Karnataka and Chhattisgarh (8% each). Himachal Pradesh and Maharastra (4% each) and the remaining 5% was contributed by Odisha, Meghalaya, Uttar Pradesh, Jharkhand, Kerala, Bihar, Assam and J&K.

1.3 Environment Clearance

For any developmental activity there is necessity to get environmental clearance from the competent authority as per EIA Notification 2006 and its subsequent amendments. The environmental clearance process is required for 39 types of projects and covers aspects like screening, scoping and evaluation of the upcoming project. The main purpose is to assess impact of the planned project on the environment and people and to try to abate/minimize the same.

1.4 Terms of Reference

The Terms of Reference is prescribed for Project seeking Environmental Clearance (EC) under the provision of the Environment Impact Assessment Notification, 2006 (except for project under item No. 8-a). The Terms of Reference issued after approval of the Ministry/SEIAA is based on the recommendation of the Expert Appraisal Committee (EAC) / State Expert Appraisal Committee (SEAC). In the present case the State Expert Appraisal Committee, Meghalaya (SEAC) in its ToR meeting held during July 21st to 22nd, 2020 (32nd Minutes of meeting) followed by SEIAA' meeting dated 10.08.2020 issued TOR letter vide no. ML/SEIAA/MIN/EKH/P-41/2020/1482 dated 27 August, 2020 for undertaking detailed EIA study for the purpose of obtaining environmental clearance in accordance with the provisions of the EIA Notification; 2006.The TOR issued and its compliance is attached as **Annexure-1** of the EIA report.

1.5 Public Consultation

Public consultation refers to the process by which the concerns of local affected persons and others who have plausible stake in environmental impacts of mining are ascertained with the view to take into account all the material concerns in the project or activity design as appropriate. Public Hearing for the proposed project was conducted on ..... Public Hearing Minutes along with its compliance is attached at Annexure 8 of EIA report.

1.6 Need for EIA

Every anthropogenic activity has some impact on the environment. More often it is harmful to the environment than benign. However, mankind as it is developed today cannot live without taking up these activities for his food, security and other needs. Consequently, there is a need to harmonise developmental activities with the environmental concerns. Environmental impact assessment (EIA) is one of the tools available with the planners to achieve the above-mentioned goal. EIA integrates the environmental concerns in the developmental activities right at the time of initiating for preparing the feasibility report. EIA can often prevent future liabilities or expensive alterations in project design. EIA is the essential tool for assessment of environmental parameters with respect to mining project or activity. This study is done on the basis of examination of compliance of the project to the applicable national standards, laws of regulations and required mitigation measures. On the basis of assessment of all relevant environmental parameters environmental management plan is proposed.

1.7 Post-Environmental Clearance Monitoring

The project managements are required to submit half-yearly compliance reports in respect of the stipulated prior environmental clearance terms and conditions to the regulatory authority concerned on 1st June and 1st December of each calendar year. All such compliance reports submitted shall be public documents. The latest such compliance report shall be displayed on the website of the concerned regulatory authority.

1.8 Transferability of Environmental Clearance

A prior environmental clearance granted for a specific project or activity to an applicant may be transferred during its validity to another legal person entitled to undertake the project or activity on application by the transferor or the transferee with a written "no objection" by the transferor, to, and by the regulatory authority

concerned, on the same terms and conditions under which the prior environmental clearance was initially granted, and for the same validity period. The present project is a new case and no prior Environmental Clearance was granted earlier. The lessee is applying for environmental clearance, on the basis of application submitted Terms of reference were already granted by the competent authority to project proponent. In case of transfer of EC to another person it shall be noted that the EC granted shall hold all the conditions as it were and the time limit will remain the same.

1.9 Generic Structure of Environmental Impact Assessment Document

As per the guideline of EIA notification of the MoEF&CC dated 14th September 2006 as amended Dec 2009, the generic structure of the EIA document should be as under-

- Introduction
- Project Description
- Description of the Environment
- Anticipated Environmental Impact & Mitigation Measures
- Analysis of Alternatives (Technology and site)
- Environmental Monitoring Programme
- Additional Studies
- Project Benefits
- Environmental Management Plan
- Summary & Conclusion
- Disclosure of Consultants engaged

The present report contents are as per generic structure of the guideline given above.

1.10 Details of Project Proponent

Shri Shembhalang K. Rymmai is the applicant of the project. Applicant is a Private Individual.

Correspondence & Registered Address:

Shri Shembhalang K. Rymmai
At- Mawthang, Sohkhyllung
District- East Khasi Hills
State- Meghalaya
Email- rymmaiwahlong2020@gmail.com

1.11 Brief Description of Project

The proposed project is for mining of Limestone mineral at the maximum rate of 162478 TPA in an area of 4.5 ha. The mining will be done by open cast semi mechanized method with drilling and blasting. Detail description is given in Chapter 2.

1.12 Regulatory Compliances: Environmental Legislations Applicable In Development Sector

The environmental consideration in any development process has become a necessity for achieving sustainable development. To achieve these goals, the Ministry of Environment & Forests, Govt. of India, has enacted various acts, legislations, guidelines and standards from time to time. The principal environmental regulatory agency in India is the Ministry of Environment & Forests, New Delhi. MoEF&CC formulates environmental policies and accords environmental clearances for different projects. Organization's adherence to laws, regulations, guidelines and specifications relevant to its business is a part of regulatory compliance. Applicant will strictly follow all the law, regulations, guidelines and standards designed by MoEF&CC and concerned agencies. Applicant is well aware that violations of regulatory compliance regulations will result in legal punishment, including federal fines.

Table- 1.2

Name	Scope and Objective	Key Areas	Operational Agencies/Key Player	Implications on our project
Water (Prevention and Control of Pollution) Act, 1974 and amendments	To provide for the prevention and control of water pollution and enhancing the quality of water	Control sewage and industrial effluent discharges	Central and State Pollution Control Boards	Yes, compliance of EC conditions will be done and PP will initiate monitoring of water quality at regular intervals
Air (Prevention and Control of Pollution) Act,1981 and amendments	To provide for the prevention and control of air pollution	Controls emission of air pollutants	Central and State Pollution Control Board	Yes, compliance of EMP and EC conditions will be done. Action onwards control of pollution and monitoring of Air quality will be taken up as per EMP given in the EIA report.
Noise Pollution	Noise	Control of	Central and	Yes, compliance of

(Regulation & Control) Rule 2000 and amendments	pollution control	noise pollution in residential, commercial, industrial and silent zones	State Pollution Control Board	EMP and EC conditions will be done. Action towards control of Noise pollution and monitoring will be taken up as per EMP given in the EIA report.
Forest (Conservation) Act, 1988 and amendments	To consolidate acquisition of common property such as forest, halt India's rapid deforestation and resulting environmental degradation	Regulates access to natural resources, state has a monopoly right over land, categories forests, restriction on reservation and using forest for non forest purpose	State Government and Central Government	No, The lease is "non forest" land
Wildlife (Protection) Act, 1972 and amendments	To protect wildlife	Creates protected areas (national parks / sanctuaries) categories of wildlife which are protected	State Government and Central Government.	No,
Ancient Monuments and Archaeological sites & Remains Act, 1958 and amendments	To protect ancient monuments of national heritage / importance	Conservation of cultural and historical remains found in India	Archaeological Survey of India	NA, There is no ancient monument within the lease area.
Hazardous & other Wastes (Management & Trans boundary Movement) Rules, 2016	Health and safety	Assessment of hazardous materials and management	Central and State Pollution Control Board	Yes, compliance of EMP and EC conditions will be done. Action towards Management and disposal of Hazardous waste will be duly complied with.

Plastic Waste Management Rules, 2016	Recyclable Waste	Assessment of Recyclable Plastic material.	Central and State Pollution Control Board	Yes, compliance of EMP and EC conditions will be done. Action towards Management and disposal of Municipal waste will be duly complied with.
Solid Waste Management Rules, 2016	Bio-degradable waste Management	Assessment of organic waste material and its management.	Central and State Pollution Control Board	Yes, compliance of EMP and EC conditions will be done. Action towards Management and disposal of Municipal waste will be duly complied with.
Biological Diversity Act, 2002 and amendments	Biodiversity conservation	Disclosure of species survey or collection activities to the National Biodiversity Authority	MoEF, New Delhi and State Forest Departments	Yes, compliance of EMP and EC conditions will be done.
Environment (Protection) Act, 1986 and amendments	To provide for the protection and improvement of environment	An umbrella legislation, supplements pollution laws	Central government nodal agency, MoEF can delegate to state departments of environment	Yes, EIA report has been prepared for the project. Yes, CTO from State Pollution Control Board will be obtained.
Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 and amendments	The new legislation will guide all land acquisitions of central and state governments, bringing in stricter norms and increasing landowners' compensation significantly.	Fair compensation to the assets acquired and proper rehabilitation and resettlement of PAFs with improvement in post acquisition social and economic status	Central and State Government	NA, no habitation exists, therefore compensation on account of land ownership is not applicable.

EIA Notification 14th Sep 2006 and amendments	Environment Impact Assessment	Environmental Protection	Project Development, State and Central Government	Yes, EIA report has been prepared for the project. Once the EC is granted, compliance of EMP and EC conditions will be done.

2.0 PROJECT DESCRIPTION

2.1 GENERAL

The proposed project is for mining of limestone mineral from lease area of 4.5 ha. The maximum production from the mine will be 162478 MT/annum. Mining of mineral will be done by opencast semi mechanized method. The applicant of the project is Shri Shembhalang K. Rymmai. Shri. Shembhalang K. Rymmai, owner of Sohmluh Limestone Mine is the authorized signatory. The Government of Meghalaya has issued Letter of Intent for mining lease of limestone (minor mineral) mining in favour of Shri. Shembhalang K Rymmai on dated Shillong 23.03.2019 vide letter no. KH/8/ML/Limestone/68/7734. He has applied for an Environment Clearance after obtaining the necessary approval of the Mining Plan and Progressive Mine Closure Plan from the Directorate of Mineral Resources, Meghalaya vide letter no. DMR/MM/34/2019/128, dated Shillong, the: 02nd May 2019. The copy of approval letter of the mining plan is given at Annexure no. 2 of the EIA report.

The project area is of private land category. No forest area is involved. The mine will be in operation as per the Mining Plan approved for the period of 5 years from the day of grant and was approved by Director of Mineral Resources, Meghalaya vide letter DMR/MM/34/2019/128, dated Shillong, the: 02nd May 2019. This EIA report is for production capacity up to 162478 TPA as per the pre-feasibility report.

The latitude of the project area N 25°10'42.19" TO N 25°10'50.5"and longitude is E 91°43'00.2" TO 91°43’09.39" E with maximum contour of 156 mRL and minimum contour of 122 mRL. The area falls in the Survey of India Topo-sheet no. 78O/12 (Restricted topo sheet). The lease area forms a part of the individual owned land taken on lease. The proposed land is a Non forest Land according to Divisional Forest Officer, Khasi Hills Ri- Bhoi (T) Division, Shillong (Ref No. KH/8/NOC/Limestone/41/pt.IV/7610, Dated 20.03.2019.

The proposed mine area is a Block (Polygon) shaped land and falls under "Non forest land".

The project comes under Schedule no. 1 (a) and category B as the mine area is less than 50 ha.

2.2.1 Nature of the Project

This is a mining project covered under Schedule 1(a), Category ‘B’ according to Environment (Protection) Act 1986 as amended dated 14th September 2006, and subsequent amendments. The proposed project is for mining of limestone mineral at the rate of 162478 MT/annum. The extent of mining lease area is 4.5 Ha. which comprises of non forest land. The estimated project cost is about Rs 30.45 Lacs.

2.2.2 Demand of the Project

The limestone boulder have a great demand in the local open market as well as for supply to the neighbouring state as building and construction material for various construction purposes as well as for supply to limestone kilns. This contributes direct revenue accruals to the state as well as central exchequer in the form of royalty, GST and cess. The limestone mine will also provide several direct and indirect employments to the local people in the area.

2.2.3 Scope of Study

As per EIA Notification 2006 every entitled project has to undergo four stages of Environmental Clearance i) Screening 2) Scoping 3) Public Consultation 4) Final Appraisal. After the initial process of determination of extent of project and its categorization comes the scoping part. During scoping the Expert Appraisal Committee determine detailed and comprehensive Terms of Reference (TOR) addressing all relevant.

Environmental concerns for the preparation of an Environment Impact Assessment (EIA) Report in respect of the project or activity for which prior environmental clearance is sought. The Committee has determined the Terms of Reference on the basis of the information furnished in the prescribed Form-1 and PFR. EIA Report has been prepared covering all the points directed in the issued Terms of Reference. The TOR from SEIAA, Meghalaya was granted vide letter no. ML/SEIAA/MIN/EKH/P-41/2020/1482; dated 27th August, 2020. Tor letter for the mine and TOR compliance has been enclosed with EIA report. Baseline study was conducted during December- 2019 to Feb 2020.

2.2 TYPE OF THE PROJECT

Present proposal pertains to open cast semi mechanized mining with drilling and blasting of limestone in district East Khasi Hills, Meghalaya. The lease having an area of 4.5 Ha. is located in Sohmluh, Elaka Wahlong, East Khasi Hills District, and State- Meghalaya and comes in Schedule S.No. 1(a), Category-B, for obtaining the environmental clearance. Lease are comes under cluster area.

Land Classification:

The project area around the block represents a rolling topography with gorges/scrap faces and with numerous streams & falls under "non forest land". The details of land classification of 4.5 Ha. of M.L. area is given below:

Table 2.1

Classification of Land within leasehold			
Private Land (Lease)			
Forest Land	**Non- Forest Land (Barren Land)**	**Deemed Forest land**	**Agriculture land**
Nil	4.5 Ha	Nil	**Nil**

2.3 LOCATION OF THE PROJECT

The existing mining site is located in East Khasi Hills district of Meghalaya State. The location map is shown in figure 2.1. The Google Image of the project is shown in figure 2.2. The detailed Environmental Setting is shown in Table 2.2.

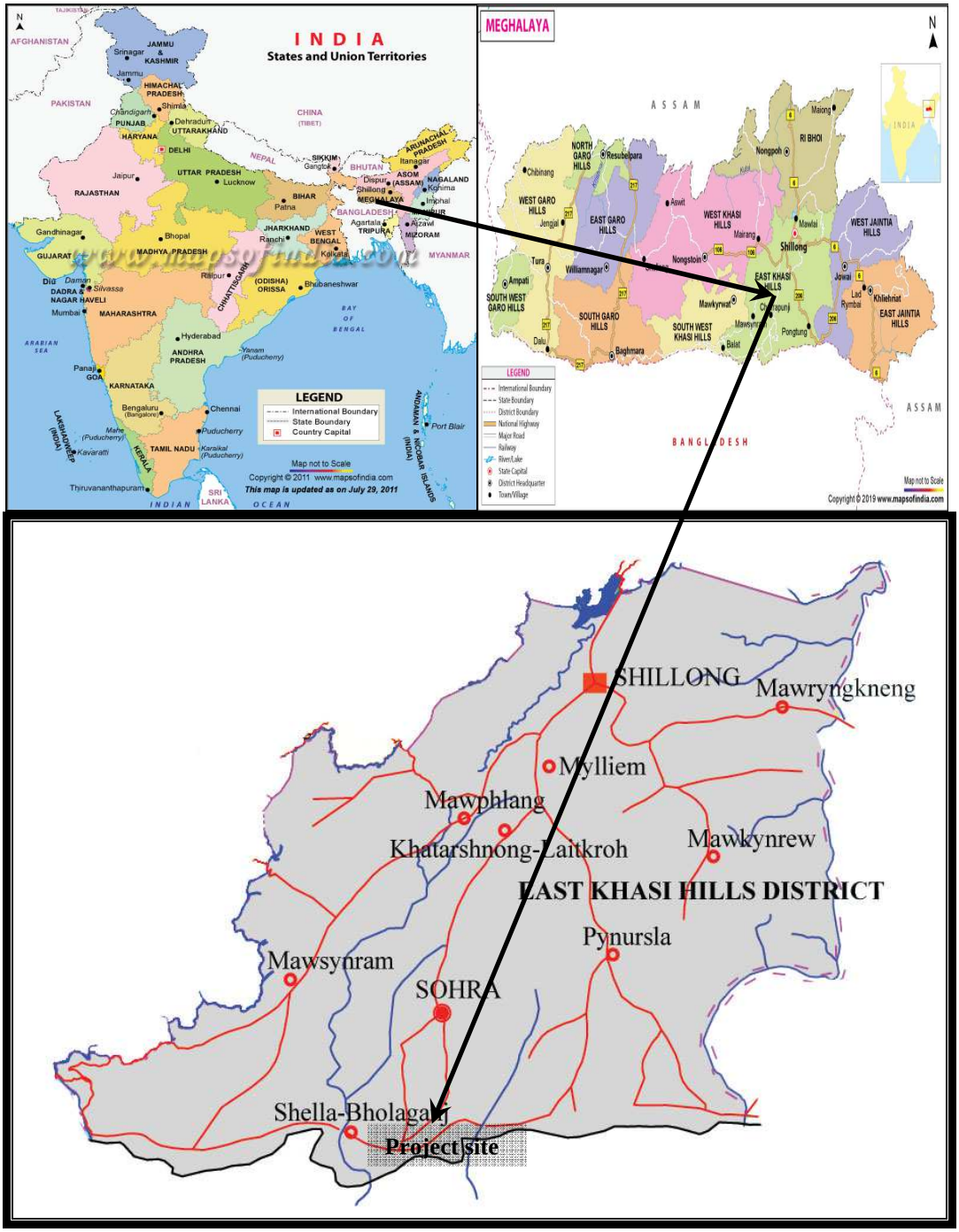


Figure 2.1: Location Map

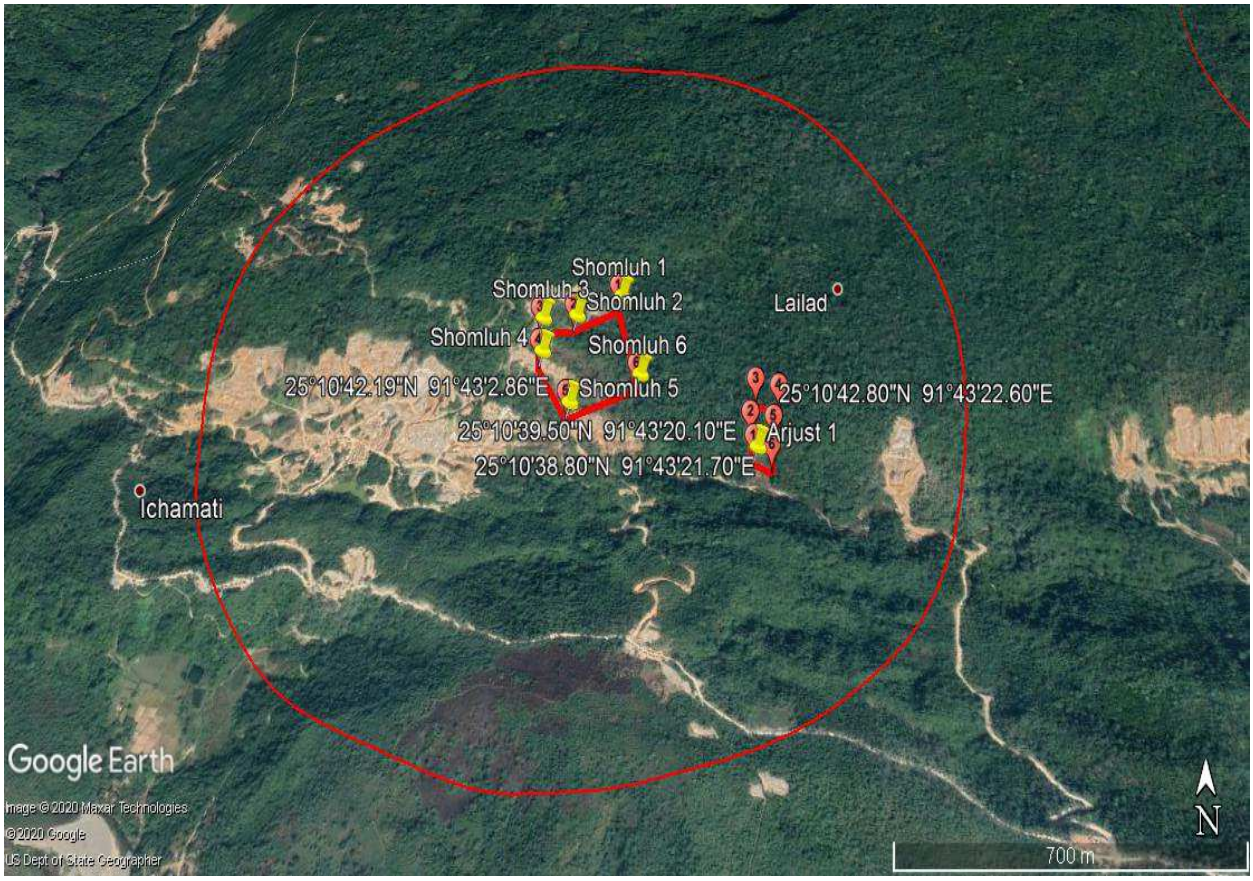


Figure 2.2: Google Image

Table 2.2. Environmental Setting

Sr. No.	Particulars	Details
1	Location	Village- Sohmluh Elaka- Wahlong District- East Khasi Hills State- Meghalaya.
2	Khasra No.	-
4	Total area	4.5 Hectares
5	Village	Sohmluh
6	District	East Khasi Hills
7	State	Meghalaya
8	Site elevation above MSL	Minimum Elevation- 122 m Maximum Elevation- 156 m
9	Geographical location in toposheets	78 O/12
10	Nearest representative IMD station	Cherrapunji, Meghalaya (10 km N)

11	Site topography	The project area around the block represents a rolling topography with gorges/scrap faces and with numerous streams.
12	Nearest highway	SH-5- Sohra- Shella Road (1.5 Km W)
13	Nearest railway station	Guwahati Railway Station (189 Km N)
14	Nearest airport	Guwahati Airport (208 Km North)
15	Nearest river/ Nalla	Wah Tharia River (3.0 Km E)
17	Nearest port	No within 10 km radius
18	Nearest town	Shillong (48 km N)
20	District headquarters	Shillong (48 km N)
21	Nearest state/national boundaries	State boundary between Assam-Meghalaya is at an aerial distance of 70.60 km NE of the mine. Bangladesh International Boundary (65 Km SW)
22	Nearest major city with 2,00,000 population	Shillong (48 km N)
23	Nearest village	Sohmluh
24	Villages within 1 km radius	Khlieh Parmaw
25	Distance from sea coast	Beyond 10 km radius
26	Hills/valleys	Lease area is Hill only
27	Nearest tourist place	Shillong (48 km N)
28	Archaeologically important places	None within 10 km radius
29	Protected areas as per wildlife protection act 1972 (tiger reverses, elephant reserve, biospheres, national parks wildlife sanctuaries, community reserves & conservation reserves)	Nil in 10 km radius
30	Reserved/protected forests	None
31	Seismicity	Seismically this area is categorized under Zone-V.
32	Defence Installations	Nil

2.4 SIZE OF THE PROJECT

The proposal is to mine limestone mineral from the lease area 4.5 Ha the rate of 162478 TPA/ 542 TPD by open cast semi mechanized method with drilling and blasting.

2.5 LEASEHOLD AREA

Topography

The project area around the block represents a rolling topography with gorges/scrap faces and with numerous streams. In the proposed block elevation difference is noted from 122 meters to 156 meters. Karst topography is prevalent with spiky surface with lots of sink-holes and solution cavities. Streams are semi-dendritic and flow towards east before taking southern turn towards Bangladesh. Most of the small tributaries are straight following bedding planes or are semi-dendritic in pattern. Being at the southern slope of the Meghalaya Plateau overlooking vast plain of Bangladesh. The area experiences severe rainfall between May and August with average annual rainfall of 11000 mm.

Drainage

There is no water body in the ML area. At about 3.0 km toward the east the River Wah Tharia is the only prominent river in the area flowing in a East direction before entering Bangladesh.

Existing Land Use of the Core Zone

It is a non forest land, involving 4.5 Ha. The surface plan is attached as Plate no.4.

Table 2.3; Existing Land use of the Mine lease area

Details	Existing (In Ha)
Quarry/ Reservoir	0
Road	0.01
Dump	0
Parapet Wall	0
Garland Drain	0
Plantation	0
Unused	4.49
Total	**4.5**

2.6 GEOLOGY

Regional Geology

In a regional Scale it is obvious that topographic expression is very rugged with the high hills and the following stratigraphic sequence is noted in this part of East Khasi Hills district of Meghalaya.

Age	Group	Formation	Member	Rock types
Palaeocene to Eocene	Jaintia	Kopili Shella Langpar	 Syllhet L. St Syllhet S. St	Argillaceous sediments dominantly limestone Ferruginous sandstone Coarse S St Sandy L. St Calc shale
Cretaceous Jurassic	Khasi Sylhet trap	Mahadek		Conglomerate with coarse, feldspathic, S.St with purple, green clay bands Volcanic trap with vesicles of zeolite and agate
Proterozoic & Archaean	Gneissic Complex			Migmatite, biotite schist and gneiss with quartz /pegmatite veins

Archaean Gneissic Complex of Proterozoic is exposed in the SW and north-central part of the country and is represented dominantly by migmatite, biotite gneiss and biotite schist. It is intruded by basaltic rock which is equivalent to the Sylhet Trap of Jurassic age that attains a thickness of about 600m. The Sylhet trap is hard, compact, massive, fine grained and greenish in colour with vesicles at the top. The upper and lower part of the trap rock is basaltic whereas the middle part is alkali basalt with rhyolite and tuff.

Sedimentary sequence of cretaceous age represented by Mahadek Formation overlies the Proterozoic rocks with a bed of basal conglomerate and is represented by very coarse, feldspathic and glauconitic sandstone that is interbanded with purple to green cloured clay.

Except the aforesaid rock types, the entire part of the region is covered by sediments of the tertiary age with age ranging from Palaeocene to Eocene. Langpar (=Therria) formation is represented by sandy limestone with calcareous shale and sandstone and conformably overlies the Mahadek formation. Limestone occurring at base is grey in colour, siliceous containing rare shells of ostrea, gryphea and lamellibranchs. Sylhet Sandstone member is coarse grained, feldspathic and the overlying Limestone Member that covers the whole southern fringe is of argillaceous limestone with fossils of forminifera. The Kopili formation that is dominantly argillaceous with sporadic

phospathic nodules overlies the Sylhet Formations. All these above Formations trend along ENE-WSW to WNW-ESE direction with southerly dip. Minor faults are recorded within the Sylhet trap and E-W and N-S trending vertical joints are common in the Langpar Formation

Local Geology

The proposed mining area is small and exposes only the limestone of the Sylhet limestone Formation. Table provides a glimpse of the Geology that is seen in the area.

Local Geological set-up in the block

Geological age	Group	Formation	Summarized rock types
Recent	Newer alluvium	Unclassified	Unconsolidated soil, scree material
Eocene	Jaintia	Sylhet	Top part with grey/white limestone Bottom part with dark /steel grey limestone

The block exposes a monotonous litho-package of marly limestone. Limestone is grayish in colour, hard and compact. At places the limestone is steel grey in colour. Fossil content is minimum with numulites, discocyclina and with occasional crystals of calcites. It is difficult to trace bedding plane as the surface is covered with thick calcareous deposition. Extensive weathering result in formation of 'karst topography' on the surface resulting in spiked surface along slopes. Solution cavities, caverns, stylolites with variable magnitude and wavelength are some of the other features seen on the limestone.

Overburden constitutes of unconsolidated fragments, boulders, angular pebbles overlain by brownish soil horizon that rarely exceeds one meter in thickness.

Soil type:

- The soils of the hills are derived from gneissic complex parent materials; they are dark brown to dark reddish-brown in colour, varying in depth from 50-200 cm. The texture of soils varies from loamy to fine loamy. The soils of the alluvial plains adjacent to the northwest and southern plateau are very deep, dark brown to reddish-brown in colour and sandy-loam to silty-clay in texture.
- Meghalaya soils are rich in organic carbon, which is a measure of nitrogen supplying potential of the soil, deficient in available phosphorous and medium to low in available potassium. The reaction of the soils varies from acidic (pH 5.0 to 6.0) to strongly acidic (pH 2.449to 5.0). Most of the soils occurring on higher altitudes under high rainfall belt are strongly acidic due to intense leaching. Base saturation of these soils is less than 35 %. These soils are not suitable for intensive crop production.

- There is not much difference in fertility classes of the soils of the State. Four soils fertility classes, namely, High Low Medium (HLM), High Medium Medium (HMM), Medium Medium Low (MML), Medium Low Medium (MLM) have been established from the soil test data so far compiled in the Soil Testing Laboratory of the State.

Exploration carried out& Future Exploration

None.

2.6.1 Geological Reserves

Resource has been divided into two categories such as Proved Reserve Probable Reserve. Up to an average depth of 60 metres (from ground level) has been taken as Proved Reserve category on the basis of Limestone exposed in the quarry face of the nearby mines and also from the exposure on hill top and slope as well as from the nala cutting section around the applied area and further up to a depth of 5 meters has been taken as Probable Reserve category.

Mineable reserve is based on the mineable part of the reserve. Mineable mineral (Limestone) reserve has been calculated from the geological in the area considering the stone which is to be left out and maintained as Safety Barrier of 7.5 meters within ML boundary and in consideration of ultimate pit limit as calculated from the Geological Plan & section.

Table 2.4

Category of Resource	**Mineable Reserves in Tonnes**	**Non Mineable in Tonnes**	
Proved (111)	3238191	**Feasibility Mineral Resources (211)**	3785360
Probable (122)	10476	**Pre Feasibility Mineral Resources (222)**	613724
TOTAL	**3248667**		**4399084**

2.6.2 Mineable Reserve

As per approved mining plan mineable reserves are 3248667 Tonnes.

2.6.2 Life of Mine

The mineable reserve of the mine area is 3248667 tonnes. Taking the average annual production target of 162433 tonnes and taking 300 as the average no. of working days per annum, the life of mine is estimated to be about 20 years (5 years in Plan period + Fifteen years in Conceptual period.

2.7 PROPOSED SCHEDULE FOR APPROVAL AND IMPLEMENTATION

Mining as proposed will be undertaken after getting the Environmental Clearance and other statutory clearances. Thereafter the project will be implemented as per the directions/guidelines issued by SEIAA, Meghalaya while granting the EC.

2.8 TECHNOLOGY AND PROCESS DESCRIPTION

The process of limestone mining will be opencast semi mechanized mining. Drilling and blasting will be done to break hard limestone.

2.8.1 Mining Method

Semi Mechanized open cast mining will be undertaken with drilling and blasting.

- The width of each bench shall always be maintained to be not less than the height which is 6 m.
- Since the deposit in this area is massive and compact in nature; it is proposed to carry out only opencast semi-mechanized mining during this plan period, i.e. five years.
- **Drilling and Blasting** The operations like drilling of shot holes, sorting of stone and breaking of large sized boulders will be excavated using hydraulic rock breakers and excavators with deploying of Jack hammer drilling (39 mm to 34 mm dia). The holes are generally made up to 3.3 m, having burden and spacing of 1.6 m x 2 m in stagger grid pattern.
- To avoid fly rock problem at the edge of the hill, light charged muffle blasting shall be under taken.

BLASTING:

Since the deposit in this area is massive and compact in nature, it is proposed to carry out only opencast semi-mechanized mining during this plan period, i.e. five years. The operations like drilling of shot holes, sorting of stone and breaking of large sized boulders will be excavated using hydraulic rock breakers and excavators with deploying of Jack hammer drilling (39 to 34 mm dia) will be practice in this area, having burden and spacing of 1.6 m x 2.0 m in stagger grid pattern. To avoid fly rock problem at the edge of the hill, light charged muffle blasting shall be under taken.

Safety precautions in blasting

- The blasting personnel, including the helpers, shall use hard hats (safety helmets) as well as mining boots while on duty.
- The mine shall be evacuated of all workers except the blasting crew, before blasting work is taken up.

- The blasting personnel should always use the blasting shelter for taking protection during blasting operation.
- A warning signal by siren or whistle shall be sounded before the charge is blasted.
- After blasting is over, all the shot holes shall be examined if there is any misfire taking place. The place shall be made safe before the all clear signal is sounded.

2.8.2 Past Production

It is a new mine for which Government of Meghalaya has issued Letter of Intent for mining lease of limestone (minor mineral) mining in favour of Shri. Shembhalang K Rymmai on dated Shillong 23.03.2019 vide letter no. KH/8/ML/Limestone/68/7734 for grant of Mining Lease over an area of 4.5Ha. at Sohmluh, Elaka Wahlong, East Khasi Hills District, Meghalaya for mineral Limestone. There is no past production of mineral from this mine.

2.8.3 Proposed Production

It is proposed to produce a maximum of 162478 TPA of Limestone per year.

Table 2.5

Year	Production of Limestone in Tonnes	Production of Soil in Cu.m
1st	162478	6085
2nd	161096	14438
3rd	161951	0
4th	162243	874
5th	160178	0
Total	**807946**	**21397**

Production schedule for remaining life of the mine will be 162478 tonnes/year.

2.8.4 Details of mining activities with respect to block wise, Calendar Wise, Zonal wise

Mining will be opencast semi mechanized with drilling and blasting with maximum production of 162478 tonnes per year. The proposed production for the planned five years are given as under-

Table – 2.6

Year	Production of Limestone in Tonnes	Production of Soil in Cu.m
1st	162478	6085
2nd	161096	14438
3rd	161951	0
4th	162243	874
5th	160178	0
Total	**807946**	**21397**

2.8.5 List of Equipment

The list of machines as existing and additional to be used is as follows:

Table – 2.7

List of Machinery to be used

Sl. No.	Equipments	Capacity	No. of Machineries
1	Excavator	0.6 cu.m	2
2	Compressor	300 cfm	2
3	Jackhammer Drill	-	2
4	Tippers	10T	2
5	Rock Breaker	-	1
6	Water Tanker	_	1

2.9 WASTE MANAGEMENT

The waste generation from the proposed project is given in the table below:

2.9.1 Waste Generation:

Waste generation from the proposed project is given below which will comprise of soil

Table 2.8;Total waste generation during the plan period

Year	Production of Waste in Cu.m
1st	6085
2nd	14438
3rd	0
4th	874
5th	0
Total	**21397**

2.9.2 Waste Management

The entire product of Limestone will be used in kilns for manufacturing of lime used as building materials. During Plan period some quantity of gritty soil will be removed and will be dumped at southern portion of the applied area with suitable precautions. Some quantity of the generated gritty soil would also be used for road maintenance and plantation program.

2.10 RECLAMATION & RESETTLEMENT MEASURES

Green Belt development

Plantation will be done in the 7.50 m barrier zone along the periphery of the mining lease area and on the backfilled area after final closure of the mines.

Table 2.9; Proposed Plantation

Sl. No.	Year of Plantation	Target of Plantation	Assumed Survival (80%)	Area to be covered in	Area of Plantation
1	First	58	46	0.036	Safety/Barrier Zone
2	Second	58	46	0.036	Safety/Barrier Zone
3	Third	58	46	0.036	Safety/Barrier Zone
4	Fourth	58	46	0.036	Safety/Barrier Zone
5	Fifth	58	46	0.036	Safety/Barrier Zone
TOTAL		**290**	**230**	**0.18**	

Resettlement

As there is no habitation and the entire area is under non forest land. Hence no resettlement will be done.

Water Conservation

The main ore body is limestone which is impervious in nature; hence water accumulated in the quarry during rainy season will help in recharging the ground water.

2.11 GENERAL FEATURES:

The raw inputs which will be mainly consumed in this mining project are diesel, water and explosives whose quantity and source of supply are discussed under following headings:

2.11.1 Power, Water Requirement

Power Requirement

No electrical energy will be required. However 100 liters of HSD will be required for daily operation of the machines such as jack hammer, rock breakers etc.

Water Requirement

Total water requirement is about 3.5 KLD (0.50 KLD Domestic Uses) + 1.50 KLD (Dust Suppression) & 1.50 KLD (Green Belt) from nearby water sources. Water for drinking purpose will be met from nearby villages. For sprinkling & plantation water will be taken from private tanker.

Table 2.10; Requirements of Raw Materials

Inputs	Approx Quantity required per day
High Speed Diesel Requirement	
Diesel	100 Liters (at peak production)
Water Requirement	
Water for Drinking	0.50 KLD
Water for Sprinkling	1.50 KLD
Water for green belt development	1.50 KLD
Total	3.50 KLD

2.11.2 Use of Mineral

India possesses a wide spectrum of dimensional stones that include granite, marble, sandstone, limestone, slate, and quartzite, spread out all over the country. The limestone boulder have a great demand in the local open market as well as for supply to the neighbouring state as building and construction material for various construction purposes as well as for supply to limestone kilns.

2.11.3 Proposed Transportation and Infrastructure

Transportation

There is existing approach roads which goes up to the quarry. Total 2 tippers of 10 T capacities will be deployed to transport the minerals from quarry to stockyard.

Infrastructure: The details of Existing and proposed infrastructure is given below:

Existing Infrastructure: The details area given below:

Physical Infrastructure: There is existing road SH-5 (Sohra- Shella Road) is 1.5 Km W of the mine site. No physical infrastructure exists at the mine site.

Social Infrastructure: The Medical facility such as PHC, CHC & Primary and Secondary Schools are located in Ichamati village at a distance of about 1.5 kms.

Proposed Infrastructure: The details area given below:

Physical Infrastructure: Site services such as temporary rest-shed, blasting shed etc. will be developed during mining.

Social Infrastructure: Proposed mining in the area will facilitate development of other small ancillary industries like Workshop, administrative building, machine shops, auto repair garages etc. Local shops are available in all villages.

2.12 HUMAN RESOURSE:

This project would provide employment to around 42 persons who include Manager, Supervisor, Skilled, Semi-Skilled and Unskilled laborers and indirect employment, in contractual works & transport to the local population.

Table – 2.11

Manpower requirement

Designation	Employees No.
Manager	1
Supervisor	1
Junior Supervisor	1
Blaster	1
Blaster Helper	1
Storekeeper	1
Attendance clerk- cum Register Keeper	1
Quarry Munshi	1
Excavator Operator	2
Compressor Operator	2
Jackhammer Drill Operator	4
Tipper Driver	2
Rock Breaker Operator	1
Water Tanker Driver	1
Semi-skilled Minors (Inclusive of absentees & Leave)	15
Unskilled	7
Total	**42**

2.13 PROJECT COST:

The project cost is about Rs. 30.45 lakhs. The breakup of the project cost is given below:

Table – 2.12: Project Cost

Sl. No.	HEAD	CAPITAL (In Rs)
1	Land	-
2	Road & Temporary structures	1,50,000.00
3	Tools & Machinery	25,00,000.00
4	Mobile Sprinkler	1,50,000.00
6	Plantation	1,45,000.00
7	Miscellaneous	50,000.00
8	Safety tools including PPE's	50,000.00
TOTAL		**30,45,000.00**

3.1 INTRODUCTION

EIA report contains a detailed description of existing environment that would be or might be affected directly or indirectly by the proposed project. Environmental baseline monitoring is a very important stage of EIA. Environmental baseline monitoring, during the operational phase, helps in judging the success of mitigation measures in protecting the environment.

The intention of environmental baseline monitoring is not just to describe all baseline conditions but to emphasis on the collection and description of baseline data on those environmental parameters that are important and are likely to be affected by the proposed project activities and is included in impact assessments. The baseline values/characteristics of the environmental parameters are discussed in this chapter -3.

3.2 METHODOLOGY

It would be apt to reiterate here that the environmental indicators mostly seen for Core and Buffer Zone separately. The area, which is going to produce impact that is mining lease is considered as core zone, whereas the surrounding area, which is going to absorb the impact is considered as Buffer Zone. As per ToR, the buffer zone is 10 km all around of mining lease area in this case.

For the present study, all the sampling locations are marked with the help of topographical maps. The land use/ land cover map has been generated on 1:50,000 scale using Satellite imagery, topographical maps, Survey of India and ground truth information. The baseline environmental quality has been assessed during **Winter Season (Dec 2019 to Feb 2020).** Meteorological data of IMD station at Cherrapunji, Meghalaya has been used for the study. Samples of air, water and soil from the site and nearby areas has been collected and analyzed for the study of existing condition. Primary and secondary data collection has been done by the Ecology and Biodiversity team for the study of flora and fauna in the core and Buffer Zone.

The baseline data is generated through field study within the impact zone (Core Zone and Buffer Zone) for various components of the environment viz. Air, Noise, Water, Land, Ecology and Socioeconomic. The baseline environmental quality has been assessed in a study area of 10 Km radius distance from the project site. While generating the baseline status of physical and biological environment of the study area, the concept of impact zone has been considered. The impact zone selection is based on preliminary screening and modeling studies. The methodology for evaluation of various environmental facets has been discussed under the same parameter for convenience.

It would be in fitness of things to start this chapter with Meteorology as the data collected from IMD is used for selection of sampling station.

3.3 METEOROLOGY

A) Long Term Meteorological Data

The meteorological data recorded during the monitoring period is very useful for proper interpretation of the baseline information as well as input for air quality prediction. Historical data on meteorological parameters also plays an important role in identifying the general meteorological regime of the region.

The year may broadly be divided into four seasons:

Winter season	:	December to February
Summer season	:	March to May
Monsoon season	:	June to September
Post-monsoon season	:	October to November

Methodology

On-site monitoring was undertaken for various meteorological parameters as per BIS and IMD guidelines to generate the site-specific data. The generated data was then compared with the meteorological data obtained from Cherrapunji, Meghalaya.

Sources of Information

Secondary information for the last thirty year's (1971-2000) meteorological conditions was collected from the nearest IMD station at Cherrapunji. Pressure, temperature, relative humidity, rainfall, wind speed and direction data's are incorporated in the report. The meteorological data, rainfall data, climatological data and solar energy and surface meteorology for the study area collected from IMD Cherrapunji is presented in **Table-3.1, Table-3.2, Table-3.3 and Table-3.4** respectively.

Analysis of IMD Data Cherrapunji

The Indian Meteorological Department records the data at two times a day viz. 08:30 hr and 17:30 hr, while the site-specific data was recorded at an hourly interval. Comparison of the site specific data generated during the study period vis-à-vis the data monitored by IMD shows that by and large these are comparable.

Temperature & Relative Humidity

The winter seasons sets in towards end of November and continues till mid of February. The last week of December to first week of January is the coolest period of the year, with lowest minimum temperature falling as low as -1.0^{0}C (20th Jan 1993). Temperature gradually rises after February. March to June is the summer season. This is also referred to as Pre-monsoon season. During this time the highest maximum temperature may rise to 30.2^{0}C (26th May 1962). From the post monsoon of October, the mean temperature falls gradually marking the onset of the winter season. The average humidity, during the monsoon season is about 78% – 96%. The humidity in Pre-monsoon (March-May) is about 64-84%. Generally the weather during the other seasons is more or less dry and in the comfortable zone.

TABLE 3.1 METEOROLOGICAL DATA FROM IMD, CHERRAPUNJI (1971-2000)

Month	Mean Station Level Pressure in hPa	Mean Relative Humidity in %	Mean High Cloud Amount in oktas	Mean Highest temp in ^{0}C	Mean Lowest temp in ^{0}C	Extreme Highest temp in ^{0}C	Extreme Lowest temp in ^{0}C
January	871.5	60	1.9	19.0	3.7	26.7	-1.0
February	870.7	61	2.3	20.8	4.8	28.9	0.3
March	870.0	64	2.9	24.1	8.0	30.6	0.6
April	868.9	78	4.9	24.8	10.5	28.3	3.9
May	866.9	84	5.9	25.8	12.2	30.2	3.3
June	864.0	93	7.0	26.1	15.1	29.2	9.2
July	863.8	96	7.4	26.0	16.5	28.6	10.0
August	865.0	92	6.9	27.0	16.5	29.5	6.0
September	868.0	89	6.3	26.6	15.5	31.1	12.4
October	870.9	73	3.8	26.0	12.2	29.9	7.8
November	872.4	62	2.4	24.3	8.8	26.9	3.7
December	872.6	61	1.8	20.6	5.4	24.0	1.7

(Source: Climatological data 1971-2000, Indian Meteorological Department)

Rainfall

Annual rainfall over the basin varies between 817 and 2992 mm with an average of 968 mm, of which 84% occurs during the monsoon season. The monsoon starts in end of May and continues till September. The maximum amount of rainfall and maximum rainy days occur in July (Table 3.2).

TABLE: 3.2 RAINFALL DATA FOR FROM IMD, CHERRAPUNJI (1971-2000)

Month	Total Rainfall in the month in mm	Heaviest 24 hrs rainfall in mm	No. of Rainy days in the month (days with rainfall > 2.4 mm)
January	16.3	97	1.4
February	52.9	376.9	3.0
March	327.0	587.4	7.9
April	817.2	644.2	16.1
May	1313.8	812.0	20.2
June	2511.7	1563.0	24.1
July	2992.3	838.2	28.2
August	1914.4	853.4	24.6
September	1034.8	985.5	19.1
October	539.4	594.0	8.4
November	74.0	332.2	2.1
December	25.6	189.7	1.0

(Source: Climatological data 1971-2000, Indian Meteorological Department)

Wind Speed / Direction

Overall Wind Rose data for study area (IMD, Cherrapunji data) is shown in Table-3.1. Wind is normally light to moderate in the area as observed from the winter season. During January, the predominant winds are Easterlies and north-Easterlies in major part of the area. In February, winds are in different directions in different parts of the area. However, the predominant directions are SW and E. The wind data collected at the site for the study period (Dec-2019 to Feb-2020) is presented in the form of Wind rose diagram in Figure 3.2.

TABLE 3.3 CLIMATOLOGICAL DATA FROM IMD, CHERRAPUNJI (1971-2000)

Month	No. of days in wind directions								Average wind speed in kmph
	N	NE	E	SE	S	SW	W	NW	
January	1	22	28	11	4	13	9	2	4.0
February	1	13	20	8	4	28	17	1	5.9
March	1	9	10	7	6	39	19	3	7.4
April	1	10	8	9	7	42	13	4	7.5
May	2	13	12	10	5	32	13	2	6.1
June	2	11	16	12	8	29	7	2	6.5
July	1	9	12	14	11	37	5	1	7.4
August	1	14	20	16	8	23	4	1	5.9
September	1	14	21	12	5	22	8	2	4.7
October	2	23	31	11	3	13	6	0	3.9
November	1	24	41	10	2	9	5	1	3.8
December	1	24	40	13	2	8	3	1	3.7

(Source: Climatological data 1971-2000, Indian Meteorological Department)

B) Micro-Meteorological Data

The meteorological data for wind speed and direction were collected in and around the core zone during the study period simultaneously AAQ monitoring. The predominant wind direction is from N, NNE & NNW. The brief data are represented in Table below:

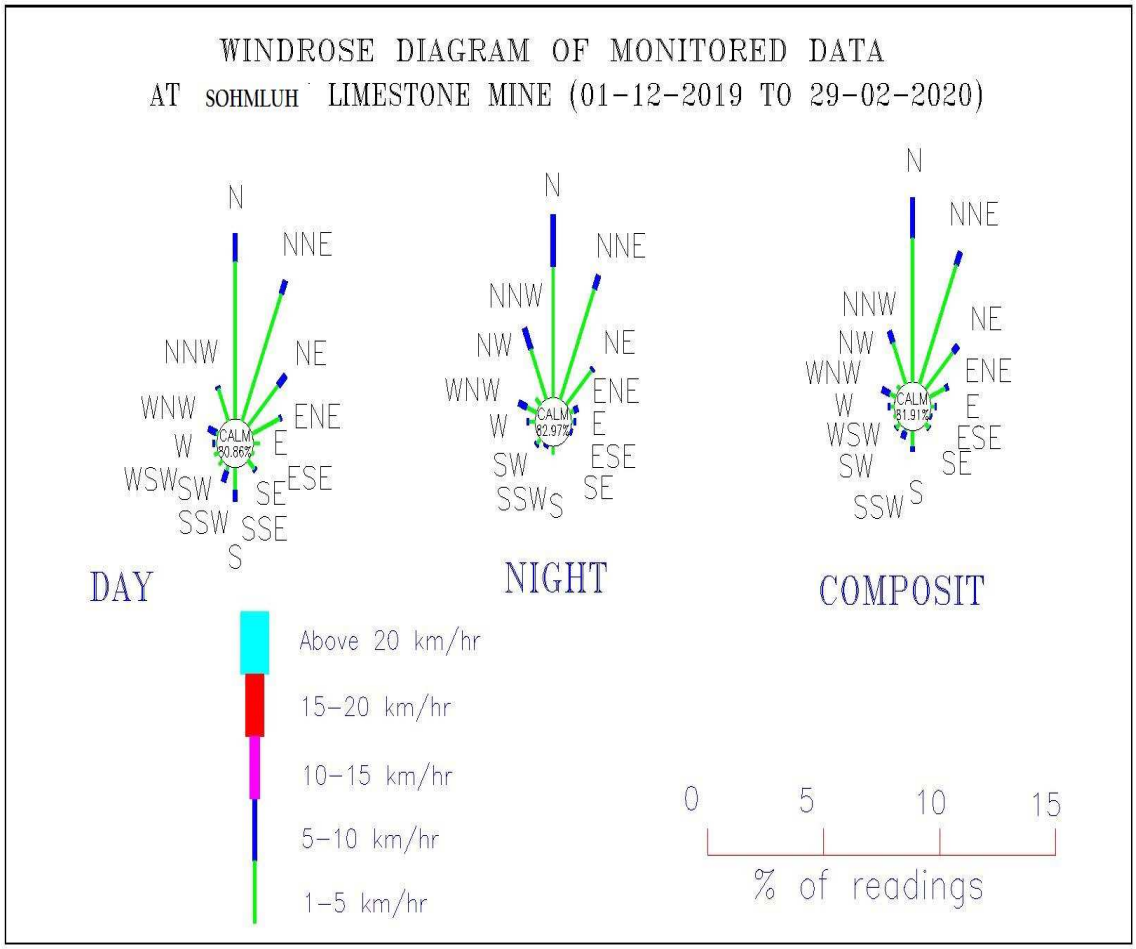
Table 3.4; Micro Meteorological Data

Month	Temperature (°C)			Humidity (%)			Wind speed (km/hr)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
1st -31st Dec 2019	11	34	21.0	22	90	55.2	0	7	0.42
1st -31st Jan 2020	14	36.3	25.6	26	86	55.7	0	7	1.13
1st -29th Feb 2020	11	32	21.6	13	95	61.75	0	5	0.20

i. **Temperature:** Temperature of the area varied from 11.0^{0}C to 36.3^{0}C.

ii. **Relative Humidity:** Humidity of the area varied from 13.0 % to 95.0%.

iii. **Wind Speed:** Wind speed was in the range of 0.0 Km/hr to 7.0Km/hr.



Seasonal Wind rose Diagram: Dec 2019 –Feb 2020

3.4 AMBIENT AIRQUALITY

The ambient air quality monitoring was carried out at 8 stations for the month of December 2019 to February 2020. The guidelines for selections of ambient air monitoring stations given in IS – 5182 part 14, 2000 were followed. These guidelines state that, "when the objective of air sampling is to identify the contribution from specific sources of pollution, the sampling locations should be located in upwind and the downwind direction of such sources".

As per the guidelines, the location of air quality monitoring stations should satisfy the following conditions:

1. The site should be representative of the area selected;
2. The stations should be selected in a way so as to yield data that can be compared with another;
3. Certain physical requirements should be satisfied at the site.

3.4.1 Sampling Stations

To select the air sampling locations, meteorological data with respect to temperature, relative humidity, wind speed and direction plays a vital role. Predominant wind direction plays an important role in determining location of monitoring stations. The monitoring stations were located in areas that were downwind from the source. Location of Air sampling stations are shown below—

Table 3.5; Sampling locations for Ambient Air Quality

Location	Name of the Location	Distance & Direction w.r.t Proposed Mine	Classification
AAQ I	ML Area of Arjust Limestone	0.4 K M – SE	-
AAQ 2	Byrong Village	1.5 K M – N	Residential
AAQ 3	Khahumrin Village	1.8 K M - W	Residential
AAQ 4	Core Zone	0.0 KM- C	Project area
AAQ 5	Mawbang Village	1.5 K M – S	Residential
AAQ 6	Diengken Village	1.2 K M – SW	Residential
AAQ 7	Bholaganj Bazar	2.9 K M – E	Market
AAQ 8	Ichamati Village	1.0 K M – W	Residential

However, the predominant wind direction is E, NE & SW and to study the maximum impact of the project on nearest localities, the sampling location was selected in the North, West & SSW direction. As from the field visit it is found that the maximum habitat is located in the North, East & West directions. To study the present ambient air scenario eight ambient air locations were selected.

3.4.2 Ambient Air Sampling Locations

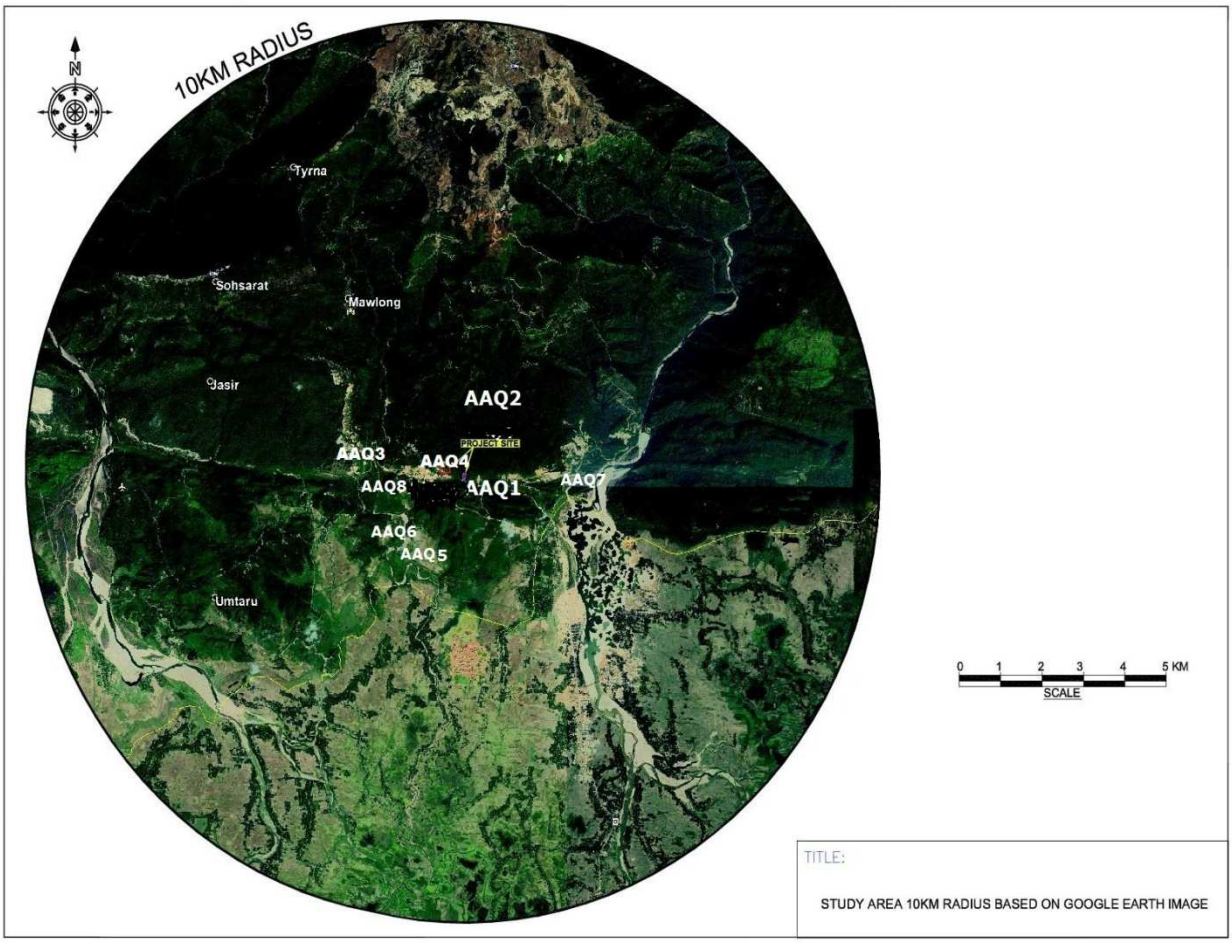


Figure 3.1; Ambient Air sampling locations on 10 Km Google satellite imagery

3.4.3 Sampling Procedure

Time averaged in-situ sampling was adopted by passing a known volume of air through a trap, and a collecting medium (filter paper). Respirable Dust Sampler & Fine Particulate sampler was used for the purpose.

This procedure was adopted because there are no short-term variations and low concentration of gaseous pollutants was expected.

3.4.4 Analytical methods followed for ambient air quality monitoring:

I. **Particulate Matter ($PM_{2.5}$): (USEPA Quality Assurance Hand Book (Vol.II) Part II, Quality Assurance Guideline Document, 2.12):** Particulate Matter ($PM_{2.5}$) was analyzed by Gravimetric Method. Particulate matter was collected on the 47.2 mm dia glass micro fiber Filter Paper. $PM_{2.5}$ value is determined from the values of volume of air passes through Fine Particulate Sampler.

II. **Particulate Matter (PM_{10}) (IS: 5182 Part 23:2006):** Particulate Matter (PM_{10}) was carried out by Respirable Dust sampler as per IS: 5182(Part 23):2006. Particulate matter was collected on the GF/A Filter Paper. Particles with aerodynamics diameter less than the cut-point of the inlet are collected by the filter. The mass of these particles is determined by the difference in filter weight prior to and after sampling.

III. **Sulphur dioxide (SO_2) (IS: 5182; Part – II – 2001):** Sulphur dioxide is absorbed by aspirating a measured air sample through a solution of Potassium or sodium tetrachloro-mercurate, TCM. This procedure results in the formation of a dichloro sulphite mercurate complex. The Sulphite Ion produced during sampling is reacted with sulphamic acid, formaldehyde and pararosaniline to form an azo dye and then determined colorimetricaly.

IV. **Nitrogen Oxides (IS: 5182; Part – VI – 2006):** Nitrogen dioxide is collected by bubbling air through a sodium hydroxide- sodium arsenite solution to form a stable solution of sodium Nitrite. The Nitrite Ion Produced during sampling is reacted with hydrogen peroxide, Sulphanilamide and NEDA to form an azodye and then determined calorimetrically.

3.4.5 Ambient Air Quality Results

At each station of ambient air quality was monitored twice a week of 3 months **(Dec 2019 to Feb 2020)** 24 hourly at uniform intervals.

Table 3.6; Ambient Air quality results of $PM_{2.5}$ &PM_{10}

Location	Min.	Max.	98 Percentile	Mean	Min.	Max.	98 Percentile	Mean
	$PM_{2.5}$ (Standard – 60 µg/m³)				PM_{10}(Standard – 100 µg/m³)			
A1	23.0	35.0	34.5	28.6	61.0	81.0	80.1	70.5
A2	22.0	29.0	29.0	25.6	61.0	70.0	69.54	65.6
A3	24.0	32.0	31.54	28.3	56.0	76.0	75.54	66.3
A4	22.0	31.0	30.5	27.3	52.0	78.0	77.1	61.4
A5	23.0	30.0	29.54	27.04	50.0	71.0	70.08	61.87
A6	24.0	33.0	33.0	28.8	57.0	79.0	78.12	69.5
A7	22.0	34.0	33.5	27.9	61.0	84.0	83.5	74.9
A8	22.0	31.0	30.08	26.46	55.0	71.0	71.0	65.75

Table-3.7; Ambient Air quality results of SO_2&NOx

Location	Min.	Max.	98 Percentile	Mean	Min.	Max.	98 Percentile	Mean
	SO_2 (Standard – 80 µg/m³)				NOx (Standard – 80 µg/m³)			
A1	5.2	7.9	7.8	6.4	5.1	8.0	8.0	6.5
A2	4.1	6.9	6.9	5.6	4.2	6.9	6.9	5.6
A3	4.3	6.8	6.8	5.2	4.2	6.9	6.9	5.2
A4	4.2	7.5	7.5	6.1	4.5	7.7	7.7	6.6
A5	4.3	7.1	7.1	5.7	4.5	7.1	7.1	5.8
A6	5.3	6.9	6.8	6.0	5.3	6.5	6.5	6.0
A7	5.4	7.9	7.9	6.8	5.8	7.9	7.9	7.0
A8	4.5	6.5	6.5	5.5	4.8	6.9	6.9	5.9

(Source of Standards: G.S.R 826(E) dated 16th November 2009 of MoEF, Laboratory engaged: Envirocheck, Kolkata (NABL Accredited).

3.4.6 Data Interpretation

Results of Core & Buffer Zone are shown in above tables & further are explained below.

PM_{10}:

The results of PM_{10} of all locations are showing variations from 69.54 μg/m^3 in the Byrong Village to 83.5 μg/m3 in the Bholaganj Bazar area. However the results are within the limits of National ambient air quality standards. The variation of PM_{10} concentration has shown in Table-3.6

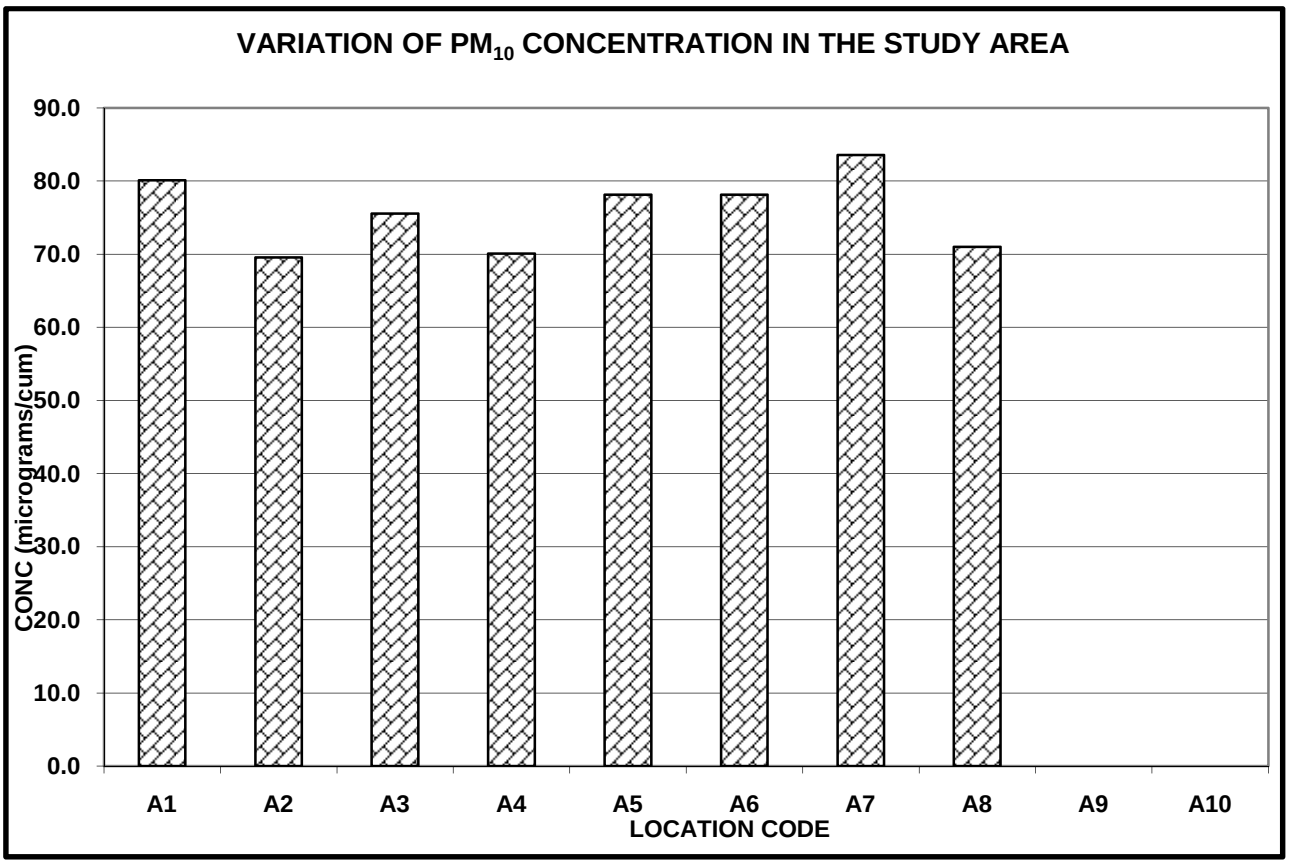


Figure 3.2; Variation of PM_{10} Concentration in the Study area

PM2.5:

The results of $PM_{2.5}$ of all locations are showing variations from 29.0 μg/m^3 in the Byrong Village to 34.5 μg/m3 in the ML Area of Arjust Limestone. However the results are within the limits of National ambient air quality standards. The variation of $PM_{2.5}$ concentration has shown in Table-3.6.

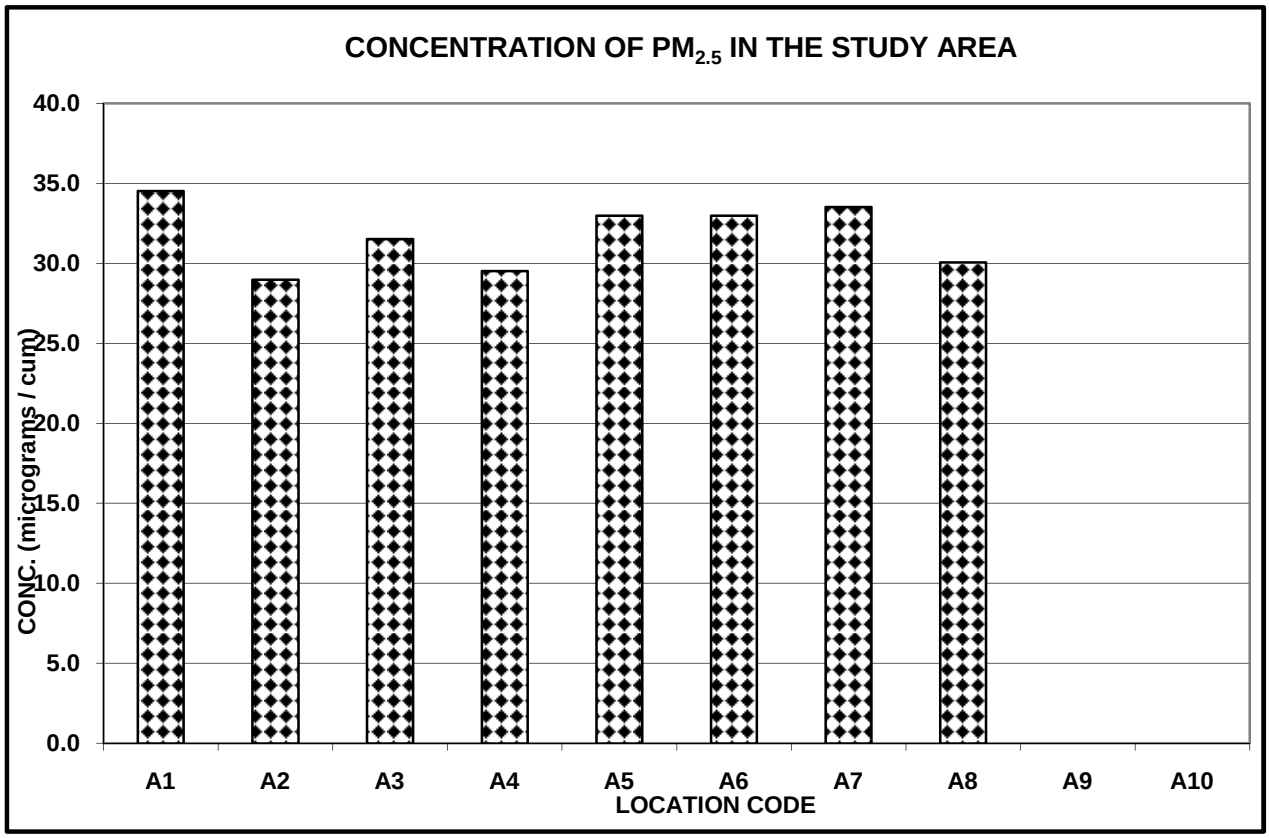


Figure 3.3; Variation of $PM_{2.5}$ Concentration in the Study area

SO2:

The results of SO_2 of all locations are showing variations from 6.5 μg/m^3 in the Tharia Village to 7.9 μg/m3 in the Bholaganj Bazar. However the results are within the limits of National ambient air quality standards. The variation of SO_2 concentration has shown in Table-3.7

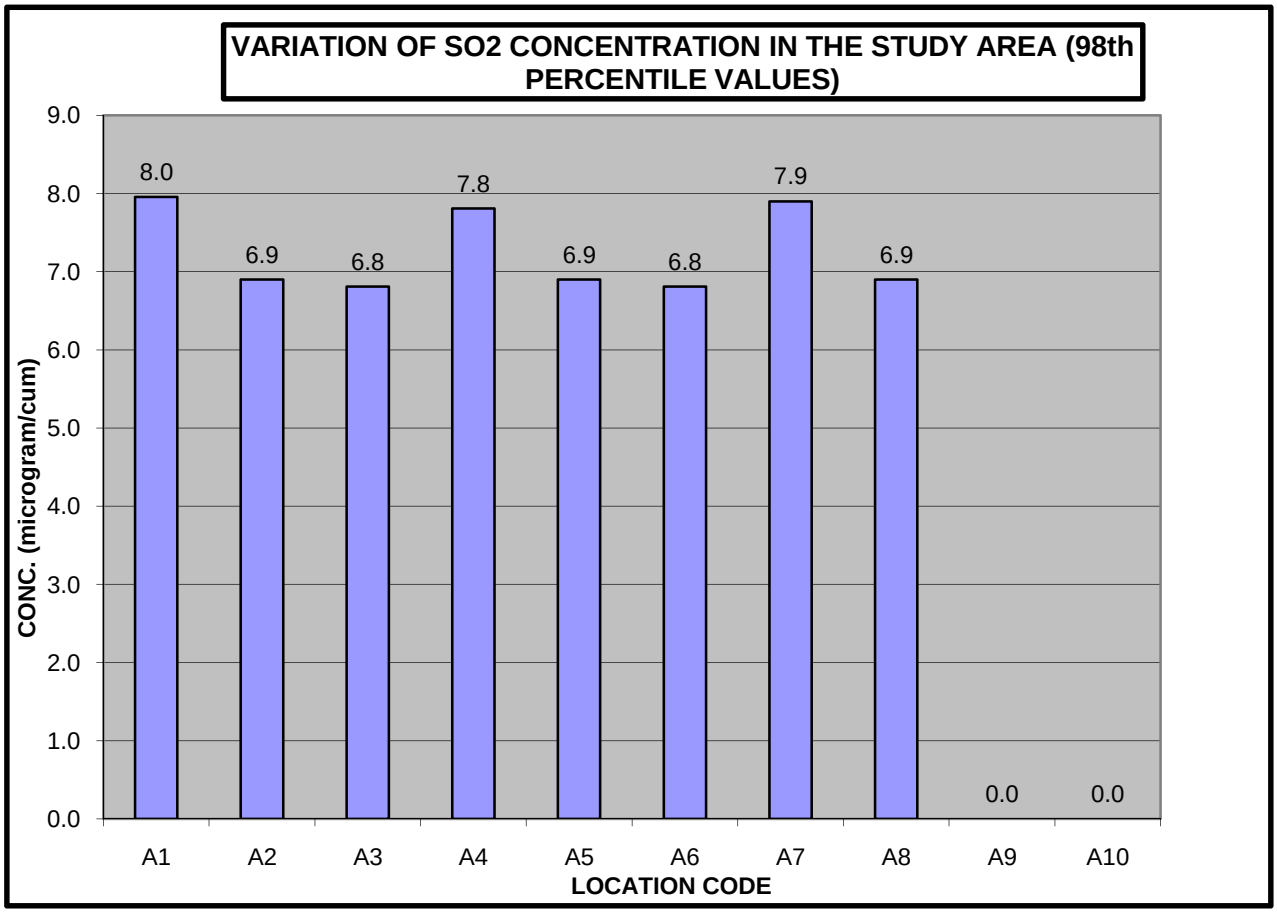


Figure 3.4; Variation of SO_2 Concentration in the Study area

NO2:

The results of NO_2 of all locations are showing variations from 6.5 µg/m^3 in the Mawbang Village to 8.0 µg/m^3 in the ML Area of Arjust Limestone. However the results are within the limits of National ambient air quality standards. The variation of NO_2 concentration has shown in Table-3.7

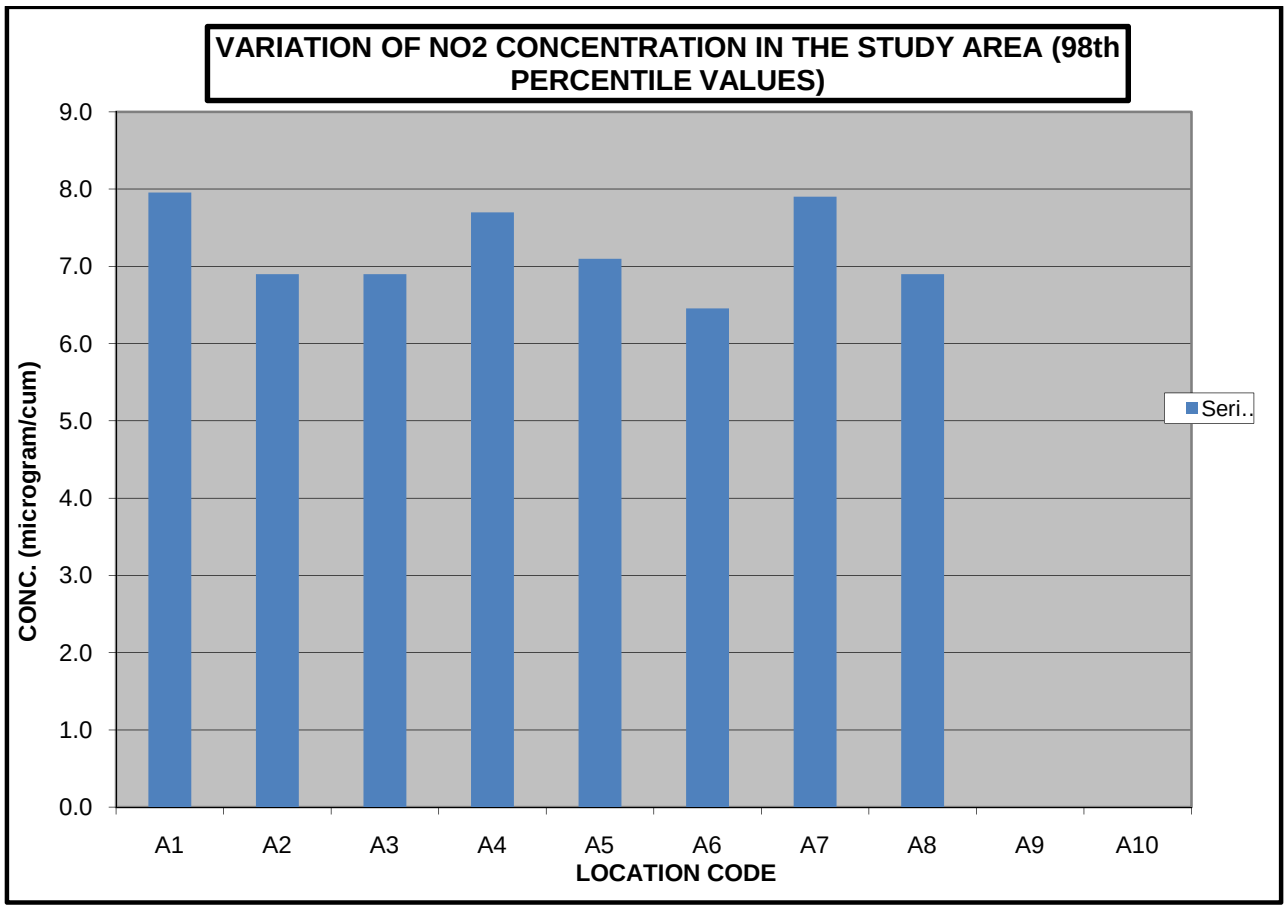


Figure 3.5; Variation of NO_2 Concentration in Study area

3.5 NOISE QUALITY

Noise Measurement Locations: To assess the noise level of the proposed area, following stations were selected. **Location of Noise sampling stations** are described below and location are given below.

LOCATIONS OF NOISE SAMPLING STATION

Table 3.8; Sampling Location for Noise quality

Location Code	Name of the Location	Distance & Direction w.r.t Proposed Mine	Classification
ANL I	ML Area of Arjust Limestone	0.4 K M – SE	-
ANL 2	Byrong Village	1.5 K M – N	Residential
ANL 3	Khahumrin Village	1.8 K M - W	Residential
ANL 4	Core Zone	0.0 KM-C	Project area
ANL 5	Mawbang Village	1.5 K M – S	Residential
ANL 6	Diengken Village	1.2 K M – SW	Residential
ANL 7	Bholaganj Bazar	2.9 K M – E	Market
ANL 8	Ichamati Village	1.0 K M – W	Residential

3.5.1 Locations of Noise Sampling Stations

The location of Noise sampling is shown below in the 10 km radius map

3.5.1 Locations of Noise Sampling Stations

The location of Noise sampling is shown below in the 10km radius map

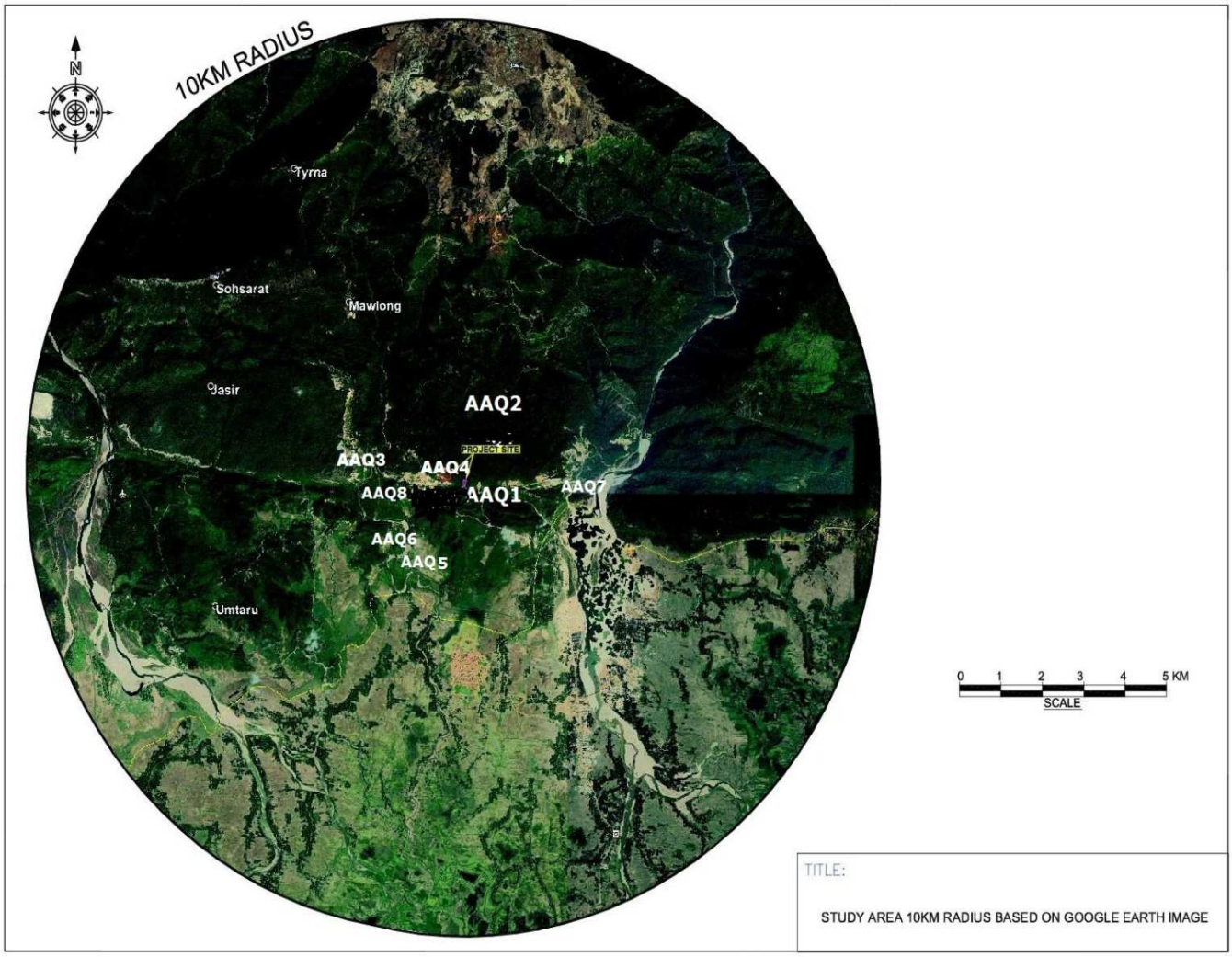


Figure 3.6; Noise sampling Locations on 10 Km Google satellite imagery

3.5.2 Methodology

At each station noise level was monitored for 24-hours simultaneously. For each measurement, dB (A) readings was taken for every 15 minutes for 24 hrs ones in a season to get Leq values.

Table 3.9; Noise quality results

S. No.	Locations	Class	L_{eq} noise level dB(A)	Maximum noise level dB(A)	Day time (6.00 A.M to 10.00P.M)	Night time (10.00 P.M to 6.00A.M)
					Standard (L_{eq} in dB(A)	Standard (L_{eq} in dB(A)
Core zone noise quality						
ANL4	**Core Zone of Sohmluh**	**Project Area**	**52.6**	**59.5**	**53.8**	**38.7**
Buffer zone noise quality						
ANL1	**ML Area of Arjust Limestone**	-	53.0	59.9	54.2	39.1
ANL2	**Byrong Village**	Residential	52.4	59.3	53.6	38.5
ANL3	**Khahumrin Village**	Residential	53.1	60.0	54.3	39.2
ANL5	**Mawbang Village**	Residential	51.9	58.8	53.1	38.0
ANL6	**Diengken Village**	Residential	52.4	59.3	53.6	38.5
ANL7	**Bholaganj Bazar**	Market	54.6	61.5	55.8	40.7
ANL8	**Ichamati Village**	Residential	52.3	59.2	53.5	38.4

Prepared by: Envirocheck, Kolkata

(Source of Standards: CPCB standards for Noise Pollution (Regulation & control) Rules, Laboratory: Envirocheck, Kolkata (NABL Accredited)

3.5.3 Data Interpretation:

The Ambient Noise Quality results are summarized above**.** The results are discussed below:

Core Zone: The details are given below:

Core Zone: ANL4: The ambient noise level during day time at the proposed project site was 53.8 dB (A) which are within the standard limit of Industrial area~75 dB (A). During night the noise level at the project site ranges from 38.7 dB (A) which is within the night-time noise standard limit of 70dB (A).
No mining activity was observed at the site.

Buffer Zone: The details are given below:

ANL1: The noise level at **ML Area of Arjust Limestone** is 54.2 dB (A) which is within the day time noise standard limit of Industrial area are ~ 75 dB (A). During night the noise level was recorded 39.1 dB (A) which is within the night time noise standard limit of Industrial area are ~ 70 dB (A).

ANL2: The noise level at **Byrong Village** is 53.6 dB (A) which is within the standard limit of residential area ~ 55 dB (A). During night the noise level was recorded 38.5 dB (A) which is within the night-time noise standard limit of ~ 45.0 dB (A).

ANL3: The ambient noise level in residential area i.e **Khahumrin Village** is 54.3 dB (A) which is within the day time noise standard limit of residential area ~ 55 dB (A). During night the noise level was recorded 39.2 dB (A) which is within the night-time noise standard limit of ~ 45.0 dB (A).

ANL5: The noise level of **Mawbang Village** is 53.1 dB (A) which is within than the day time noise standard limit of residential area are ~ 55 dB (A). During night the noise level is 38.0 dB (A) which is within the night time noise standard limit of residential area are ~ 45 dB (A).

ANL6: The noise level of **Diengken Village** is 53.6 dB (A) which is within the day time noise standard limit of residential area are ~ 55 dB (A). During night the noise level is 38.5 dB (A) which is within the night time noise standard limit of residential area are ~ 45 dB (A).

ANL7: The noise level of **Bholaganj Bazar** is 55.8 dB (A) which is lower than the standard limit of commercial areas of ~ 65 dB (A). During night the noise level is 40.7 dB (A) which is within the standard limits of commercial area ~ 55 dB (A).

ANL8: The noise level of **Ichamati Village** is 53.5 dB (A) which is within the day time noise standard limit of residential area are ~ 55 dB (A). During night the noise level is 38.4

dB (A) which is within the night time noise standard limit of residential area are ~ 45 dB (A).

3.6 Ground Water

The occurrence of ground water is directly related to the geological setup and structure. It would be in fitness of things to assess the geology before going to the hydrology of the area. Further ground water is controlled by the various factors influencing it regionally; therefore, it would be wise not to divide the study in core and buffer zone.

3.6.1 Geology:

In a regional Scale it is obvious that topographic expression is very rugged with the high hills and the following stratigraphic sequence is noted in this part of East Khasi Hills district of Meghalaya.

Age	Group	Formation	Member	Rock types
Palaeocene to Eocene	Jaintia	Kopili Shella Langpar	 Syllhet L. St Syllhet S. St	Argillaceous sediments dominantly limestone Ferruginous sandstone Coarse S St Sandy L. St Calc shale
Cretaceous Jurassic	Khasi Sylhet trap	Mahadek		Conglomerate with coarse, feldspathic, S.St with purple, green clay bands Volcanic trap with vesicles of zeolite and agate
Proterozoic & Archaean	Gneissic Complex			Migmatite, biotite schist and gneiss with quartz /pegmatite veins

Archaean Gneissic Complex of Proterozoic is exposed in the SW and north-central part of the country and is represented dominantly by migmatite, biotite gneiss and biotite schist. It is intruded by basaltic rock which is equivalent to the Sylhet Trap of Jurassic age that attains a thickness of about 600m. The Sylhet trap is hard, compact, massive, fine grained and greenish in colour with vesicles at the top. The upper and lower part of the trap rock is basaltic whereas the middle part is alkali basalt with rhyolite and tuff.

Sedimentary sequence of cretaceous age represented by Mahadek Formation overlies the Proterozoic rocks with a bed of basal conglomerate and is represented by very coarse,

feldspathic and glauconitic sandstone that is interbanded with purple to green cloured clay.

Except the aforesaid rock types, the entire part of the region is covered by sediments of the tertiary age with age ranging from Palaeocene to Eocene. Langpar (=Therria) formation is represented by sandy limestone with calcareous shale and sandstone and conformably overlies the Mahadek formation. Limestone occurring at base is grey in colour, siliceous containing rare shells of ostrea, gryphea and lamellibranchs. Sylhet Sandstone member is coarse grained, feldspathic and the overlying Limestone Member that covers the whole southern fringe is of argillaceous limestone with fossils of forminifera. The Kopili formation that is dominantly argillaceous with sporadic phospathic nodules overlies the Sylhet Formations. All these above Formations trend along ENE-WSW to WNW-ESE direction with southerly dip. Minor faults are recorded within the Sylhet trap and E-W and N-S trending vertical joints are common in the Langpar Formation.

3.6.2 Hydrology

The district of East Khasi Hills is covered mainly by crystalline rocks with Tertiary sedimentary rocks. The secondary porosity in consolidated formation e.g. fractures; joints, etc developed due to major, minor tectonic movements, prolonged physicochemical weathering, form the conduits as well as reservoirs of ground water. The weathered mantle varies from 10 to 30 m bgl. Ground water occurs under water table condition in the top weathered quartzite and in semi-confined condition in the fractured and jointed rocks. At hydro geologically feasible locations, well drilled down to the depth of about 80 -150 m below ground level may yield a moderate discharge of 5-15m3/hr in Archaean and Pre-Cambrian Group of rocks. Depth to water level is found to occur between 2 and 15 m bgl. The valley areas are found to be favourable for the construction of dug wells and bore wells in other steep areas. It should be borne in mind that the zones are not uniform in characteristics as the aquifer material, fracture density and distribution and hydro geological characteristics vary widely over short distances. Consequently, their water yielding capabilities vary considerably.

Ground water development in the district is mainly through dug /open well tapping the water in the weathered zone and bore wells are constructed to tap ground water from the fractures/joints in the hard rocks. In the shallow aquifer, the depth to water level ranges from less than 2 m bgl to 6 m bgl.

Springs play a major role to cater water requirement of the people throughout the year. Most of the springs are gravity springs. It is observed that discharge of most of the springs lie within the range of 5000-25000 lpd in pre- & post monsoon period.

(Source: Central Ground Water Board, India)

3.6.3 Ground water Development

In the district of East Khasi Hills, the Board has constructed a total of 15 numbers of exploratory wells so far. The depth of the exploratory well ranges from 60 to 247.6 m below ground level, tapping aquifer thickness of 15-135 m. The bore wells tapping the deeper aquifer are encountered with two sets of fractures within a depth range of 120 m. Other set of fracture may extend deep beyond 120 m bgl. The depth to water level of the exploratory wells ranges from 1.95 to 49 m below ground level. The yield of the wells varied from 5- m 3 /hr. Transmissivity (T) is in the order of 7.46 m2 /day. The summarized details of Ground Water Exploration carried out in the district are given below-

Table 3.10: Summarized Details of Ground Water Exploration

S. No	Location	Depth drilled (m)	Aquifer type	Aquifer zones tapped (m. below ground level)	SWL (m.bgl)	Discharge (m^3/hr)	DD (m)	T (m^2/day)
1	Mamluh, Sohra	201.3	Limestone	---	dry	dry	---	
2	Dymper	80	Quartzite	---	---	---	---	---
3	MES, Shillong	108.8	Quartzite with Khasi Greenstone intrusive	16.7-17.4,45-46,56-57,70-71,74-75,106.5-108.5	8.2	---	2.4	86.87
4	NEHU	100.9	Quartzite	67	---	40	---	---
5	12th Mile, Mylliem	231.95	Mylliem Granite	135	3.52	32.4	38.1	0.43
6	ASI, Mawblei	140.7	Quartzite	43.5-47,110-114	26.04	9.3	---	---
7	Kynton –U-Mon	70	Quartzite	5.7-12,15-19,20-28,30-35.5,55.2-60.0	2.05	8.45	2.5	11.4
8	Mawryngkneng	59.45	Quartzite	4.0-19.0,22.0-59.45	5.91	8.08	13.08	7.26
9	Umlyngka	80	Quartzite	13.0-20.0,56.0-60.0	3.5	5.3	40	---
10	Mawsmai, Sohra	247.6	Limestone	17	49	2.1	---	---
11	Thynroit	80	Quartzite	---	1.95	0.54	24.1	---
12	Umtyngar	200.45	Mylliem Granite	---	14.15	15	-	-
13	Mawdiangdiang	200.05	Quartzite	12-15,150-168,168-180	78.75	7	-	-
14	Mawkynrew	153.70	Quartzite	32-39,39-82,124-127, 148.6-153.7	8.3	16	-	-
15	Laitkor Lumheh	190.95	Quartzite-Khasi Greenstone	93.35-117.75.175.65-178.75	28.1	24	-	18
16	Mawlyngad	200.05	Quartzite-Khasi Greenstone	35.32-38.45,96.35-114.65, 154.35-178.75	0.52	13	-	3

It may be clearly observed that the ground water development in the region, in which lease area falls in safe category.

3.6.4 Water Conservation & Artificial Recharge-

During rains the water will be collected in the pit and same shall be re-use for various activities during non- rainy days.

3.7 WATERQUALITY

The various indicators of water quality form one of the most important tools for impact assessment in future, therefore it is imperative to assess the existing water quality of both ground and surface water occurring in the core and buffer zone. The details of the study of water quality are given below:

3.7.1 Sampling station

To assess the water quality of the proposed area, following 8 stations (6 ground water & 2 surface water) were selected. **Location of Water sampling stations** is described below and location below:

Table 3.11; Sampling locations for water quality

Station No.	Location	Classification	Distance & Direction from Project area	Environmental Significance
G W 4	Core Zone of Sohmluh Limestone	Hand Pump	0.0 KM- C	**Existing Ground water quality at Core zone**
G W 1	ML Area of Arjust Limestone	Hand Pump	0.4 KM- SE	**Existing Ground water quality at Buffer zone**
G W 2	Byrong Village	Hand Pump	1.5 KM – N	
G W 3	Khahumrin Village	Hand Pump	1.8 KM - W	
G W 5	Mawbang Village	Hand Pump	1.5 KM – S	
G W 6	Diengken Village	Hand Pump	1.2 KM – SW	
SW 1	Tharia River (US)	Surface Water	4.6 KM - NNE	**Existing Surface water quality at Buffer zone**
SW 2	Tharia River (DS)	Surface Water	3.5 KM - ESE	

Surface Water: To assess the surface water quality of the proposed area, stations were selected. All the stations were taken in the buffer zone as core zone did not have any surface water body. Location of surface water sampling stations is shown in the map—

3.7.2 Criteria of Selection of sampling Locations:

Water sampling locations were selected on the basis of following criteria: source of water, flow of water, geological structure (hydrogeology), use of water, depth of water table etc.

In buffer zone, Ground water samples were collected from 6 villages. Onsite (Hand Pump), Byrong Village (Hand Pump), Khahumrin Village (Hand Pump), ML Area of Arjust Limestone (Hand Pump), Mawbang Village (Hand Pump) & Diengken (Hand Pump).

Surface water was collected from Upstream & downstream to study the chemical parameters. During surface water sampling flow of water pays an important role. In present study, source of surface water is Tharia River.

3.7.3 SURFACE WATER

The core zone does not have any surface water body. However, following water bodies were observed across the buffer zone in the vicinity of the mining lease.

Tharia River

The river is about 3.1 km from lease area towards East. It is flowing towards East.

3.7.4 Sampling Locations:

The sampling locations have been shown on 10 km radius Map.

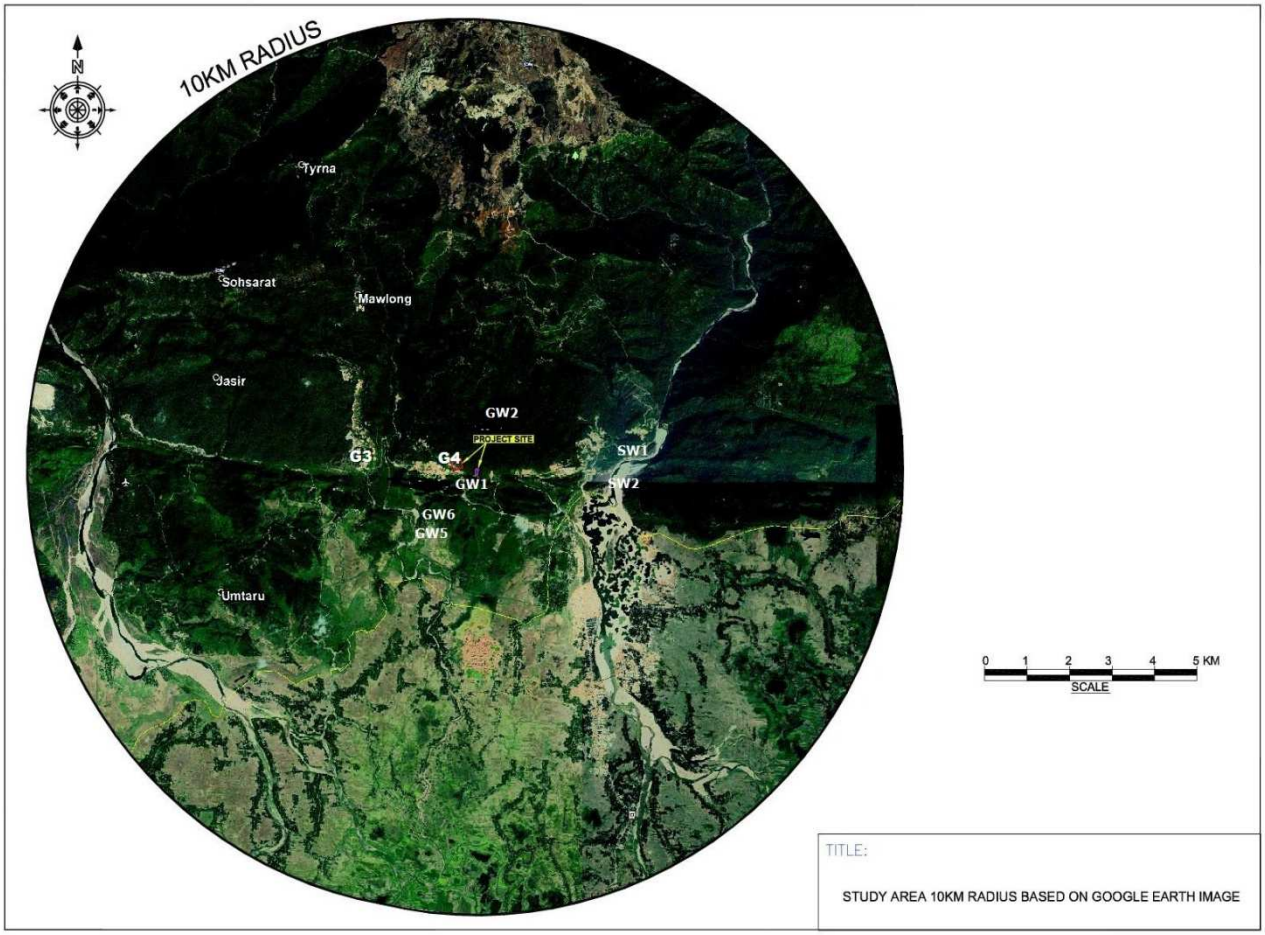


Figure 3.7; Water sampling Locations on 10 Km Google satellite imagery

3.7.5 Sampling Frequency and Sampling Techniques:

As per the standard practice grab sampling was done for 8 locations. Water samples were taken as per the Standard Methods (IS & APHA, 23nd Edition 2012). Necessary precautions were taken for preservation of samples.

The physical parameters viz. pH, temperature and conductivity were measured at site using portable water analyzer.

As evident from the sampling locations for water quality assessment represented surface and groundwater. The results of water quality assessment are presented below:

3.7.6 Groundwater Quality Results

The water quality assessment was done based on the IS-10500, the analysed parameters were compared with IS-10500 to assess portability of the water available in the area. The detailed results are given in the **Annexure -6.** The results of water quality assessment for the parameters, which were found close to the limiting values as per IS-10500 are presented and discussed here. The results of the 6 sample of ground water in core and buffer zone are given as ahead —

3.7.7 Ground Water Quality results of Core and Buffer Zone

Table 3.12; Core and Buffer Zone Water quality result

SN	Parameter	Unit	IS:10500-93 Drinking Water Standards	GW1 ML Area of Arjust Limestone (Hand Pump water)	GW2 Byrong Village (Hand Pump water)	GW3 Khahumrin Village (Hand Pump water)	GW4 Core Zone of Sohmluh (Hand Pump water)	GW5 Mawbang Village (Hand Pump water)	GW6 Diengken Village (Hand Pump water)
1.	pH Value	-	6.5 to 8.5	7.20 at 23.7°C	7.10 at 23.7°C	6.90 at 23.7°C	7.10 at 23.7°C	7.20 at 23.7°C	7.10 at 23.7°C
2.	Turbidity NTU	NTU	5 (10)	0.6	0.4	0.6	0.5	0.4	0.4
3.	Electrical Conductivity at 25^0C	µS/cm	-	159	174	153	174	179	182
4.	Apparent Colour	-	5	<1	<1	<1	<1	<1	<1
5.	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
6.	Taste	mg/l	Agreeable	-	-	-	-	-	-
7.	Total Dissolved Solids (TDS)	mg/l	500 (2000)	106.00	102.00	108.00	107.00	106.00	103.00
8.	Total Hardness (CaCO3)	mg/l	300 (600)	63.20	64.80	64.20	69.80	67.60	99.10
9.	Iron (as Fe)	mg/l	0.3 (1.0)	0.19	0.22	0.19	0.21	0.22	0.20
10.	Chlorides (as Cl)	mg/l	250 (1000)	44.30	44.30	45.10	47.30	46.10	44.90
11.	Calcium (as Ca)	mg/l	75 (200)	23.10	22.40	24.30	24.10	25.20	24.60
12.	Magnesium (as Mg)	mg / l	30 (100)	3.14	3.25	3.20	3.90	3.60	4.10
13.	Sulphate (as SO4)	mg / l	200 (400)	10.10	9.70	11.20	9.90	10.30	12.10
14.	Nitrates (as NO3)	mg / l	45	1.02	0.85	1.05	0.89	0.94	1.30
15.	Fluoride (as F)	mg / l	1.0 (1.5)	0.04	0.06	0.04	0.08	0.07	0.08
16.	Total Alkalinity (CaCO3)	mg /	200 (600)	58.00	56.10	61.40	61.10	64.20	61.80
17.	Free Residual Chlorine	mg /	Min0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
18.	Copper as(Cu)	mg /	0.05 (1.5)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
19.	Manganese as (Mn)	mg /	0.1 (0.3)	0.05	0.04	0.05	0.05	0.05	0.04
20.	Mercury as (Hg)	mg / l	0.001	< 0.0005	< 0.0004	< 0.0003	< 0.0003	< 0.0003	< 0.0003

21.	Cadmium as (Cd)	mg / l	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
22.	Selenium as (Se)	mg / l	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
23.	Arsenic as (As)	mg / l	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
24.	Lead as (Pb)	mg / l	0.05	< 0.005	< 0.004	< 0.005	< 0.005	< 0.005	< 0.005
25.	Zinc as (Zn)	mg / l	5 (15)	< 0.1	< 0.2	< 0.3	< 0.3	< 0.3	< 0.3
26.	Chromium as (Cr)	mg / l	0.05	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
27.	Aluminium as (Al)	mg / l	0.03 (0.2)	0.008	0.007	0.005	0.006	0.007	0.006
28.	Boron as (B)	mg / l	1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
29.	Cyanide as (CN)	mg / l	0.05	< 0.003	< 0.004	< 0.003	< 0.005	< 0.005	< 0.005
30.	Total Coliform	MPN/100 ml	Nil	< 1	< 1	< 1	< 1	< 1	< 1
31.	Phenolic Compounds	mg / l	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
32.	Anionic Detergents	mg / l	0.2(1.0)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
33.	Polynuclear aromatic Comp (as PAH)	µg / l	-	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
34.	Mineral Oil	mg / l	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

3.7.8 Data Interpretation of Ground water quality (Buffer zone):

The Ground water quality results clearly explain that:

Buffer zone ground water results: is taken as the area within 10 km radius from the proposed project site. Collected samples are from ground and Surface water sources.

1. The Ground water quality at location **GW4 (Core Zone, Hand Pump Water)** shows that parameters like Total Hardness (63.20 mg/l); Total dissolved solids (106.0 mg/l), Magnesium (3.14 mg/l), & Alkalinity (58 mg/l) is well within drinking water standards (IS: 10500).
2. The Ground Water results in the location **GW1 (ML Area of Arjust Limestone, Hand Pump Water)** shows all parameters within the permissible range.
3. The Ground Water results in the location **GW2 (Byrong Village, Hand Pump Water)** shows all parameters within the permissible range.
4. The Ground Water results in the location **GW3 (Khahumrin Village, Hand Pump Water)** shows all parameters within the permissible range.
5. The Ground water quality at **GW5 (Mawbang Village, Hand Pump Water)** shows

parameters within the permissible range.

6. The Ground water quality at **GW6 (Diengken Village, Hand Pump Water)** shows parameters within the permissible range.

The detailed tables are given at Annexure no.8.

3.7.9 Surface Water Quality Results:

The surface water quality assessment was done based on the IS-10500 as well as on CPCB Surface Water Criteria; the analyzed parameters were compared with IS-10500 to assess portability of the water available in the area also against the norms of CPCB for surface water. The detailed results are given in the **Annexure -8.** The results of water quality assessment for the parameters, which were found close to the limiting values as per IS-10500, are presented discussed here —

Table 3.13: Surface water Quality results of Tharia River

S. No.	Parameters	Unit	As Per IS:2296: 1992 Category - C	SW1 (Upstream)	SW2 (Downstream)
1.	Colour	Hazen units	300	<1	<1
2.	Odour	-	Un - Objectionable	Agreeable	Agreeable
3.	Turbidity NTU	NTU	-	0.6	0.5
4.	pH Value	-	6.5 to 8.5	7.30 at 24°C	7.20 at 24°C
5.	DO	mg / l	≥ 4	7.2	7.4
6.	BOD (3d, 250C)	mg / l	3	1.20	1.10
7.	COD	mg / l	-	6.00	5.80
8.	Total Hardness (CaCO3)	mg / l	-	74.20	71.20
9.	Oil and Grease	mg / l	0.1	<1	<1
10.	Iron (as Fe)	mg / l	50	0.21	0.23
11.	Chlorides (as Cl)	mg / l	600	51.20	53.60
12.	Electrical Conductivity at 25^0C	µs/cm	-	198	191
13.	Total Dissolved Solids (TDS)	mg / l	1500	112.00	114.00
14.	Calcium (as Ca)	mg / l	-	27.20	26.50
15.	Magnesium (as Mg)	mg / l	-	4.25	4.70
16.	Sulphate (as SO4)	mg / l	400	13.40	12.70
17.	Free residual chlorine	mg / l	-	< 0.1	< 0.1
18.	Nitrates (as NO3)	mg / l	50	0.85	0.93
19.	Fluoride (as F)	mg / l	1.5	0.03	0.04
20.	Free Ammonia (as NH3)	mg / l	-		
21.	Copper as(Cu)	mg / l	1.5	< 0.02	< 0.02
22.	Manganese as (Mn)	mg / l	-	0.08	0.08
23.	Cadmium as (Cd)	mg / l	0.01	< 0.001	< 0.001
24.	Selenium (as Se)	mg / l	0.05	< 0.001	< 0.001
25.	Arsenic as (As)	mg / l	0.2	< 0.01	< 0.01
26.	Mercury as (Hg)	mg / l	-	< 0.0003	< 0.0003
27.	Lead as (Pb)	mg / l	0.1	< 0.005	< 0.005
28.	Zinc as (Zn)	mg / l	15	< 0.3	< 0.3
29.	Boron as (B)	mg / l	-	< 0.1	< 0.1
30.	Chromium as (Cr +6)	mg / l	0.05	< 0.03	< 0.03
31.	Cyanide as (CN)	mg / l	0.05	< 0.005	< 0.005
32.	Phenolic Compounds	mg / l	0.005	< 0.001	< 0.001
33.	Anionic Detergents as MBAS	mg / l	1	< 0.001	< 0.001
34.	Total Coliform	MPN/ 100 ml	5000	< 1	< 1
35.	Polynuclear aromatic Comp (as PAH)	ppb	-	< 0.03	< 0.03

Source: Laboratory: ***Envirocheck, Kolkata (NABL Accredited)***

All the parameters marked with *** are also compared with the surface water quality criteria of CPCB,which is for all classes 'A' to 'E" is shown as below —

S.No.	Parameters	Unit	CPCB Surface water quality criteria				
			Class 'A'	Class 'B'	Class 'C'	Class 'D'	Class 'E'
1	pH Value	-	6.5-6.8	6.5-8.5	6.5 – 9.0	6.5-8.5	6-8.5
2	BOD	mg/l	≤2	≤3	≤3		
3	DO	mg/l	≥6	≥5	≥4	-	-

3.7.10 Data Interpretation of surface water quality (Buffer zone):

The Surface water quality of the **Tharia river** shows that all the parameters are within the CPCB Water Quality Criteria Class of water 'A', 'B', 'C', 'D' & 'E'. BOD of Upstream and Downstream water (1.20 mg/l & 1.10 mg/l) of the river, which is less than CPCB Water Quality Criteria Class of water 'C'; DO of upstream & downstream water (7.2 mg/l & 7.4 mg/l) is acceptable as per CPCB Water Quality Criteria Class of water 'A'.

3.8 Topography:

The project area around the block represents a rolling topography with gorges/scrap faces and with numerous streams. In the proposed block elevation difference is noted from 122 meters to 156 meters. Karst topography is prevalent with spiky surface with lots of sink-holes and solution cavities. Streams are semi-dendritic and flow towards east before taking southern turn towards Bangladesh. Most of the small tributaries are straight following bedding planes or are semi-dendritic in pattern. Being at the southern slope of the Meghalaya Plateau overlooking vast plain of Bangladesh. The area experiences severe rainfall between May and August with average annual rainfall of 11000 mm.

Drainage-

There is no water body in the ML area. At about 3.0 km toward the east the River Tharia is the only prominent river in the area flowing in a north south direction before entering Bangladesh.

3.9 SOIL QUALITY

To assess the soil quality of the proposed area, following stations were selected. Soil profile and quality was studied at 5 different locations.

3.9.1 Sampling location:

Location of Soil sampling stations is described below.

Table 3.14; Sampling location for soil quality

Station No.	Location	Distance & Direction from Project area	Project area / Study area	Environmental Significance
S4	Core Zone of Sohmluh Limestone	0.0 K M – C	Project Area	Existing Soil quality at core zone
S1	ML Area of Arjust Limestone	0.4 Km- SE	Project Area	Existing Soil quality at Buffer zone
S2	Byrong Village	1.5 Km – N	Agricultural Land	
S3	Khahumrin Village	1.8 Km - W	Agricultural Land	
S5	Mawbang Village	1.5 Km – S	Agricultural Land	

3.9.2 Locations of soil sampling stations:

Location of Soil sampling stations are shown in the map below and described ahead —

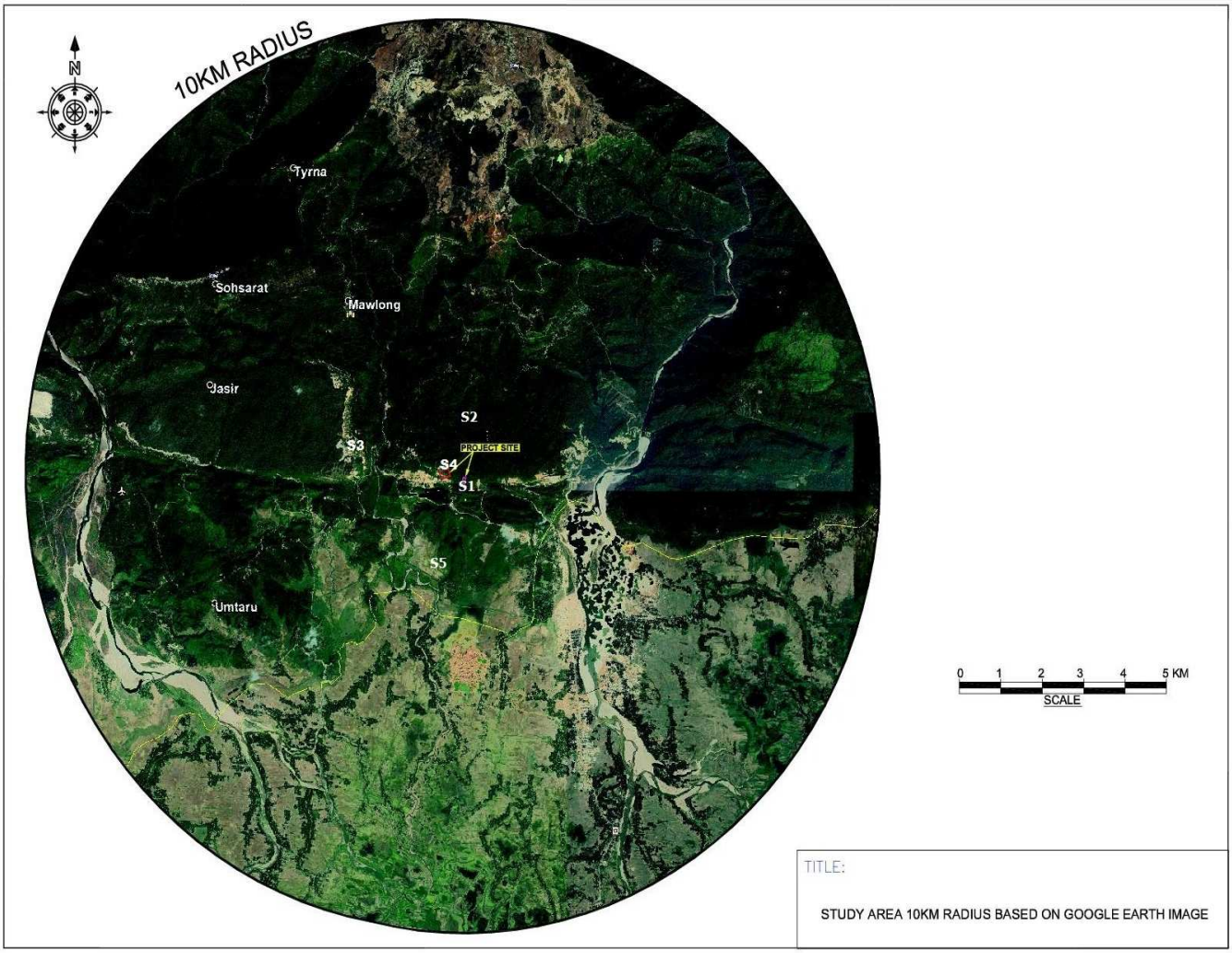


Figure 3.8; Soil sampling locations on 10 Km Google Satellite image

3.9.3 Sampling procedure & Analysis:

Augur method was used and samples were collected at 15 cm depth after removing the upper crust. Sample from each spot were well mixed with hand on a clean polythene sheet. About 1 kg of soil was retained after process of quartering. This sample was kept for some time for air-drying at room temperature, stored in polythene bag with label at the top. Samples were analyzed for bulk density, pH, nitrogen, phosphorus, calcium, magnesium and organic contents.

The soil quality assessment has been carried out at 5 locations were identified for collection of soil samples from the study area. The sampling locations are shown in Figure-3.8. and their distances and bearings from the project site are listed in Table 3.14

Physical Characteristics of soil

Physical characteristics of soil are delineated through specific parameters viz. bulk density, moisture, Infiltration rates and texture are presented in Table 3.15.

Regular cultivation practices increase the bulk density of soils thus inducing compaction. This results in reduction in water percolation rate and penetration of roots through soils. The soils with low bulk density have favourable physical conditions where as those with high bulk density exhibit poor physical conditions for agriculture crops. The bulk density of the soil in the study area ranged between 1.43 to 1.51 gm/cm^3 which indicates favourable physical condition for plant growth.

TABLE 3.15
PHYSICAL CHARACTERISTICS OF SOIL

S. No.	Location	Bulk Density gm/cm^3	Moisture %	Infiltration Rates cm/hr	Texture
1	ML Area of Arjust Limestone	1.51	1.7	43.00	Loamy Sand
2	Byrong Village	1.43	1.6	55.00	Loamy Sand
3	Khahumrin Village	1.47	1.8	52.00	Loamy Sand
4	Core Zone	1.49	1.7	42.00	Loamy Sand
5	Mawbang Village	1.43	1.7	55.00	Loamy Sand

Chemical Characteristics of soil

Data collected for chemical characteristics of soils through selected parameters viz. pH, EC, Total Organic, cations and anions are presented in Table 3.16 & 3.17.

pH is an important parameter indicative of alkaline or acidic nature of soil. It greatly affects the microbial population as well as solubility of metal ions and regulates nutrient availability. Variation in the pH of the soil in the study area is presented in Table 3.16 and it is found to be neutral to slightly basic (7.7 to 7.9).

Electrical conductivity, a measure of soluble salts in the soil is in the range of 102.5 μs/sec to 104.9 μs/sec as seen in Table 3.16. The important cations in the soil are calcium and magnesium whose concentrations range from 5531.44 to 5623.54 mg/Kg and 331.20 to 340.10 mg/Kg respectively.

Organic matter present in soil influences its physical and chemical properties and is responsible for stability of soil aggregates. Total Organic Carbon and nitrogen are found in the range of 0.70 – 0.79 % and 0.94% – 0.99 %. This shows that soil is moderately good in organic and nutrient contents. Plant requires some of the heavy metals at microgram level for their metabolic activities. These heavy metals are termed as micronutrients. Their deficiency becomes a limiting factor in plant growth, but at the same time their higher concentration in soil leads to toxicity.

TABLE 3.16
CHEMICAL CHARACTERISTICS OF SOIL IN STUDY AREA

S. No.	Location	pH	EC (μs/sec)	Org. C	Cl	SO4	Ca	Mg
				%			mg/Kg	
1	ML Area of Arjust Limestone	7.81	104.2	0.71	0.081	0.049	5621.74	336.12
2	Byrong Village	7.80	102.5	0.79	0.075	0.040	5531.44	336.56
3	Khahumrin Village	7.70	104.7	0.76	0.072	0.038	5536.22	340.10
4	Core Zone of Sohmluh	7.80	104.9	0.70	0.080	0.046	5623.54	331.20
5	Mawbang Village	7.90	102.5	0.79	0.075	0.040	5531.44	336.56

TABLE 3.17 FERTILITY STATUS

S. No.	Location	Organic Carbon (%)	Nitrogen (%)	Phosphorus (%)	Potassium (mg/kg)
1.	ML Area of Arjust Limestone	0.71	0.99	0.21	238.20
2.	Byrong Village	0.79	0.99	0.21	265.20
3.	Khahumrin Village	0.76	0.94	0.22	259.10
4.	Core Zone of Sohmluh	0.70	0.96	0.20	236.30
5.	Mawbang Village	0.79	0.99	0.21	265.20

The soil quality of the core & Buffer one is discussed below:

Soil Quality Results: Core Zone: The result shows that pH is 7.80. The availability of many plant nutrients in the soil changes as a result of reactions in the soil, which are largely controlled by soil pH. Amount of primary nutrients like Total Organic Carbon 0.70 %, the available nitrogen 0.96% is lower in range, the available Potassium 236.30 mg/kg is moderate in range while available Phosphorous 0.20% is higher in range, Primary nutrient profile shows that soil is low in fertility due to the availability of low amount of nitrogen and potassium.

Buffer Zone: The result shows that texture of soil has clay loam texture. Colour varies from 4/4 Dull Reddish Brown to 4/6 Brown and 5/6 Yellowish Grey, pH ranges from 7.70 to 7.90. Amount of primary nutrients like Total Organic Carbon 0.71% to 0.79%, the available nitrogen 0.94% to 0.99%, the available phosphorus 0.21%- 0.22% is higher in range while Available Potassium 238.20 mg/kg to 265.20mg/kg is lower in range, Primary nutrient profile shows that soil is low in fertility due to the availability of low amount of nitrogen, available potassium.

3.10 LAND USE

Core Zone Land Use: The core zone consists of total 4.5 Ha. The classification of the land is Private, Barren & Non- Forestland.

Classification of Land within leasehold			
Government Land		Private Land	
Forest Land	Non- Forest Land(Barren Land)	Barren land	Agriculture land
Nil	Nil	4.5 Ha.	Nil

The land use of the core zone is given below:

Land Use of the Core Zone

It is a deemed forest land**,** involving 4.5 ha. The surface map is attached as **Plate 4.**

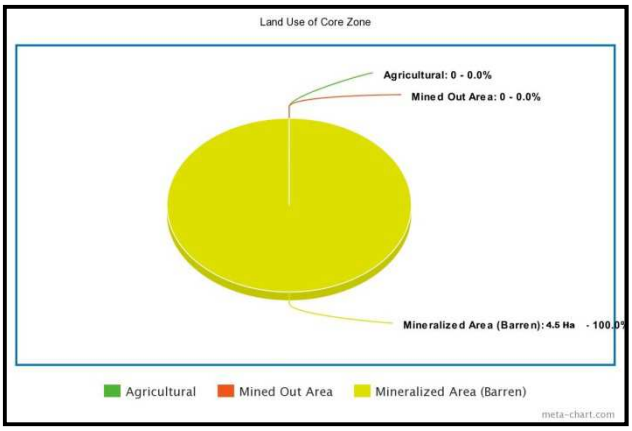


Figure 3.9; Existing Land Use of Core Zone

Existing Land use of the Mine lease area

Land Use	Area in Ha. (existing)
Agricultural	Nil
Mined Out Area	Nil
Mineralized area (Barren)	4.5
Total	**4.5**

Land use of Buffer Zone:

Information on land use/ land cover is the basic prerequisite for land resource evaluation, environmental assessment, utilization and management. As a precursor, it is necessary to understand the 'cause and effect' of the transformations through scientific studies. The scope of the present study is limited to mapping the current land use / land cover pattern, their assessment, spatial distribution and extent using remote sensing and GIS techniques. The land environment will mainly deal with the land use, land cover within core and buffer zone.

3.10.1 Methodology

Image processing software and GIS Software were used for the project. Image Processing Software was used for digital processing of the spatial data. Digital image processing techniques were applied for the mapping of the land use/land cover classes of the provided area from the satellite data. The methodology applied comes under following steps:

- Satellite imageries for the Area of Interest were created through image processing software.
- Geometric correction includes correction for geometric distortions due to sensor, earth geometry variations and conversion of the data to real world coordinates.
- Image enhancement is one of the important image processing functions primarily done to improve the appearance of the imagery to assist in visual interpretation and analysis.
- Google image is used as a reference map for base layer preparation.
- Visual interpretation technique has been used for digitization of geographical feature for different land use and vegetation cover classes based on spatial pattern of geographic feature.

TABLE 3.18; Land Use

S No.	Category	Area in SQ Km	Area In Ha	Percentage
1	Forest land	0	0	0
2	Area under Non-Agricultural Uses	7.80	780.00	100.00
3	Barren & Un-cultivable Land	0	0	0
4	Permanent Pastures and Other Grazing Land	0	0	0
5	Land Under Misc. Tree Crops etc.	0	0	0
6	Culturable Waste Land	0	0	0
7	Fallows Land other than Current Fallows	0	0	0
8	Current Fallows	0	0	0
9	Net Area Sown			
	Total	**7.80**	**780.00**	**100.00**

3.10.2 Results and Conclusions:

Land use Buffer zone:

The land use/ land cover map has been generated on 1:50,000 scale using Satellite Imagery and ground truth information. Based on the methodology developed for the present land use/ land cover, categories have been grouped under the following major land use/land cover categories.

The land use distribution in the buffer zone of 10 Km radius (from periphery) is given in the table given ahead.

Forest Land:

Based on Satellite Imagery and ground truth no forest land was found in 10 km radius area.

Area under Non-Agricultural Uses:

Based on Satellite Imagery and ground truth Non-Agricultural land their area extent has been extracted. The Non-Agricultural area is about 780 hectares which is 100 percent of the total 10 km radius study area.

Barren & Un-cultivable Land:

Based on Satellite Imagery and ground truth no Barren & Un-cultivable Land was found in 10 Km radius.

Permanent Pastures and Other Grazing Land:

Based on Satellite Imagery and ground truth no Permanent Pastures and Other Grazing Land were found in 10 Km radius.

Land Under Misc. Tree Crops etc.:

Based on Satellite Imagery and ground truth no Land under Misc. Tree Crops etc was found in 10 Km radius.

Culturable Waste Land:

Based on Satellite Imagery and ground truth no Culturable Waste Land was found in 10 Km radius.

Fallows Land other than Current Fallows:

Based on Satellite Imagery and ground truth no Fallows Land other than Current Fallows was found in 10 Km radius.

Current Fallows Land:

Based on Satellite Imagery and ground truth no Current Fallows Land was found in 10 Km radius.

Net Area Sown:

Based on Satellite Imagery and ground truth no Sown Land was found in 10 Km radius

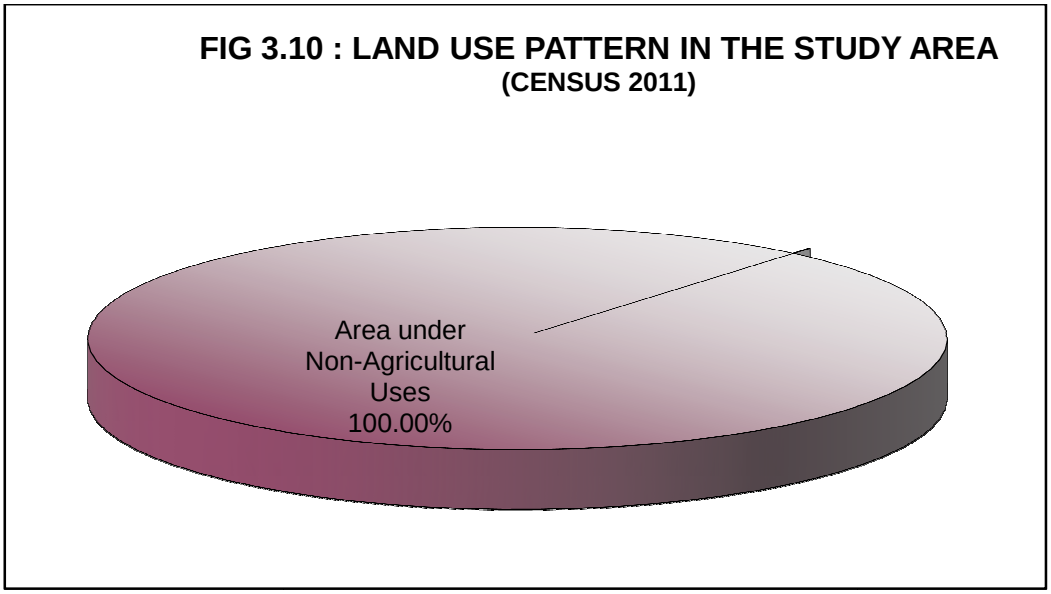


Figure 3.10, Land use Map of 10 Km Buffer Zone

3.11 ECOLOGY & BIODIVERSITY:

Complete study has been done and given below on the ecological environment of the study area.

3.11.1 Introduction on Ecology and Biodiversity:

The Ecology and Biodiversity is the study of mechanisms that regulates biodiversity and allow for the maintenance of ecosystem functioning in our changing world. In the web of life and natural ecology, the diversity, density and abundance of plants and animal species are decisive factors for assessing the bio diversity of any area. Documenting local species that are ecologically important may be helpful in restoration and planning of greenbelt development. With the help of actual field observations and published reports, a list of Flora and Fauna existing in the core zone and buffer zone was prepared.

An ecological survey of the study area was conducted, particularly with reference to listing of species and assessment of the existing baseline ecological conditions in the study area. The main objective of the ecological survey is aimed at assessing the existing flora and fauna components in the study area. Data has been collected through extensive survey of the area with reference to flora and fauna. With the change in environmental conditions, the vegetation cover as well as animals reflects several changes in its structure, density and composition. The proposed project is for mining of Limestone mineral at Sohmluh, Elaka Wahlong, East Khasi Hills District.

Objectives of Biological Studies:

The present study was undertaken with the following objectives:

- To assess the nature and distribution of vegetation in and around the project site (within 10 km. radius)
- To assess the species richness, biodiversity (within 10 km radii)

To achieve the above objectives a study area was undertaken. The different methods adopted were as follows:

- Compilation of secondary data with respect to the study area from published literature and various government agencies;
- Generation of primary data by undertaking systematic ecological studies in the area.

Selection of Sampling Location for the study of Flora and Fauna:

- **Core Zone:** Core Zone is considered as the areas where Limestone Mine is proposed. The proposed project is a mining of Limestone mineral by semi mechanized opencast method with drilling and blasting at Sohmluh, Elaka Wahlong, East Khasi Hills District.
- **Buffer Zone:** The zone falling within 10 km radius around the project area is Buffer Zone. For Study and sampling purpose, buffer zone is further divided in 1 Km and 5 Km.

Introduction of the project highlighting the Environmental sensitivity:

- The proposed project is a mining of Limestone mineral by semi mechanized opencast method with drilling and blasting at Sohmluh, Elaka Wahlong, East Khasi Hills District. There is no Wildlife Sanctuary in 10 km radius & and 1 water bodies Tharia River (3.0 Km, E).

Type of Forest

Meghalaya, situated in the north eastern region of India is a narrow stretch of land, running between Bangladesh on the South and West and Assam on the North and East, Meghalaya lies between 24° 58′ N to 26° 07′N latitudes and 89° 48′E to 92° 51′ E longitudes. The state has three distinct regions namely, Gao Hills, Khasi Hills and Jainta Hills. The climate is monsoonic with distinct warm-wet and cold dry periods and soil largely lateritic. The forests of Meghalaya can be broadly grouped into tropical, subtropical and temperate types. The Indian Institute of Remote Sensing have classified the vegetation of Meghalaya into tropical evergreen, tropical semi-evergreen, tropical moist deciduous, subtropical broad leaved, subtropical pine and temperate forest types, grasslands and savanna. The entire forest rich in plant like *Mesua ferrea, Terminalia myriocarpa, Vitex peduncularis, Mechelia champaca, Amoora wallichii* etc which have economical and medicinal significance and

animal biodiversity like Hoollock Gibbon, Serow, Slow Loris, Sloth Bear, Irrawaddy Squirrel, Otter, Mongoose, varieties of fruit Bats etc.

3.11.2 Methodology for the study of Flora and Fauna:

Methodology for Study of Flora:

During the study, the floral composition of the area was evaluated through primary survey. The study area was divided according to habitat types followed by the random sampling method, surveys, exploration, collection, and preparation of specimens toward building an inventory of floral diversity of the area. Phytosociological studies were conducted to assess the composition, diversity, distribution, and their status in the nature. This was cross-checked with the traditional knowledge of the people of the study region.

Methodology for study of Fauna:

Different species were observed at different timing during the day

Bird: Birds were watched during dawn.
Nocturnal and Burrowing animals: After Sunset.
Animals: Morning & Evening

Collection of Secondary Data

Secondary data is collected from the Forest Department, Working Plan of the Area other relevant records such as plantation journals and records of wild life / forest offence cases.

Cropping Pattern: The main crops grown in nearby areas are Wheat, rice, pulses, potatoes and pulses. In terms of productivity, rice is the predominant crop in Meghalaya. Beside these crops fruits like Banana, Citrus etc. and vegetables are also cultivated.

3.11.3 Description of Core Zone with flora and Fauna Details:

Flora of core Zone:

The density of the plant in core zone in general is very low due to rocky terrain and low soil content. In the core zone, place where mining is to be done is vacant land with patches of *Tetrameles nudiflora, Toona,* Alstonia Scholaris, Garuga gamblei which often reach up to the height of 20 m characterize the unmined core zone.

Flora of Buffer Zone:

The floral found in the whole of the study area are representative of the Tropical Lower Montane Forest, Tropical Semi-Evergreen, Moist-Broadleaf Forest, Tropical Deciduous/Semi-Deciduous, Broadleaf Forest and Tropical Sparse trees. The forest besides the study area is quite dense. The general survey has shown extreme biotic pressure in the area due to limestone mining (excavation), leading to widespread reduction of trees in the area.

Due to heavy rainfall in the region, there is a admixture of trees in the broad leaved evergreen forest. The common species found in the area are of Castonopeis indica, Castonopeis hystrix, Derris robusta, Macaranga denticulate, Schima wallichii & Musa superba.

The height of the dominant trees ranges from 4m to 9m which generally grow densely alongwith Musa superba and Clerodendron species. Numerous climbers are found in the area and they usually exhibit mesophytic adaption. The forest stands are dominated mostly by a Mimosaceae tree species of *Albizia*. Very few stands are dominated by *Tectona* and *Bombax ceiba* tree species. Overall forest areas are characterised by high species diversity. All the stands are dominated by *Castonopsis indica, Castonopsis hytrix, Derris robusta, Macaranga denticulate* or *Schima*. There is no degraded forest because of heavy rainfall along with high intensity sunlight.

Perennial grasses like cynodon dactylon and Saccharum spontaneum of Poaceae family grow in this area. A thin layer of grass growth can be noticed after the rains. Various types of woody growth along with shrubs also can be noticed in the area. There are no threatened species in the area. List of Flora (Trees, Shrubs, Herbs, Climber, Ornamental spices) in the Core zone and Study area has been given as follows Table 3.19

In the Buffer Zone varieties trees, shrubs, herbs, Ornamental plants, weed and grasses such as *Bombax ceiba, Castanopsis indica, Citrus sp., etc.*

Table 3.19, Flora (Trees, Shrubs, Herbs Ornamental spices) of Buffer Zone

Trees: *Acacia auriculiformis, Actinodaphne obovata, Ailanthus grandis, Alangium chinensis, Albizia lucida, Albizia lebbeck, Alstonia scholaris, Anthocephalus chinense, Aralia armata, Ardisia nerifolia, Artocarpus heterophyllus, Azadirachta indica, Bauhinia acuminate, Bauhinia purpurea, Bischofia javanica, Bombax ceiba, Bridelia tomentosa, Butea monosperma, Callicarpa arborea, Carallia branchiata, Caryota urens, Castanopsis indica, Castanopsis tribuloides, Cinnamomum bezolghota, Cinnamomum obtusifolium, Cyathea sp. Cynometra polyandra, Dalbergia sp., Dalbergia sisso, Duabanga grandiflora, Delonix regia, Drypetes assamica, Dysoxylum binectariferum, Elaeocarpus aristatus, Elaeocarpus sp., Englegardtia spicata, Exbucklandia populnea, Ficus benghalensis, Ficus elmeri, Ficus geniculata, Ficus hirta, Ficus hispida, Ficus religiosa, Ficus rumphii, Garuga gamblei, Ficus sp., Garcinia acuminata, Gmelina arborea, Grewia disperma, Grewia sp., Hevea brasiliensis, Hydnocarpus kurzii, Lagerstroemia parviflora, Leucaena leucocephala, Licuala peltata, Litsaea sebifera, Litsea citrita, Litsea laeta, Litsea salicifolia, Litsea sp., Macaranga denticulate, Macropanax disperma, Magnolia hodgsonii, Mallotus tetracoccus, Mangifera indica, Meliosma sp., Oroxylum indicum, Ostodes paniculata, Pandanus sp., Persea sp., Pithecellobium sp., Pongamia pinnata, Premna milleflora, Prunus acuminata, Psidium guajava, Pterospermum acerifolium, Pterospermum lancifolium, Quercus lancifolia, Quercus spicata, Rhus javanica, Sapium baccatum, Sarcosperma griffithii, Saurauia roxburghii, Saurauia sp., Schima wallichii, Shima sp., Spondias pinnata, Sterculia villosa, Streospermum chelenoides, Strobilanthus anisophyllus, Symplocos racemosa, Syzygium cumini, Syzygium sp., Terminalia bellerica, Terminalia chebula, Terminalia myriocarpa, Tetrameles nudiflora, Toona ciliata, Toona febrifuga, Travesia palmata, Trema orientalis, Villebrunea frutescens, Vitex negundo, Vitex pedunculata, Vitex sp., Wallichii densiflora, Wendlandia paniculata & Xerospermum sp.*
Shrubs: *Ageratum conyzoides, Allamanda cathartica, Allophylus sp., Alpinia sp. Amblyanthus grandulosus, Ardisia crispa, Ardisia nerifolia, Ardisia paniculata, Aroides sp., Baliospermum montana, Baliospermum sp., Boehmaria sp., Breynia patens, Breynia vitis-idaea, Buddleja asiatica, Calotropis gigantia, Calotropis procera, Cassia alata, Cassia tora, Cassia occidentalis, Citrus sp., Clerodendron colebrookianum, Clerodendron viscosum, Clerodendrum sp., Clorophytum khasianum, Coffea sp., Coix lacryma-jobi, Datura metal, Dendrocalamus hamiltonii, Dendrocnide sinuate, Dracaena angustifolia, Elaegnus conferta, Eupatorium odoratum, Helixanthera ligustrina, Hibiscus macrophyllus, Holmskioldia sanguine, Homonoia riparia, Hymenodictyon sp., Ilex sp., Jasminium sp., Jatropha curcas, Lantana camara, Leea aspera, Leea indica, Manihot esculenta, Melastoma malabathricum, Morinda angustifolia, Mussaenda roxburghii, Nyctanthus arbortristis, Ocimum gratissimum, Ophiorrhiza sp., Phoenix sylvestris, Rauwolfia serpentine, Rubus alceifolius, Rubus ellipticus, Rubus lucens, Saccharum spontaneum, Saccharum arundinaceum, Salamona sp., Saurauia sp., Scoperia dulcis, Sida rhombifolia, Solanum torvum, Strobilanthes anisophyllus, Xerospermum glabratum*
Herbs: *Alternanthera sessilis, Amaranthus spinosus, Amaranthus viridis, Ambrosia artemesifolia, Amischotolype mollissima, Amorphophalus bulbifera, Amorphophalus sp., Arundina graminifolia, Begonia hatacoa, Begonia sp, Bidens biternata, Bidens pilosa, Blachnum sp., Boehmeria glomerulifera, Boehmeria sp., Calamus flagellum, Calamus leptospadix, Carax cruciata, Castos speciosus, Chenopodium sp., Coleus sp., Commelina benghalensis, Commelina sp., Crassocephalum crepidioides, Cyathula prostrate, Dichrocephala integrifolia, Dracena trifasciata,*

Drymeria diandra, Diplezium esculentum, Elatostema monandrum, Eleusine indica, Erigeron Canadensis, Eupatorium adenophorum, Eupatorium odoratum, Euphorbia hirta, Euphorbia sp., Fagopyrum dibotrys, Fimbristylis dichotoma, Floscopa scandens, Fagopteris auriculata, Ferns sp., Forrestia sp., Globba multiflora, Globba clarkeii, Hedychium sp., Jasminum sp., Laportea crenulata, Leea indica, Leea sp., Licuala peltata, Luduwigia octovalis, Lycopodium sp., Maesa indica, Maesa sp., Melastoma malabathricum, Mannihot esculenta, Mimosa himalayana, Morinda angustifolia, Musa sp., Osbeckia sp., Osbekia crenata, Oscimum sanctum, Oxalis corniculata, Oxyspora sp., Ophiorrhiza sp., Phrynium capitata, Phrynium pubenervae, Pinanga gracilis, Polygonum chinense, Pteris sp., Randia sp. Rhynchotecum ellipticum, Rubus rugosus, Rungia sp., Scoparia dulcis, Selaginella monospora, Selaginella sp., Solanum torvum, Spilanthus paniculata, Tabernaemontana divericata, Thysanolaena maxima, Trevesia palmate, Triumfetta pilosa, Urena lobata, Wallichia densiflora, Sida acuta, Sida cordata, Spilanthes paniculata, Tridax procumbens, Vernonia cineraria & Viola betonicifolia
Climbers: *Acacia oxyphylla, Acacia pinnata, Acacia prunascens, Acampe sp., Aeschynanthus sp., Agapetes sp., Ampelocissus barbata, Asplenium nidus, Bauhinia scandens, Bauhinia vahlii, Byttneria aspera, Calamus leptospadix, Cayratia pedata, Cissampelos pareira, Combretum dasystachyum, Cryptolepis sinensis, Diascorea alata, Diascorea bulbifera, Dendrobium sp., Derris sp., Diascorea sp., Entada rheedei, Ficus sp., Gnetum scandens, Hedyotis scandens, Hodgsonia macrocarpa, Hoya sp., Ipomea nervosa, Jasminium flexile, Leea compactiflora, Luisea sp., Lygodium flexuosum, Lygodium fluxuosa, Melocalamus compectiflorus, Melothria heterophylla, Merremia umbellate,Microsorum sp.,Mikania micrantha, Milletia cinerea, Mucuna sp., Nepenthes khasiana, Paederia scandens, Parabaena sagittata, Pegia nitida, Piper thomsonii, Poikilospermum suaveolens, Porana paniculata, Pothos sp., Raphidophora decursiva, Raphidophora lancifolia, Rubus alceifolius, Scefflera venulosa, Smilex lancifolia, Tetrastigma angustifolia, Tetrastigma leucostophylum, Tetrastigma serrulatum, Thunbergia grandiflora & Zizyphus oenoplia*
Grasses: *Apluda mutica,Bambusa tulda, Cymbopogon martini, Cynodon dactylon, Cyperus compressus, Cyperus cyperinus, Cyperus rotundus, Dendrocalamus hemiltonii, Dendrocalamus strictus, Digitaria bicornis, Heteropogon contortus & Neohouzeaua helferii*
Epiphytes: *Aeschynanthus parasitica, Agapetes setigera, Aglaomorpha coronus, Asplenium nidus, Bulbophyllum careyanum, Dendrobium densiflorum, Eria lasiopetala, Hoya parasitica, Liparis viridiflora, Microsorum punctatum, Pholidota articulate, Pathos cathcartii, Pyrrosia adnascens, Pyrrosia flocculosa, Rhaphidophora calophyllum, Rhaphidophora lancifolium, Rhynchostylis retusa, Cuscuta reflexa &Vanda roxburghaii*
Hydrophytes: *Nelumbo nucifera & Nymphaea stellata*

The complete table is given in detail at **Annexure 14 of the EIA report**

3.11.4 Study of Fauna:

Fauna in core zone: - During study, it was found that the faunal diversity in the core site was limited to Butterflies, insects, some species of mammals & reptile. The core site has avifauna species like crow, pigeon, sparrow parrot, etc.

Table 3.20, Fauna (Mammals, Aves, Reptiles Amphibians, Fishes, Insects & Mollusca) of Study Area

Mammals: *Canis aureus, Cannomys badius, Callosciurus erythraeus, Crocidura attenuate, Suncus murinus, Felis chaus, Funambulus pennant, Funambulus palmarum, Herpestes edwardsi, Lepus nigricollis, Lutra Lutra, Muntiacus muntjak, Mus booduga, Mus musculus, Niviventer fulvescens, Ratufa bicolor, Rattus nitidus, Rattus rattus, Rhinolophus affinis, Rhinolophus hipposideros, Vulpes bengalensis, Presbytis entellus & Presbytis pileatus*
Aves: *Acridotheres tristis, Bambusicola fytchii, Ketupa flavipes, Cinnyris asiaticus, Columba livia, Coracias bengalensis, Corvus splendens,Eudyna mysscolopaceus, Milvus migrans, Francolinus pondicerianus, Hirundo rustica, Dendronanthus indicus, Passer domesticus, Psittacula krameri, Pycnonotus cafer, Scolopax rusticola, Alcedo atthis & Streptopelia chinensis*
Reptiles & Amphibians: *Amolops afghanus, Bufo parietalis, Bufo stomaticus, Bufoides meghalayana, Bungarus caeruleus, Calotes versicolor, Sinomicrurus macclellandi, Natrix natrix, Rhacophorus maximus, Hylarana garoensis, Odorrana livida, Varanus bengalensis, Chameleon sp., Calotes maria, Mobuya carinata, Microhyla ornate, Naja naja, Ptyas mucosus, Ptyctolaemus gularis*
Fishes: *Danio rerio, Catla catla,Danio aequipinnatus, Danio dangila, Labeo dero, Labeo rohita, Labeo fimbriatus, Mystus aor, Mystus vittatus & Puntius shalynius*
Insecta: *Acrida turrita, Acontia marmoralis, Orthetrum luzonicum, Agriocnemis pygmaea, Apis cerana, Ariadne merione, Ceriagrion coromandelianum, Euploca core, Eurema brigitta, Graphium sarpedon, Halpe kumara, Heterojinus semilaetaneus, Holochlora indica, Ischnura aurora, Matapa druna, Musca domestica, Papilio arcturus, Periplaneta Americana, Pseudagrion rubriceps, Apodemia mejicanus & Vespa orientalis*
Mollusca: *Bellamya bendalensis, Cypraea limacine & Turbo marmoratus*

The complete table is given in detail at **Annexure 14 of the EIA report.**

3.11.5 Photographs of Study Area:


Vegetation in the study area

3.11.6 Endangered Species:

There are is no schedule I Species of Fauna found in both core as well as buffer zone. Monkey of Schedule II is the only threatened species. There are no threatened species of plants also.

3.11.7 Cropping Pattern:

The main crops grown in nearby areas are Wheat, rice, potatoes and pulses. In terms of productivity, rice is the predominant crop in Meghalaya. Beside these crops fruits like Banana, Citrus etc. and vegetables are also cultivated.

3.12 SOCIO-ECONOMICSCENARIO

The proposed project is for mining of limestone mineral from lease area of 4.5 ha. The maximum production from the mine will be 162478 TPA. Mining of mineral will be done by opencast semi mechanized method. The applicant of the project is Shri. Shembhalang K Rymmai has applied for mining lease for minor mineral (Limestone) in her Raiyati owned land over an area of 4.5 Ha.

The latitude of the project area is N 25°10'42.19" TO N 25°10'50.5" and longitude is E 91°43'00.2" TO 91°43’0939" E.

Demographic profile

There is no habitation within the project area, i.e., the area of land acquired for the project. Hence, no rehabilitation will be required.

In the study area, i.e. the area falling within radius of 10 km from the proposed Limestone Mine, there are 104 inhabited revenue villages. Out of the 104 villages, 6 falls under

Khatarshnong Laitkroh tehsil and 89 in Shella Bholaganj & 9 in Pynursla tehsil of East Khasi Hills district of Meghalaya. Demographic profile of individual villages as per Census 2011 Census records, are presented in Annexure 12. A summary of the same is presented in Table 3.18. Distribution of population & percentage of literates, and the percentage of SC&ST population are presented through pie graphs in Fig 3.11 and 3.12 respectively and tabulated in Table 3.22.

TABLE 3.21
TEHSIL WISE POPULATION

District	Tehsil	Total Population	Male	Female
East Khasi Hills	Khatarshnong Laitkroh	2127	1057	1070
	Shella Bholaganj	40395	20345	20050
	Pynursla	3267	1618	1649
Grand Total		**45789**	**23020**	**22769**

TABLE 3.22
DEMOGRAPHIC DETAILS OF STUDY AREA

Description	Total	% of total population
No. of households	9032	
Total population	45789	100
Male Population	23020	50.27
Female Population	22769	49.73
Females/1000 males	989.09	-
Family size, persons/family	5.06	-
Schedule caste	1093	2.39
Schedule Tribe	38357	83.77
Total literates	29169	63.70
Male literate	14755	32.22
Female literate	14414	31.48

FIG 3.11 : LITERACY LEVEL IN THE STUDY AREA
(CENSUS 2011)

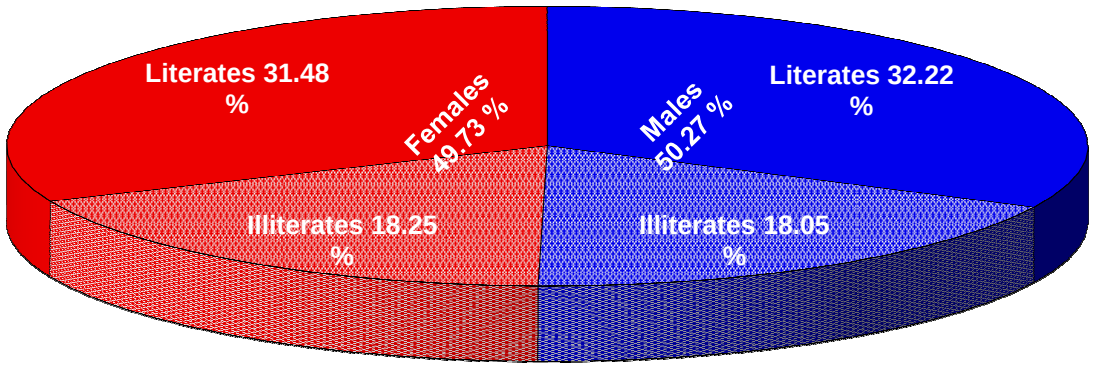
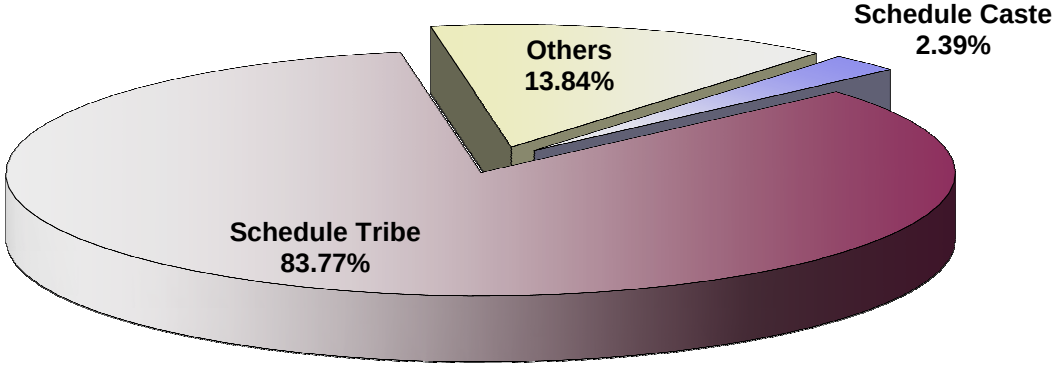


FIG 3.12 : BREAK UP OF SC & ST IN THE STUDY AREA
(CENSUS 2011)



Salient features of the demographic profile are as follows:

a) There is a slight predominance of males (50.27%) to females (49.73%)
b) Schedule tribes form a large part of the population, about 83.77% of the total population.
c) Male literacy rate is higher than female literacy rate.
d) Schedule caste population is 2.39% of total population

3.12.2 Employment and occupation

Employment pattern and occupation are the two main indicators of the economic profile, and the same for the individual villages based on 2011 Census data, are presented in **Annexure 15**. Pie diagrams showing employment pattern and occupation are depicted in Fig 3.13, 3.14, 3.15 & 3.16. A summary of employment pattern and occupation for the study area is presented in Table 3.23.

TABLE 3.23
SUMMARY OF EMPLOYMENT AND OCCUPATION IN STUDY AREA

Description	Total	% of total population
Main workers	13929	30.42
Marginal workers	2314	5.05
Non-workers	29546	64.53
Total	**45789**	**100.00**
Break-up of Main workers		
Cultivator	1641	11.78
Agricultural labour	2378	17.07
Household industries	99	0.71
Other workers	9811	70.44
Total	**13929**	**100.00**
Break-up of Marginal workers		
Cultivators	288	12.45
Agricultural labour	495	21.39
Household industries	30	1.30
Other workers	1501	64.87
Total	**2314**	**100.00**

FIG 3.13 : EMPLOYMENT PATTERN IN THE STUDY AREA
(CENSUS 2011)

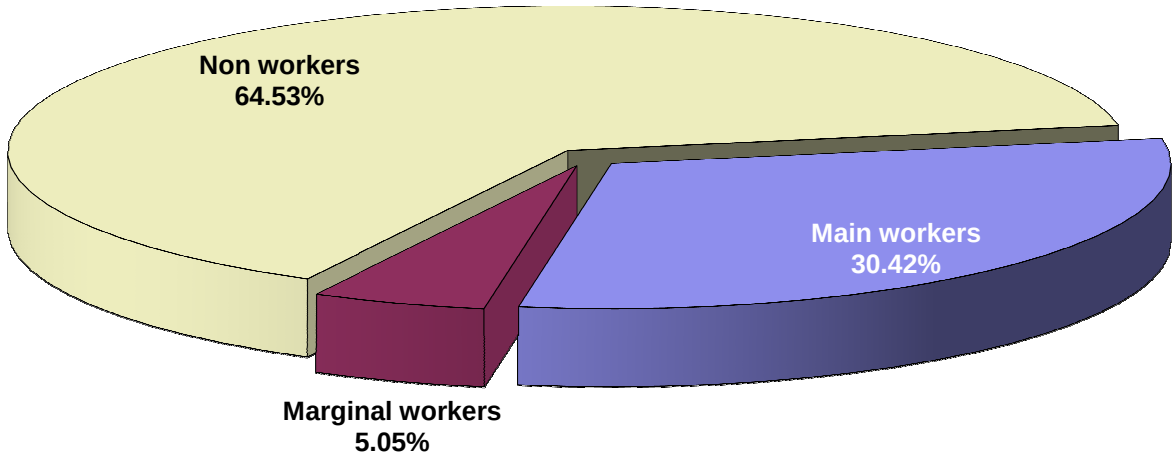


FIG 3.14 : BREAK UP OF MAIN WORKERS IN THE STUDY AREA
(CENSUS 2011)

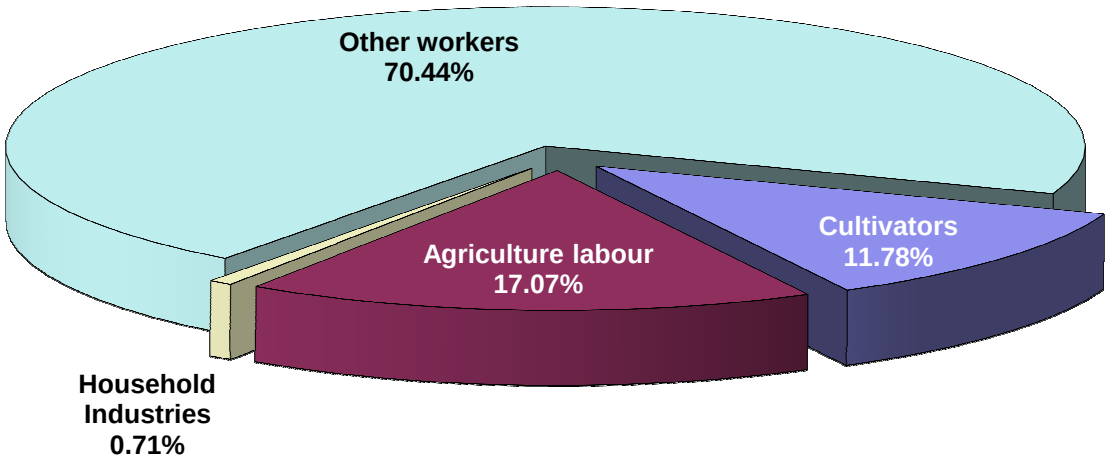


FIG 3.15 : BREAK UP OF MARGINAL WORKERS IN THE STUDY AREA
(CENSUS 2011)

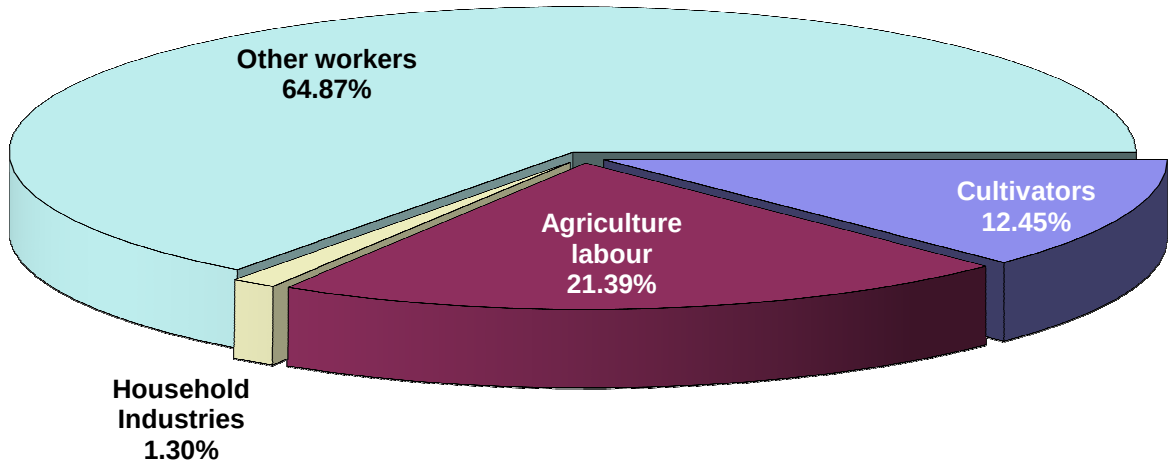
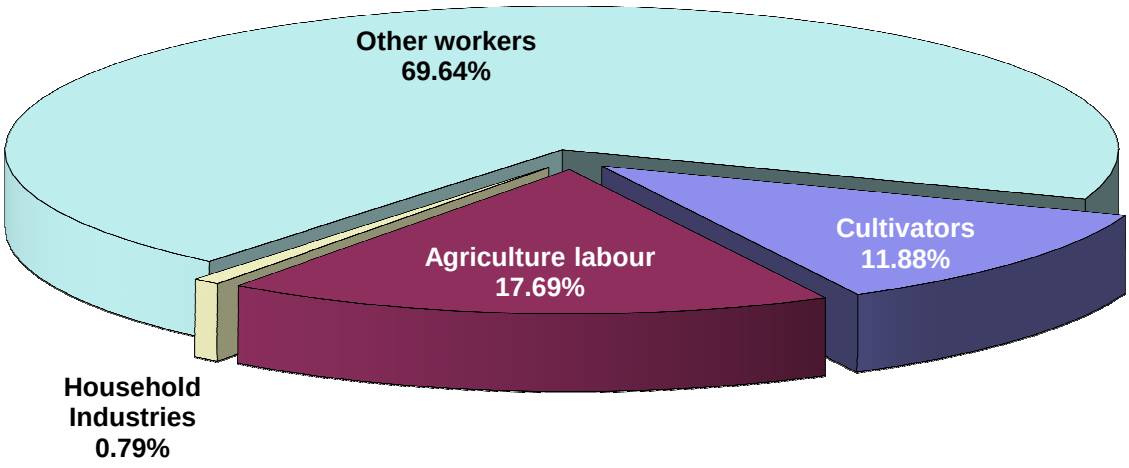


FIG 3.16 : BREAK UP OF TOTAL WORKERS (Main & Marginal) IN THE STUDY AREA
(CENSUS 2011)



3.12.3 Amenities

Details of amenities available in the individual villages are given in Annexure 16. A summary of the same is as follows:

- Educational facilities in the study area comprise of 131 Pre primary schools, 109 Primary Schools, 36 Middle Schools, 10 secondary schools & 1 senior secondary school,
- For drinking water, hand pump are used is 10, tap water treated is 43, tap water un treated is 51, well water is 19, tank water is 15, tube well water is 4, 29 river water, 46 spring water and 6 other water sources.
- Census data for power supply shows that from the total villages, 100 villages have power supply for domestic purpose and 1 village have power for all purpose.
- Census data for post and telegraph facilities shows that there are 7 villages have sub post offices & 24 telephone connections.
- There are 34 pucca roads, 82 Kachha roads, 13 MDR, 11 ODR, 10 SH and 8 AWR to villages in the study area.
- Census data for medical facilities shows that there are 1 CHC, 3 PHC, 7 PHSC, 4 MCWC, 4 family welfare centers, in the study area.
- Census data for communication shows that there are 21 Public Bus service and 27 Private Bus service in the study area.
- Census data for Banks/credit societies shows that there are 3 commercial, 2 co-operative banks, 37 Self Help Group in the study area.

3.13 PLACES OF TOURISM /HISTORICAL /ARCHAEOLOGICAL IMPORTANCE

There are no historical/tourist or religious places or places of archaeological importance in core zone of the proposed Limestone Mine. However there are some important places for tourists such as follows:

1. **Cherrapunji** has often been credited as being the wettest place on Earth, but for now nearby Mawsynram currently holds that distinction. It is about 10.0 KM in North of lease area. The geography of the hills with many deep valley channels encompassing the low-flying (150–300 m) moisture-laden clouds from a wide area converges over Cherrapunji. The extreme amount of rainfall is perhaps the best-known feature of orographic rain in northeastern India.

2. A **Double Décor living Root Bridge** is a type of simple suspension bridge formed of living plant roots by tree shaping can be seen in Nongriat, Tyrna near Cherrapunji is about 9.0 KM in the North-West Direction. They are common in the southern part of the Meghalaya. They are handmade from the aerial roots of rubber fig trees (Ficus elastica) by the Khasi and Jaintia peoples of the mountainous terrain along the southern part of the Shillong Plateau. Most of the bridges grow on steep slopes of subtropical moist broadleaf

3. Nohkalikai Falls is the tallest plunge waterfall in India. Its height is 1115 feet (340 metres). The waterfall is located near Cherrapunji. It is about 11.5 KM in the North-West of the lease area. Nohkalikai Falls are fed by the rainwater collected on the summit of a comparatively small plateau and decrease in power during the dry season in December - February. Below the falls there has formed a plunge pool with unusual green colored water.

3.14 INDUSTRIES IN THE STUDY AREA

There are a few Limestone mines in the vicinity of the proposed Limestone Mine. They are as follows:

Table 3.24: Industries in the Study area

Sl No	List of industries	Type of Industries	Distance & Direction
1.	Dron Limestone Mine	Limestone Mine	2.40 Km NE
2.	Ruieng Limestone Mine	Limestone Mine	2.00 Km NE
3.	Pritimai Limestone Mine	Limestone Mine	2.40 Km NE
4.	Arjust Limestone Quarry	Limestone Mine	0.40 Km SE
5.	Lafarge Umiam Mining Pvt. Ltd	Cement Plant	10.10 Km W

3.15 TRAFFIC DENSITY

The traffic study was done in the nearby road ascertain the present traffic was on the road and thereafter impact be because of addition of traffic due to the operation of Project.

The traffic density for road Between ML & Approach Road & Sohra-Shella Road is given in Table below.

Monitoring location and methodology

Traffic density monitoring station was located as follows:

Table 3.25: Trafic Monitoring Location

Location	Name of the Location	Distance & Direction w.r.t Proposed Mine	Remarks
TD I	Between ML & Approach Road	0.5 KM- SSE	MDR-27
TD 2	Sohra-Shella	2.1 K M – W	SH-5

Traffic density measurements were made continuously for 24 hours by visual observation and counting of vehicles under four categories, viz., heavy motor vehicles, light motor vehicles, two/three wheelers and cycles. As traffic density on the roads is low, two skilled persons were deployed simultaneously during each shift – one person on each of the two directions for counting the traffic. At the end of each hour, fresh counting and recording was undertaken. Thus, total numbers of vehicles per hour under the four categories were determined. A summary of the traffic density monitored during survey period is given in Table 3.26.

TABLE 3.26
TRAFFIC DENSITY

Traffic vehicle	No. of vehicles per day	
	TD I	**TD 2**
H.M.V.	60	150
L.M.V.	25	74
Two/three wheelers	50	85
Grand Total	**135**	**309**

4.0 ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

4.1 GENERAL

Any economic development project has some environmental implications adverse or beneficial. An impact can be defined as any change in physical, chemical, biological, cultural and/or socio-economic environment that can be attributed to activities related to alternatives under study for meeting the project needs. The operations involved in proposed project are studied in details before implementation.

The objective of impact identification is to specify areas that are likely to be affected by the implementation of the project. Impact methodology provides an organized approach for prediction and assessing these impacts. The nature of the impacts due to said project activities are identified. This will help to minimize and mitigate the further additional pollution load due to the proposed project on surroundings. The objectives of impact identification are as follows:-

- To ensure compliance with regulations.
- To provide a comprehensive coverage of a full range of impacts, including social, economic and physical.
- To distinguish between positive and negative, large and small, long term and short term, reversible and irreversible impacts.
- To identify secondary, indirect and cumulative impacts as well as direct impacts.
- To consider impacts within the constraints of an area's carrying capacity.

4.2 DETAILS OF INVESTIGATED ENVIRONMENTALIMPACTS

The project activities influencing the following environmental attributes have been studied and their impacts on the following attributes have been assessed.

- Air Quality
- Noise Quality
- Water Quality
- Land use
- Soil Quality
- Biotic Condition
- Socio-Economic Condition
- Traffic Condition

The mining and allied activities in the proposed project area have influence on the above

environmental attributes. These activities include:

- Site preparation
- Excavation
- Loading and Transportation

The magnitude of the proposed mining activity being small is not likely to create any serious impacts on the existing environmental set up of the area. However, the likely impacts of the proposed mining and allied activities on the various environmental parameters are discussed with the help of Monitoring done during **December 2019 to February 2020.**

4.3 AIR ENVIRONMENT

Any surface mining, including opencast coal mining has always been a dusty business. Sources of particulate matter in open cast mine are excavation, transportation, handling, loading and hauling operation. Dust generation due to mining operation occurs within the mine pit, from overhaul roads as well as dumping areas. At the same time, the HEMM operations and truck movement will release air emissions from their exhausts also. The impacts due to the above listed activities are already occurring at the site as mine is in operation.

Operations that will cause addition to the pollution load in air in the form of particulate matters, SO2, NOx etc. are:

- Operation of additional diesel fuel based equipments and vehicles
- Removal of vegetation and soil from excavation area
- Handling & transport of additional mineral and waste material (within/ outside of project)
- Dumping activities
- Drilling and blasting

Existing ambient air quality data on various sections of the project was collected to establish a baseline database. **December 2019 to February 2020** for parameters PM_{10}, $PM_{2.5}$, SO_2, and NO_x values were analyzed**.** Samples were collected from 8 sampling locations:

Core Zone: The value of $PM_{2.5}$ is ranging from 22-31 μg/m^3 and mean value is 30.5 μg/m^3 against standard limit of 60 μg/m^3. Value of PM_{10} is ranging from 52.0 -78.0 μg/m^3 and mean value is 77.1 μg/m^3 against standard limit of 100 μg/m^3. The mean value of SO_2 is 7.5 μg/m^{3}against standard limit of 80 μg/m^3 & mean value of NOx is 7.7 μg/m^3 against standard limit of 80 μg/m^3.

Buffer Zone: The results of the Buffer Zone shows that PM_{10} was maximum at Bholaganj Bazar (within prescribed standard limits) and Mawbang Village were minimum. The $PM_{2.5}$ is ranging from 25.6-28.8μg/m^3. PM_{10} is ranging from 61.87-74.9μg/m^3. The SO_2 is ranges from 5.2-6.8 against standard limit of 80μg/m^3& NOx ranges from 5.2-7.0 μg/m^3 against standard limit of 80 μg/m^3. These are within standard limits of National ambient air quality standards.

The values of both the parameters are well within prescribed limits.

4.3.1 Impact on air quality of the area

- Generation of suspended particulate matter during mining operations, material storage, transportation and handling (loading/unloading)
- Generation of SO_2 , NOx due to fuel burning
- Generation of dust due to drilling & blasting
- Deterioration in ambient air quality due to project
- Health impacts to workers working at dust generation area.
- Accidental Spillage of mineral during loading and unloading

For estimating the increase in the air pollutants, air quality prediction modeling has been carried out using ISCST3 model.

ISCST3 Model

ISCST3 is a steady-state Gaussian plume model which can be used to assess pollutant concentrations from a wide variety of sources associated with an industrial complex. This model can account for the following: settling and dry deposition of particles; downwash; point, area, line, and volume sources; plume rise as a function of downwind distance; separation of point sources; and limited terrain adjustment. ISCST3 operates in short-term mode.

Model Input Data: For the modeling purpose, the total fugitive particulates (suspended particulate matter i.e. SPM) has been estimated and PM_{10} and $PM_{2.5}$ have been proportioned with respect to it. SO_2 and NO_2 from machinery operation have also been modelled. This modelling has been done for the maximum possible excavation and material handling in any given year during plan period.

This modeling has been done considering 50000 TPA from Arjust Limestone Mine from 0.7162 Ha. and 162478 TPA from Sohmluh Limestone Quarry in operation. Annually 250 working days with 8 hourly one shift has been considered as per approved Mining Plan. The assumptions, input data and other details are given in **Annexure 13** along with GLC isopleth maps and the results are summarized in **Table 4.1** for PM_{10}, $PM_{2.5}$, SO_2 and NO_2. While the GLC at various air quality locations are given in Table 4.2 below.

TABLE 4.1
PREDICTED INCREMENTAL GROUND LEVEL CONCENTRATION (μg/m³) BY ISCST3 MODEL

Rank	Co-ordinates		PM_{10}	Co-ordinates		$PM_{2.5}$
	X	Y	GLC	X	Y	GLC
1	10702.13	10267.83	6.91496	10702.13	10267.83	3.97610
2	10702.13	10267.83	5.68574	10702.13	10267.83	3.26930
3	10702.13	10267.83	5.46482	10702.13	10267.83	3.14227
4	10768.24	10397.11	5.27181	10768.24	10397.11	3.03129
5	10702.13	10267.83	4.94826	10702.13	10267.83	2.84525
6	10459.61	10441.78	4.57454	10459.61	10441.78	2.63036
7	10770.01	10185.71	4.53539	10770.01	10185.71	2.60785
8	10702.13	10267.83	4.43421	10702.13	10267.83	2.54967
9	10876.08	9941.78	4.33874	10876.08	9941.78	2.49477
10	10876.08	10096.08	4.26883	10876.08	10096.08	2.45458
11	10821.42	10309.82	4.12874	10821.42	10309.82	2.37402
12	10768.24	10397.11	4.00029	10768.24	10397.11	2.30017
13	10768.24	10397.11	3.99758	10768.24	10397.11	2.29861
14	10702.13	10267.83	3.97023	10702.13	10267.83	2.28288
15	10414.14	10441.78	3.69032	10414.14	10250.44	2.12194
16	10459.61	10441.78	3.44400	10459.61	10441.78	1.98030
17	10459.29	10269.14	3.44244	10459.29	10269.14	1.97941
18	10768.24	10397.11	3.32857	10768.24	10397.11	1.91393
19	10702.13	10267.83	3.31566	10702.13	10267.83	1.90650
20	10459.29	10269.14	3.26659	10459.29	10269.14	1.87829
21	10702.13	10267.83	3.26397	10702.13	10267.83	1.87678
22	10684.74	9979.84	3.18950	10684.74	9979.84	1.83396
23	10459.29	10269.14	3.14365	10459.29	10269.14	1.80760
24	10459.29	10269.14	3.10796	10459.29	10269.14	1.78708
25	10702.13	10267.83	3.07952	10702.13	10267.83	1.77073
26	10770.01	10185.71	3.07840	10770.01	10185.71	1.77008

Rank	Co-ordinates		PM_{10}	Co-ordinates		$PM_{2.5}$
	X	Y	GLC	X	Y	GLC
27	10459.29	10269.14	3.07267	10459.29	10269.14	1.76679
28	10459.61	10441.78	3.05456	10459.61	10441.78	1.75637
29	10876.08	10206.51	2.91217	10876.08	10206.51	1.67450
30	11209.99	10303.47	2.89677	11209.99	10303.47	1.66564
31	10684.74	9979.84	2.86633	10684.74	9979.84	1.64814
32	10459.29	10269.14	2.86445	10459.29	10269.14	1.64706
33	10459.61	10441.78	2.80491	10459.61	10441.78	1.61282
34	10459.61	10441.78	2.80491	10459.61	10441.78	1.61282
35	11305.57	10263.88	2.75814	11305.57	10263.88	1.58593
36	11338.02	10250.44	2.72366	11338.02	10250.44	1.56610
37	11107.41	10210.45	2.72127	11107.41	10210.45	1.56473
38	10821.42	10309.82	2.71886	10821.42	10309.82	1.56335
39	10414.14	10250.44	2.71508	10414.14	10250.44	1.56117
40	10768.24	10397.11	2.70586	10768.24	10397.11	1.55587
41	10414.14	10250.44	2.68550	10414.14	10250.44	1.54416
42	10768.24	10397.11	2.60198	10768.24	10397.11	1.49614
43	10684.74	9891.78	2.60042	10684.74	9979.84	1.49524
44	10958.43	10407.67	2.58542	10958.43	10407.67	1.48662
45	10821.42	10309.82	2.56115	10821.42	10309.82	1.47266
46	10770.01	10185.71	2.56089	10770.01	10185.71	1.47251
47	10702.13	10267.83	2.54404	10702.13	10267.83	1.46282
48	10459.61	10441.78	2.53475	10459.61	10441.78	1.45748
49	10414.14	10250.44	2.52349	10414.14	10250.44	1.45101
50	10770.01	10185.71	2.48040	10770.01	10185.71	1.42623

Rank	Co-ordinates		SO_2	Co-ordinates		NO_2
	X	Y	GLC	X	Y	GLC
1	10702.13	10267.83	.53911	10702.13	10267.83	1.07822
2	10702.13	10267.83	.44288	10702.13	10267.83	.88575
3	10702.13	10267.83	.42605	10702.13	10267.83	.85211
4	10768.24	10397.11	.41101	10768.24	10397.11	.82201
5	10702.13	10267.83	.38380	10702.13	10267.83	.76761
6	10459.61	10441.78	.35664	10459.61	10441.78	.71329
7	10770.01	10185.71	.35351	10770.01	10185.71	.70702
8	10702.13	10267.83	.34569	10702.13	10267.83	.69139
9	10821.42	10309.82	.32189	10821.42	10309.82	.64377
10	10876.08	10096.08	.32090	10876.08	10096.08	.64180
11	10876.08	9941.78	.31974	10876.08	9941.78	.63948
12	10768.24	10397.11	.31165	10768.24	10397.11	.62330
13	10768.24	10397.11	.31117	10768.24	10397.11	.62234
14	10702.13	10267.83	.30827	10702.13	10267.83	.61653
15	10414.14	10250.44	.28766	10414.14	10250.44	.57532
16	10459.29	10269.14	.26838	10459.29	10269.14	.53677
17	10459.61	10441.78	.26788	10459.61	10441.78	.53576
18	10702.13	10267.83	.25714	10702.13	10267.83	.51427
19	10768.24	10397.11	.25663	10768.24	10397.11	.51327
20	10459.29	10269.14	.25437	10459.29	10269.14	.50873
21	10702.13	10267.83	.25384	10702.13	10267.83	.50768
22	10684.74	9979.84	.24834	10684.74	9979.84	.49668
23	10459.29	10269.14	.24504	10459.29	10269.14	.49007
24	10459.29	10269.14	.24226	10459.29	10269.14	.48453
25	10459.29	10269.14	.23955	10459.29	10269.14	.47911
26	10702.13	10267.83	.23930	10702.13	10267.83	.47859
27	10459.61	10441.78	.23778	10459.61	10441.78	.47556
28	10770.01	10185.71	.23767	10770.01	10185.71	.47534
29	10459.29	10269.14	.22332	10459.29	10269.14	.44664
30	10684.74	9979.84	.22331	10684.74	9979.84	.44661
31	10459.61	10441.78	.21868	10459.61	10441.78	.43736
32	10459.61	10441.78	.21868	10459.61	10441.78	.43736

Rank	Co-ordinates		PM_{10}	Co-ordinates		$PM_{2.5}$
	X	Y	GLC	X	Y	GLC
33	10876.08	10206.51	.21606	10876.08	10206.51	.43211
34	10414.14	10250.44	.21144	10414.14	10250.44	.42288
35	10768.24	10397.11	.21042	10768.24	10397.11	.42085
36	11209.99	10303.47	.21011	11209.99	10303.47	.42022
37	10414.14	10250.44	.20937	10414.14	10250.44	.41874
38	10821.42	10309.82	.20932	10821.42	10309.82	.41865
39	10768.24	10397.11	.20286	10768.24	10397.11	. 40572
40	11305.57	10263.88	.20105	11305.57	10263.88	.40211
41	10958.43	10407.67	.19960	10958.43	10407.67	.39921
42	10821.42	10309.82	.19876	10821.42	10309.82	.39753
43	11338.02	10250.44	.19862	11338.02	10250.44	.39724
44	10770.01	10185.71	.19831	10770.01	10185.71	.39663
45	10459.61	10441.78	.19762	10459.61	10441.78	.39523
46	10414.14	10250.44	.19670	10414.14	10250.44	.39340
47	10702.13	10267.83	.19321	10702.13	10267.83	.38643
48	10684.74	9979.84	.19199	10684.74	9979.84	.38399
49	10770.01	10185.71	.19198	10770.01	10185.71	.38396
50	10872.55	10433.83	.19127	10872.55	10433.83	.38254

A perusal of above table shows that the incremental values of 6.5 $\mu g/m^3$, 3.6 $\mu g/m^3$, 0.5 $\mu g/m^3$ and 1.0 $\mu g/m^3$ for PM_{10}, $PM_{2.5}$, SO_2 and NO_2, respectively are anticipated at a distance of 100 m from the mine lease boundary.

TABLE 4.2

ANTICIPATED INCREMENTAL GLC VALUES AT THE AIR QUALITY MONITORING STATIONS (μg/m³)

Pollutant	Sampling Station	Maximum observed value	Incremental	Total	NAAQS Standards 2009
PM_{10}	AQ1	81.0	0.365	81.365	100
	AQ2	70.0	0.039	70.039	
	AQ3	76.0	2.231	78.231	
	AQ4	78.0	0.137	78.137	
	AQ5	71.0	0.087	71.087	
	AQ6	79.0	0.224	79.224	
	AQ7	84.0	0.042	84.042	
	AQ8	71.0	0.494	71.494	
$PM_{2.5}$	AQ1	35.0	0.210	35.21	60
	AQ2	29.0	0.022	29.022	
	AQ3	32.0	1.283	33.283	
	AQ4	31.0	0.007	31.007	
	AQ5	30.0	0.050	30.05	
	AQ6	33.0	0.129	33.129	
	AQ7	34.0	0.024	34.024	
	AQ8	31.0	0.283	31.283	
SO_2	AQ1	7.9	0.028	7.928	80
	AQ2	6.9	0.002	6.902	
	AQ3	6.8	0.173	6.973	
	AQ4	7.5	0.001	7.501	
	AQ5	7.1	0.006	7.106	
	AQ6	6.9	0.017	6.917	
	AQ7	7.9	0.003	7.903	
	AQ8	6.5	0.038	6.538	
	AQ1	8.0	0.056	8.056	
	AQ2	6.9	0.005	6.905	
	AQ3	6.9	0.034	6.934	

Pollutant	Sampling Station	Maximum observed value	Incremental	Total	NAAQS Standards 2009
NO_2	AQ4	7.7	0.002	7.702	80
	AQ5	7.1	0.012	7.112	
	AQ6	6.5	0.034	6.534	
	AQ7	7.9	0.006	7.906	
	AQ8	6.9	0.076	6.976	

It can be seen from **Table 4.1** that after addition of the incremental GLC's to the existing air quality, the concentration of pollutants would increase, but still they would remain within the prescribed standards at all the sampling stations as per applicable standards

4.3.2 Mitigation Measures

- *Drilling machines will be equipped with dust collector arrangement and wherever required wet drilling arrangement will be used to prevent generation and spreading of dust.*
- *Optimum blast design parameters will be adopted after study. Optimum stemming in blast holes will be done to minimize generation of dust and fly rocks.*
- *Blasting will be done during favorable atmospheric conditions and will be avoided during high windy periods, night times and temperature inversion periods.*
- *To avoid secondary blasting rock breaker will be used.*
- *Optimum bucket size loading equipment will be used which will reduce the number of bucket passes to fill the dumper and thus comparatively less dust will be generated during loading. This will also reduce the chances of spillage from the bucket.*
- *Water sprinkling over blasted pile of ROM will be done which will reduce dust generation during loading.*
- *Water tankers with suitable sprinkling system will be deployed along haul roads and other unworked areas to control fugitive emission. The sprinkling frequency will depend upon the humidity present in the atmosphere.*
- *Overloading of the dumpers and tippers will be avoided.*
- *The vehicles deployed for material transportation shall be spillage proof to avoid or minimize the spillage of the material during transportation.*
- *Personnel working on the drills and other mining activities will be provided with dust mask and other necessary Personal Protective Equipments (PPE). Health checkups will be done biannually to monitor the health of the workers.*
- *Plantation of local thriving species will be done in the 7.5m statutory boundary for arresting dust.*
- *Regular maintenance of vehicles and machinery will be done.*

- *Vehicles/equipment will be periodically subjected for emission tests and will have valid POLLUTION UNDER CONTROL certificates.*
- *Excavators and dumpers will have dust proof cabins to minimize dust exposure of workers.*
- *No impacts are expected on micro-climatic conditions of the project due to this small scale mining activity.*
- *Monitoring to ensure compliance with emission limits would be carried out during operation.*
- *Air Dispersion Modeling study has been carried out and report will be furnished.*

GLC CONTOURS OF PM_{10}

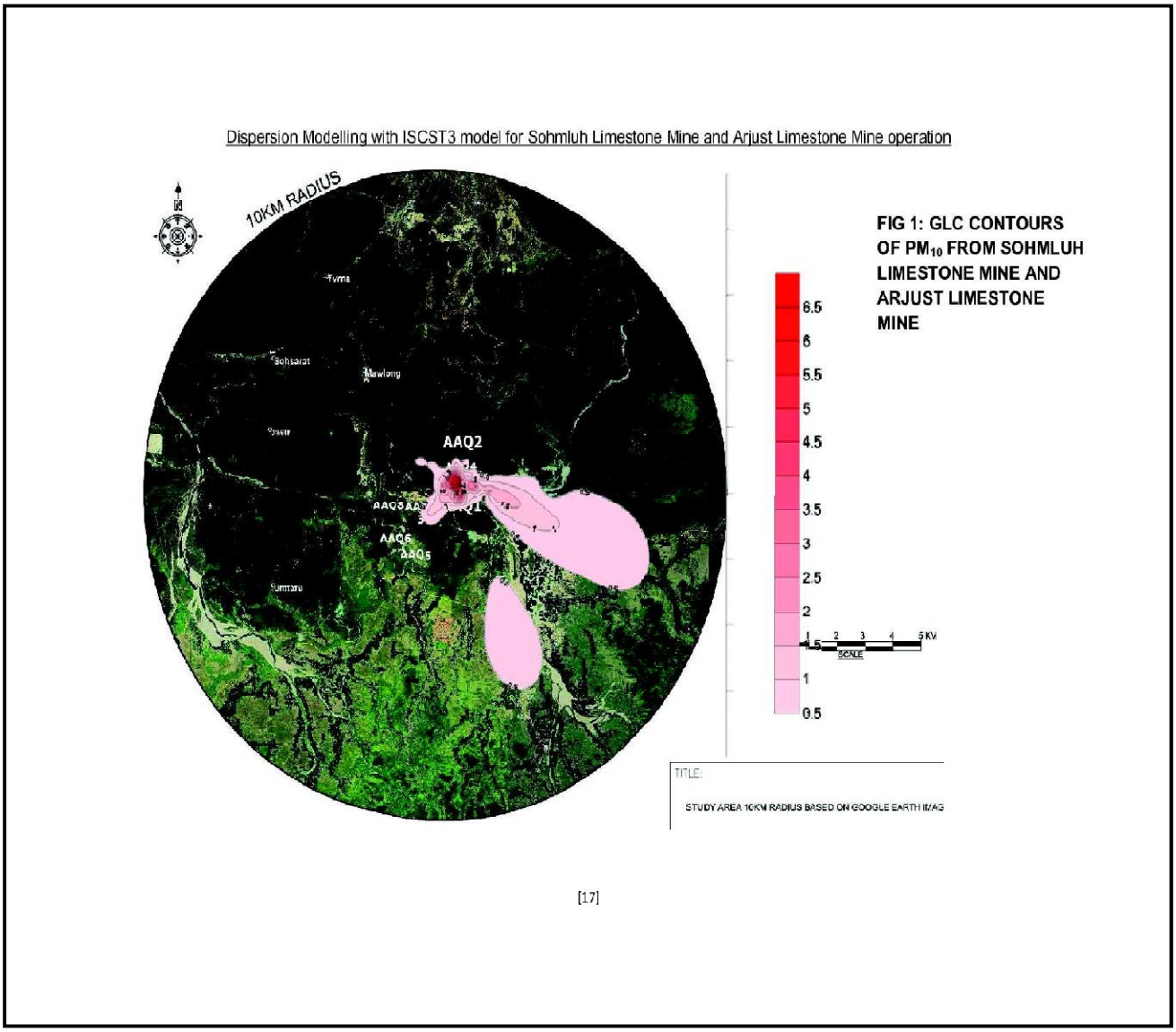


FIG 1: GLC CONTOURS OF PM_{10} FROM SOHMLUH LIMESTONE MINE AND ARJUST LIMESTONE MINE

Figure 4.1; GLC Contours of PM10

GLC CONTOURS OF $PM_{2.5}$

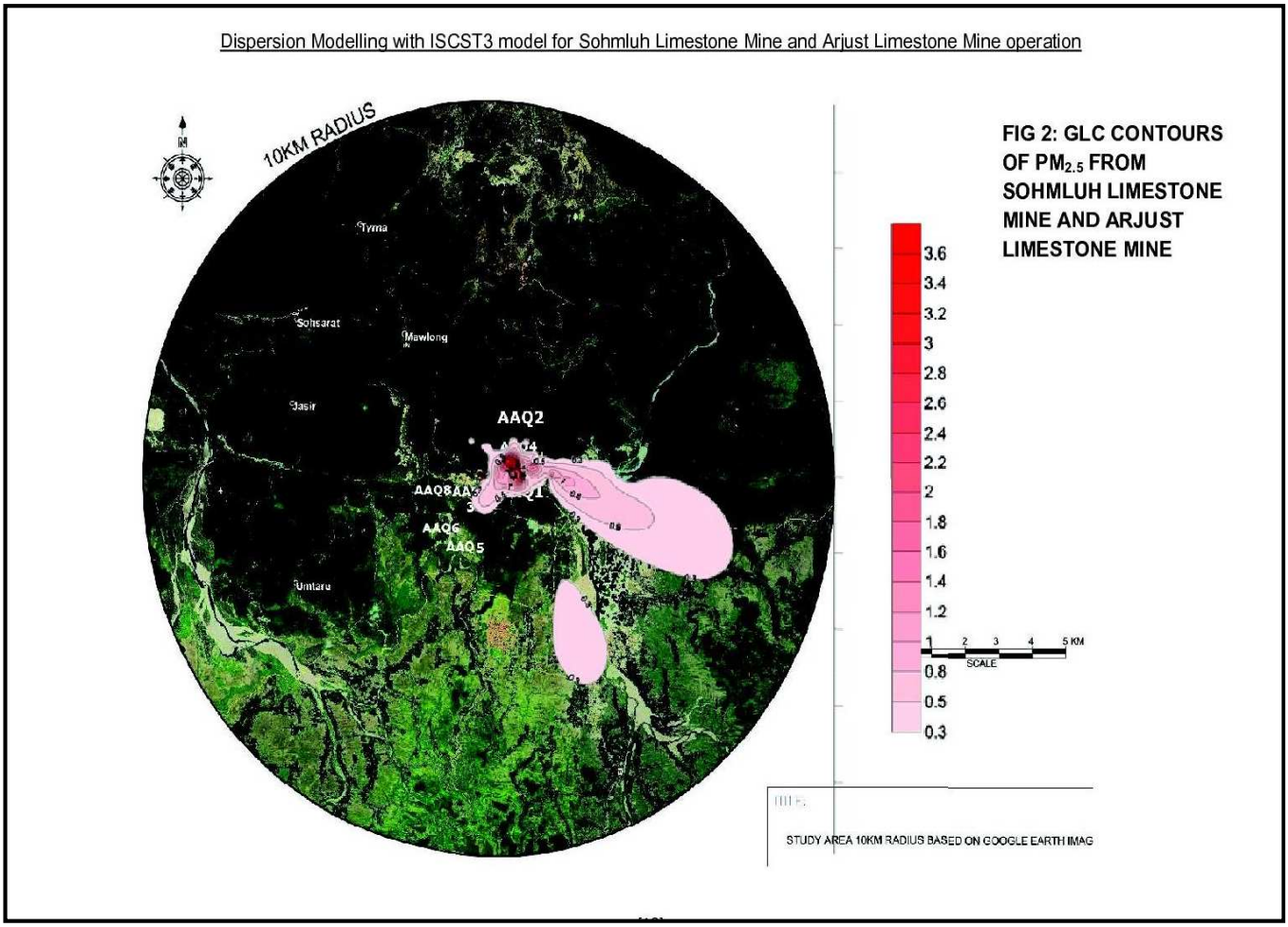


Figure 4.2; GLC Contours of $PM_{2.5}$

GLC CONTOURS OF NO_2

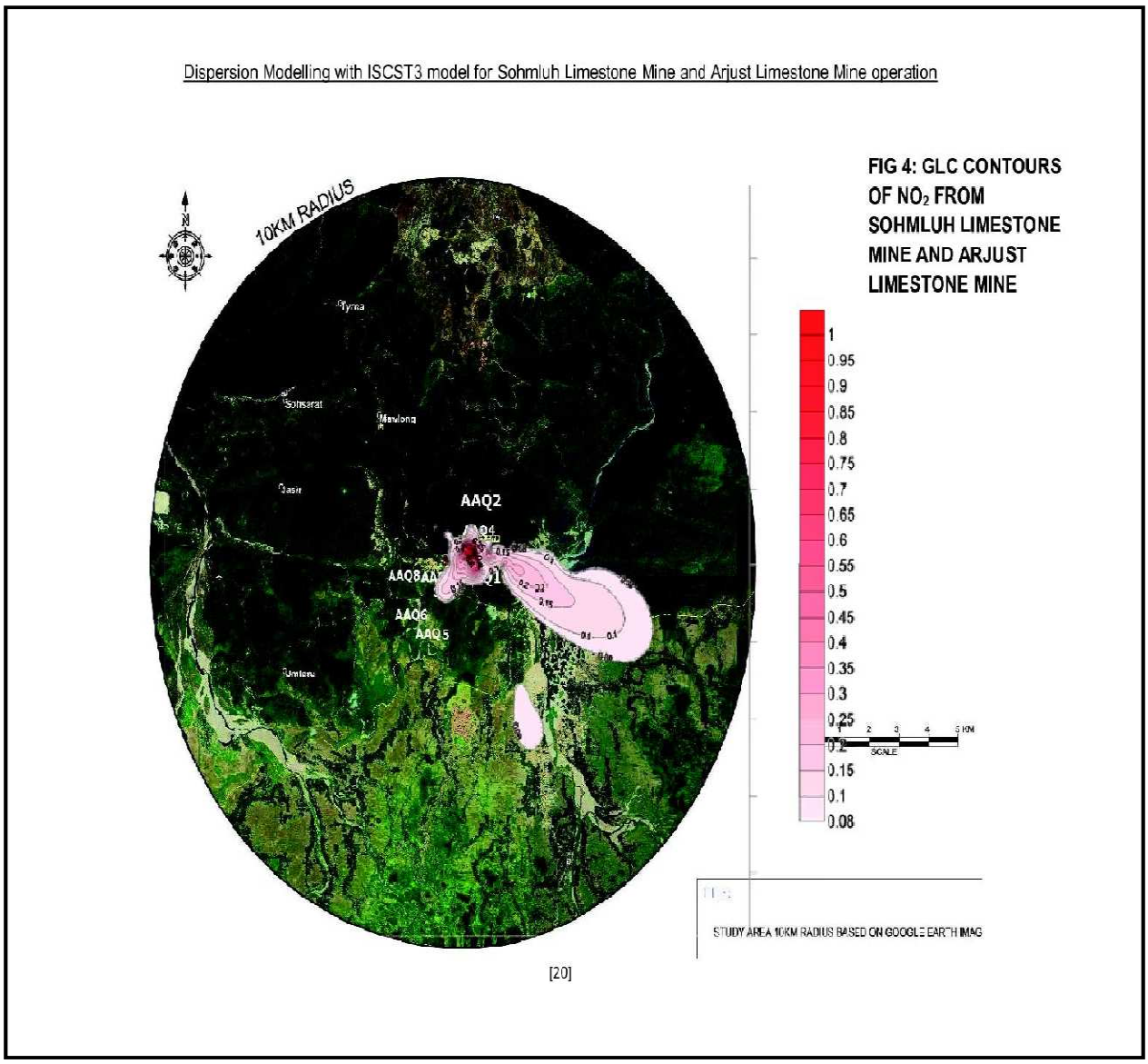


Figure 4.3; GLC Contours of NO_2

GLC CONTOURS OF SO_2

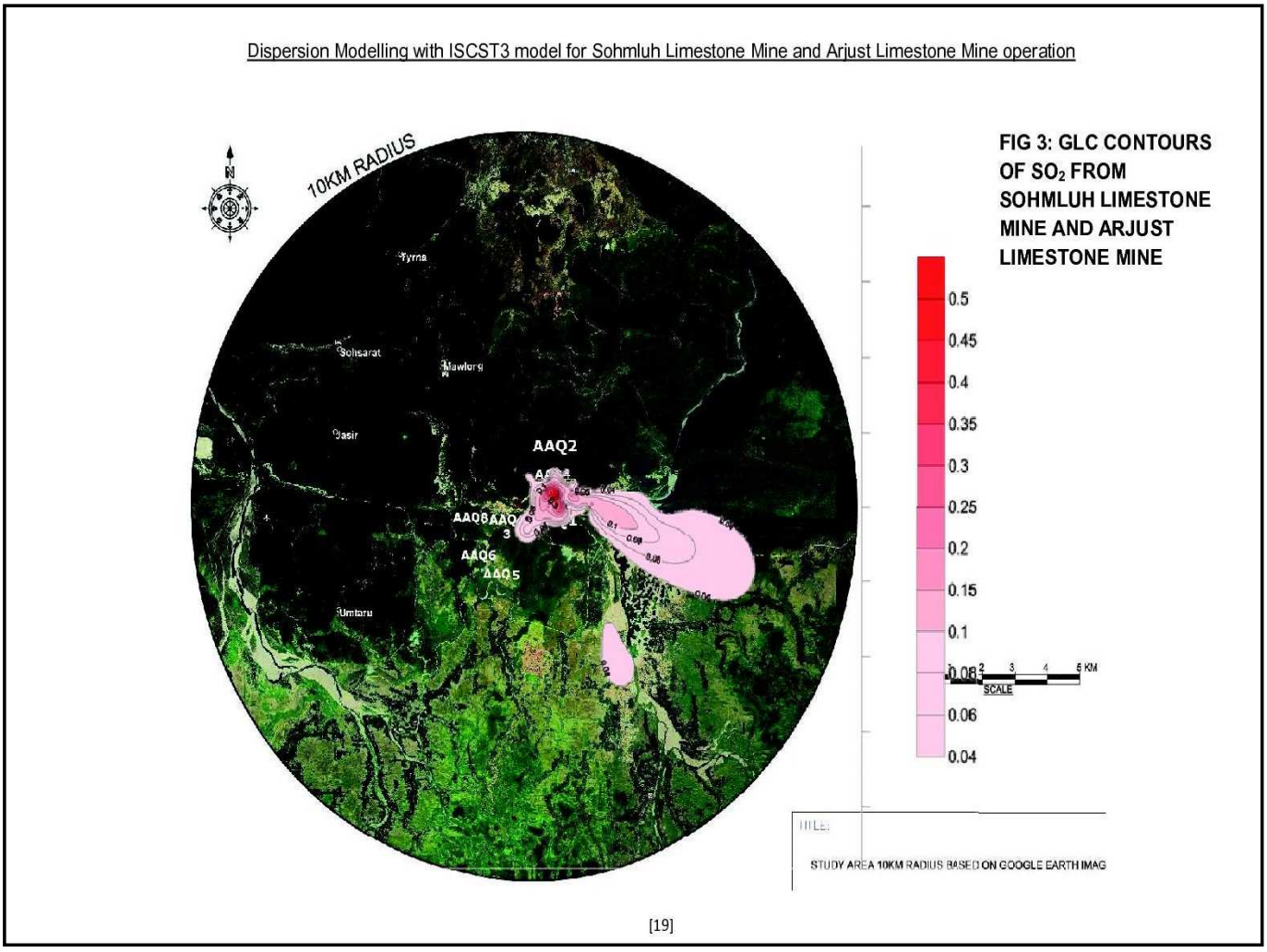


Figure 4.4; GLC Contours of SO2

From the results generated by AERMOD in form of Isopleth and results of same in table above show that maximum GLC of PM10/ PM2.5/SO_2/NO_2 after commencement of project does not have a significant impact on environment/ ambient air quality on sensitive receptors of the project.

Detailed Air Dispersion report is attached at **Annexure 13.**

4.4 NOISE &VIBRATION

4.4.1 Noise:

Environmental noise is a complex phenomenon because its intensity and characteristics vary with time depending upon the frequency as well as type of mining method to be applied along with the mining machinery and transportation vehicles. Ambient noise level in the core zone is likely to increase because of drilling & blasting operation, deployment of equipment such as heavy earth moving machineries, loading and noise in buffer zone will be a result of transportation of the excavated mineral and local village activities.

4.4.2 Impact on noise quality

Generally, the main sources of noise and vibration in the mines occur due to drilling, blasting, mobile mining equipments, transportation, loading and unloading. Noise Quality study was conducted and the results are given below:

Noise Quality results: Samples were collected from 8 locations and the results show:

Core Zone: The ambient noise level during day time at the proposed project site was 53.8 dB (A) which are within the standard limit of Industrial area~75 dB (A). During night the noise level at the project site ranges from 38.7 dB (A) which is within the night-time noise standard limit of 70dB (A).

Buffer Zone: The ambient noise level during day time are maximum at Bholaganj Bazar 55.8 dB(A) as per the standard limit of Commercial area are ~ 65 dB (A). The night time noise result at the location is 40.7 dB (A) which is within the standard limits of commercial area ~ 55 dB (A). At rest all locations Noise Level is within the standard limit.

In case of the proposed project additional likely impact of noise and vibration will be as follows:

- Mining can cause negative effect on noise quality in the area.
- Noise and vibration generated due to drilling and blasting activity involving Jack hammers drilling equipments.
- Noise and vibration due to mobile mining equipments like excavators, loaders.
- Noise generated due to transportation activity i.e. from dumpers, tippers, trucks and other vehicles

4.4.3 Mitigation Measures

- *Drilling equipments will be regularly maintained as per maintenance manual. Anti- vibration mounts for compressors will be provided.*
- *Optimum parameters for drilling and blasting will be designed to have controlled blasting which will reduce noise and vibrations.*
- *Blasting will be carried out when the wind conditions are favorable (i.e. when wind is blowing in opposite directions of inhabitated areas or in low velocity).*
- *Ear Muffs will be provided to the exhaust of wagon drills to minimize the noise level.*
- *Blasting operations will be carried out during the noon time when the temperature inversions are not likely to occur.*
- *Proper stemming will be done to reduce air blast.*
- *To check vibration, values of peak particle velocity will be maintained within the prescribed limit by DGMS.*
- *The excavators which will be used for loading will have noise proof cabin to avoid adverse effect to the operator. The helpers working near the excavators will be provided ear plugs and muffs. The maintenance of the excavators will be carried out as per manual.*
- *Proper free face will be maintained for optimal blasting which will also reduce noise and vibration.*
- *Periodical monitoring of noise and vibrations will be done.*
- *The dumpers, trucks and other transportation vehicles will be maintained in good running condition so that noise will be reduced to minimum possible level.*
- *Plantation of trees along the 7.5m periphery of the lease area and along the slope of the dump will be done to dampen the noise.*
- *Each blast will be carefully planned, checked and executed under the supervision of statutory personnel.*
- *Road will be regularly maintained as better road will lead to less noise.*
- *Imposition of speed limit on heavy earth moving machineries near residential areas.*
- *Truck drivers will be instructed and trained to make minimum use of horns at the residential area.*
- *Vehicles will have anti-vibration mountings, vibration- damped panels.*
- *Timely maintenance of vehicles and their silencers to minimize vibration and sound.*
- *Phasing out of old and worn out machineries.*
- *Task rotation of workers will be done exposed to noise.*

4.5 WATERENVIRONMENT

The mining operations may have adverse impact on water regime. The important impacts on water regime include change in surface run-off and base flow relationship and possible contamination of surface run-off with excavated overburden. There is no river or water body flowing across the mine site. The nearest perennial water body is Tharia river- 3.0 km East from the mining site.

4.5.1 Hydro-geology of the area

The district of East Khasi Hills is covered mainly by crystalline rocks with Tertiary sedimentary rocks. The secondary porosity in consolidated formation e.g. fractures; joints, etc developed due to major, minor tectonic movements, prolonged physicochemical weathering, form the conduits as well as reservoirs of ground water. The weathered mantle varies from 10 to 30 m bgl.

Ground water occurs under water table condition in the top weathered quartzite and in semi-confined condition in the fractured and jointed rocks. At hydro geologically feasible locations, well drilled down to the depth of about 80 -150 m below ground level may yield a moderate discharge of 5-15m3/hr in Archaean and Pre-Cambrian Group of rocks. Depth to water level is found to occur between 2 and 15 m bgl. The valley areas are found to be favourable for the construction of dug wells and bore wells in other steep areas. It should be borne in mind that the zones are not uniform in characteristics as the aquifer material, fracture density and distribution and hydro geological characteristics vary widely over short distances. Consequently, their water yielding capabilities vary considerably.

Ground water development in the district is mainly through dug /open well tapping the water in the weathered zone and bore wells are constructed to tap ground water from the fractures/joints in the hard rocks. In the shallow aquifer, the depth to water level ranges from less than 2 m bgl to 6 m bgl.

Springs play a major role to cater water requirement of the people throughout the year. Most of the springs are gravity springs. It is observed that discharge of most of the springs lie within the range of 5000-25000 lpd in pre- & post monsoon period.

(Source: Central Ground Water Board, India)

GROUNDWATER DEVELOPMENT

In the district of East Khasi Hills, the Board has constructed a total of 15 numbers of exploratory wells so far. The depth of the exploratory well ranges from 60 to 247.6 m below ground level, tapping aquifer thickness of 15-135 m. The bore wells tapping the deeper aquifer are encountered with two sets of fractures within a depth range of 120 m. Other set of fracture may extend deep beyond 120 m bgl. The depth to water level of the exploratory wells ranges from 1.95 to 49 m below ground level. The yield of the wells varied from 5- m 3

/hr. Transmissivity (T) is in the order of 7.46 m2 /day. The summarized details of Ground Water Exploration carried out in the district are given below-

Table 4.3: Summarised Details of Ground Water Exploration

S. No	Location	Depth drilled (m)	Aquifer type	Aquifer zones tapped (m. below ground level)	SWL (m.bgl)	Discharge (m^3/hr)	DD (m)	T (m^2/day)
1	Mamluh, Sohra	201.3	Limestone	---	dry	dry	---	
2	Dymper	80	Quartzite	---	---	---	---	---
3	MES, Shillong	108.8	Quartzite with Khasi Greenstone intrusive	16.7-17.4,45-46,56-57,70-71,74-75,106.5-108.5	8.2	---	2.4	86.87
4	NEHU	100.9	Quartzite	67	---	40	---	---
5	12th Mile, Mylliem	231.95	Mylliem Granite	135	3.52	32.4	38.1	0.43
6	ASI, Mawblei	140.7	Quartzite	43.5-47,110-114	26.04	9.3	---	---
7	Kynton –U-Mon	70	Quartzite	5.7-12,15-19,20-28,30-35.5,55.2-60.0	2.05	8.45	2.5	11.4
8	Mawryngkneng	59.45	Quartzite	4.0-19.0,22.0-59.45	5.91	8.08	13.08	7.26
9	Umlyngka	80	Quartzite	13.0-20.0,56.0-60.0	3.5	5.3	40	---
10	Mawsmai, Sohra	247.6	Limestone	17	49	2.1	---	---
11	Thynroit	80	Quartzite	---	1.95	0.54	24.1	---
12	Umtyngar	200.45	Mylliem Granite	---	14.15	15	-	-
13	Mawdiangdiang	200.05	Quartzite	12-15,150-168,168-180	78.75	7	-	-
14	Mawkynrew	153.70	Quartzite	32-39,39-82,124-127, 148.6-153.7	8.3	16	-	-
15	Laitkor Lumheh	190.95	Quartzite-Khasi Greenstone	93.35-117.75.175.65-178.75	28.1	24	-	18
16	Mawlyngad	200.05	Quartzite-Khasi Greenstone	35.32-38.45,96.35-114.65, 154.35-178.75	0.52	13	-	3

(Source: Central Ground Water Board, India)

It may be clearly observed that the ground water development in the region, in which lease area falls in safe category.

4.5.2 Impact on water quality

- Additional load on water demand due to mining and allied activities
- Ground water quantity due to extraction for facilitating mining activity
- Ground water quality due to open defecation by mine workers

Mine seepage and impact on ground water regime

Impact on surface water bodies through indiscrete disposal of liquid waste and suspended solids carried by flowing rainwater

It would be apt to reiterate here that the quality of ground water was not potable at many places in core and buffer zone as summarized below-

- **Ground Water Quality**: The samples were collected from 6 ground water locations and 2 surface water sources:

- **Core Zone: (Lease Area, Hand Pump Water)** shows that parameters like Total Hardness (69.80 mg/l); Total dissolved solids (107.0 mg/l), Magnesium (3.90 mg/l), & Alkalinity (61.10 mg/l) are well within drinking water standards (IS: 10500).
- **Buffer zone: Ground Water results:** All results were found within standard drinking water standards (IS: 10500).
- **Surface Water results in Buffer Zone:** The Surface water quality of the Upstream and Downstream water of Tharia River is within prescribed CPCB Water Quality Criteria Class of water.

  The excavated material will not carry any reacting and harmful constituent leading to deterioration of chemical quality.

4.5.3 Mitigation measures

- *Total Water requirement will be 3.50 KLD for the mining process. Potable drinking waters hall be sourced from the nearby villages. It is estimated that daily drinking/domestic water requirement will be about 0.50 KLD. Besides for sprinkling & green belt development water requirement will be 1.50 KLD and 1.50 KLD respectively.*
- ***Conservation of Ground Water:** Mining will be restricted up to a depth of 30 m. Water stored in the mined out area will act as water recharging source in the area. Therefore, mining activity in the leasehold area will have positive impact on ground water.*
- *There is no possibility of mining encountering any surface/subsurface water body. However, during the course of mining, rainwater in the form of surface runoff will be there during monsoon only. No water from the quarry will be discharged to any natural water course directly. The accumulated rain water will partly be used for dust suppression and afforestation and limestone being pervious in nature much of the water will percolate below the quarry surface.*
- *To avoid contamination of ground water from the open defecation by workers, toilets will be provided for the workers at site with septic tank followed by soak pit.*
- *To prevent silt being carried during monsoon period, series of plants would be planted.*

4.6 LAND ENVIRONMENT

Mine lease encompasses total area of 4.5 Ha. Mining will be open cast semi mechanized mining with drilling & blasting. There shall be maximum production of 162478 TPA from this mine. The project area is classified as "Non forestland".

4.6.1 Impact on land environment

Changes in the land use pattern will be caused due to the breaking, dislodging of rocks and transportation.

Impact on Land Use of Core Zone

As aforementioned, changes in the land use pattern are caused due to breaking, dislodging of rocks and transportation. The change / impact on land use pattern of core zone after the end of the life of the mine are as follows:

Table 4.4 Land Use: Core zone

Details	Conceptual (In Ha)
Quarry	3.91 (Including reclamation)
Road	
Dump	
Parapet Wall	
Garland Drain	
Plantation	0.59*
Unused	0
Total	**4.50**

The change in land-use is graphically depicted in the figure given below —

Over all Changes in Land use of the core zone area

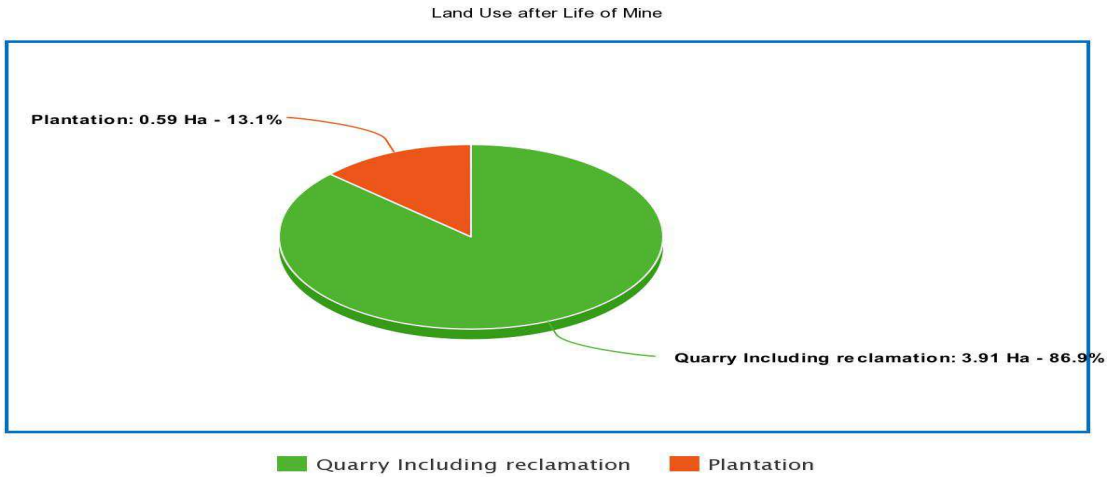


Figure 4.5; overall changes Land use of the core zone area

Impacts on Land Use: The possible impacts on land environment are —

- Effect on productivity of land due to mining by loss of topsoil.
- Dust generation due to mining cause dust cover problems on the nearby vegetation.
- Effect on public buildings of monuments if any.

4.6.2 Mitigation Measures

In order to prevent the environmental degradation of mine lease area and its surroundings, the following measures shall be taken;

- *The proposed project of limestone mining will definitely change the land use. However the area will be reclaimed by the following measures:*
  - *To minimize the effect of mining plantation will be in done along the 7.5m boundary of the mine area and after the exhaustion of the pit whole area will be reclaimed into green cover. After the conceptual mining there will be a mine void which will be extensively planted.*
  - *Mining operations will be confined strictly within the demarcated area.*
  - *The soil and overburden that is removed from the mine site will be stored in the western safety barrier and will be used for future reclamation of the mined out area.*
  - *The dust generation due to the mining will be minimized by sprinkling of water through water sprinkler.*
  - *No effect on public buildings or monuments is envisaged as there are no public buildings/ monuments in the close vicinity of the mining lease area.*

4.7 IMPACT ON SOIL QUALITY

The soil and overburden that is removed from the mine site will be stored in the western safety barrier and will be used for future reclamation of the mined out area. Mining operation and allied activities will not pollute the soil.

As no toxic substance will be generated or involved, the impact on soil quality is not likely to be more intensive than the existing level. The dust generated during loading and unloading operations and vehicular movements normally constitute heavier particles that would readily settle on very small areas within the plant itself. Raw material and product will also be stored.

Thus negligible impact on soil quality is envisaged

4.7.1 Mitigation Measures

- *During Plan period some quantity of gritty soil will be removed and will be dumped at southern portion of the applied area with suitable precautions. Some quantity of the generated gritty soil would also be used for road maintenance and plantation program.*
- *Plantation shall be done on 7.5 m statutory boundary to increase quantity of humus in the area.*

4.8 SOLID WASTE MANAGEMENT

Due to the project there will be various kinds of solid wastes generated, which will cause adverse effects on environment and thereby cause pollution both on the surface and beneath. Littering of waste can cause contamination of water course. The types of wastes generated and their impacts on environment is discussed ahead—

Mine Waste generation: As per the scheme of mining, the waste generated at the end of plan period will be:

Alluvial Soil	: **21397 Cu.m.**
Siliceous Limestone	: **Nil**
Sandstone	: **Nil**

****Table for Waste generation is given in Chapter 2 Table no.2.6.***

Domestic Solid Waste generation: This type of waste comprises of organic and inorganic materials such as paper, kitchen refuse, bottles, foils, packaging etc. There will be about 42 workers working at the mine site at any point of time. It is expected that about 7.0 Kg/day of solid waste will be generation on this account. Out of which, organic waste will be around 4.0 kg and remaining 3 kg waste will be recyclable and inert waste.

Hazardous waste generation: In proposed project hazardous waste will be mainly generated due to used oil generated from machineries used in mining. There will be deployment of machinery such as excavator; trucks, water tanker, light vehicles etc. and thus about 100

Lit/day of diesel will be required during peak mining days. Thus, daily used oil generation will be 1.7 litres/day.

Plastic waste and E-Waste will be given to approved vendor.

4.8.1 Mitigation Measures

- ***Mine waste:*** *During Plan period some quantity of gritty soil will be removed and will be dumped at southern portion of the applied area with suitable precautions. Some quantity of the generated gritty soil would also be used for road maintenance and plantation program.*
- *As per conceptual planning total area of 3.91 ha of the quarry area will be used to for mining. Afforestation will be carried out in the entire stretch of the land to develop green cover.*
- *Domestic Solid Waste generated due to mine workers will be collected in coloured bins of green and blue colour. Organic part of solid waste will be stored in green bins. There will be composting of biodegradable waste generated from both plant site and mine site will be undertaken and compost will be used for development of green belt in the plant as well as in the mine site.*
- *Inorganic waste such as wrappers, plastic waste, foils, etc will be stored in blue bins and will be sold to recycler authorized by CPCB.*
- *Mobile Toilets at the site will be maintained and waste water will be disposed off into septic tank followed by soak pit.*
- *Hazardous waste generated from the mine will be only used oil which will be stored into HDPE drums and used oil shall be sold only to the registered recycler.*
- *Mining machinery engaged will not be washed at the site as the machines will be hired from the dealer.*

4.9 TRANSPORTATION

Proposed production from the mine will be 162478 TPA. As the daily production from the mine will be 542 T. OB will be stacked separately at stack yard and mineral will be transported to market. There will be deployment of 2 no. of tippers of capacity 10 tonnes. The lease area has no habitation in close proximity so traffic on the roads is minimal. Steps will be taken to coordinate and organize traffic in the mining area and the mining trucks route, road repairing in coordination with govt. officials. Awareness campaign among dumper/truck drivers will be generated for clearance of road and lower down the pollution load due to transportation.

4.9.1 Anticipated Impact Due to plying of Hauling units and its mitigation measures:

The Limestone ore raised from the mine face will be transported by haul road upto the stock yard to be centrally located in ML area. The entire production of mine shall be moved to through dumpers.

The direct impact on the existing traffic load due to the proposed project will be only due to service vehicles moving outside ML area. Therefore, the traffic to & fro of proposed "**Sohmluh Limestone Quarry**" will not create any traffic congestion.

4.9.2 Other Mitigation Measures:

- *To regulate the traffic, Sign boards shall be displayed for safety purposes during mineral transportation.*
- *The proposed increase in traffic density will not cause significant impact on the traffic since the connecting road and nearby S*H-5 (Sohra – Shella Road) *at 2.1 Km W is capable of handling this increase in traffic density. The trucks will be properly covered with tarpaulin and overloading will not be allowed to avoid spillage on roads.*
- *Haul roads will be sprinkled with water to keep the dust suppressed.*
- *A supervisor will be appointed to regulate the traffic movement near the site.*
- *Speed breakers will be constructed accident prone areas to calm the traffic and its speed.*
- *Awareness campaign among dumper /truck drivers will be generated for clearance of road and lower down the pollution load due to transportation.*

4.10 BIOLOGICAL ENVIRONMENT

The details of impact and mitigation for the biodiversity in and around the lease area are given below:

4.10.1 Anticipated Impact on Flora

Mining can affect vegetation in the core zone. The mining activity will generate dust which may impact the nearby biological environment.

(A)Impact on Ecology:

There will hardly be any negative impacts on terrestrial eco-system comprising birds and animals as the ML area is only 4.5 Ha. On the contrary, with progressive growth of greenery, terrestrial eco-system will improve in course of time. Due to excess hunting of birds and animals, around, animal life is very less, hence adverse impact on biological environment will be negligible. The air pollutants will be the dust generated during earth moving activities and emissions from vehicles, portable diesel generators, etc.

Though the site is located within barren land, the impact zone is part of landscape involving rural areas. There is growth of vegetation and meager presence of fauna. Impacts on biological environment will be negligible. The dust emission will affect the effective photosynthesis and biological processes by covering the plant/tree leaves by thin dust layer

during dry months which however will be washed away on rainy days. It may be noted that are plenty of rains, hence photosynthesis is not anticipated to be effected. Operation activities will have some impact on the eco-system as follows:

a. Impacts on fauna

Bright light and unusual noise during operation activity could shift the activity site of the birds and animals to little away from the location. Presence of water and food wastes during the day time will attract birds and animals. Due to excessive hunting the animals & birds are hardly seen on the fringes. They go deep inside the jungle and stay there. So, during the operation phase, there will hardly be any negative impact on the biological environment comprising birds and animals. On the contrary, with the progressive growth of greenery, biological terrestrial environment will improve in due course of time.

b. Impacts on flora

During operation phase, main pollutants will be emission from vehicles. There would be meagre impact of such pollutants on vegetation and crops, since the predicted levels will be much less than the levels specified for industrial and mixed use areas. Waste water from domestic and other facilities will be released only after treatment.

c. Impact on aquatic eco-system

Impact on aquatic eco-system will be negligible as no polluted water will be released into natural drainage channels. The Project would adopt zero water discharge concept.

4.10.2 Mitigation Measures

Following measures are proposed to mitigate ecological impact

I. Plantation programme

To reduce the impact of air pollution, particularly the SPM content, it has been proposed to a green belt around Barrier/ safety Zone. Plantation will be carried out within the lease area where fugitive dust emissions are anticipated. Lawns and gardens will also be created near the office areas and other service areas like canteens, parking lot, etc. The plantation programme to be carried out is shown in Fig 4.7.

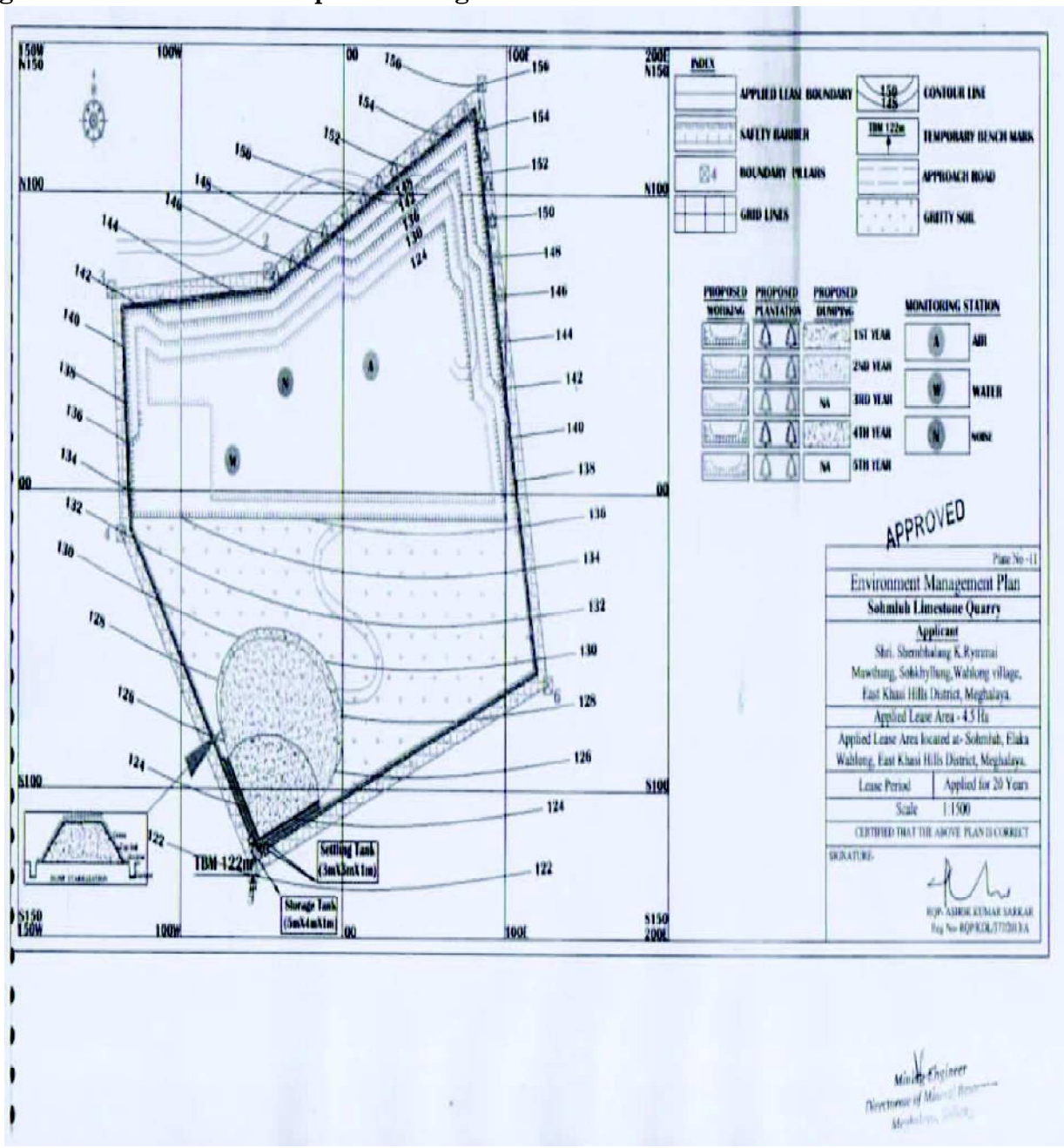
Special care has to be taken while planting trees, as regards the type and the number, within the plant premises in order to confine the pollutants to the area and prevent their dispersal. The number of trees to be planted as apart of the plantation programme is taken as 290 trees for green belt development.

In addition to the trees planted as mentioned in the above table, a variety of small flowering shrubs and plants will be planted in the gardens and lawns. These flowering plants will improve the aesthetics of the area. Year wise plantation programme is given in **Table 4.5**.

TABLE 4.5
YEAR WISE PROPOSED PLANTATION PROGRAMME

Sl. No.	Year of Plantation	Target of Plantation	Assumed Survival (80%)	Area to be covered in Ha	Area of Plantation
1	First	58	46	0.036	Safety/Barrier Zone
2	Second	58	46	0.036	Safety/Barrier Zone
3	Third	58	46	0.036	Safety/Barrier Zone
4	Fourth	58	46	0.036	Safety/Barrier Zone
5	Fifth	58	46	0.036	Safety/Barrier Zone
TOTAL		**290**	**230**	**0.18**	

Fig 4.6. Green Belt Development Programme



The selection of trees to be planted has to be done judiciously keeping in mind the adaptability of trees to the climate of the region. As mentioned in Chapter 3, the trees which are found in relative abundance as compared to the other species as well as species with proven survival rate will be preferred. Consultation with the forest officers and experts in the field will further help to identify the exact species to be planted, and these can be obtained from the nurseries in the nearby areas. The social aspects of requirements of fodder and fuel of the community will not be affected by this project.

II. **Wildlife conservation programme**

The list of animal diversity is prepared by visualizing and interviewing many local residents of nearby villages. Due to ban in poaching many animals have shown increasing trend. There is no schedule I species observed in the study area.

There are no threatened species of plants. Monkey of Schedule II is the only threatened species. No special measures are required except that the employees as well as the population of surrounding villages will be educated for conservation and protection of the Monkey through specially arranged camps and continuous campaign through posters at prominent places.

Some additional measures shall be taken as follows:

- *Mining will not affect flora in core and buffer zone because mining will be carried out within the demarcated area.*
- *In buffer zone there is good vegetation. Mining will be limited to the core zone. Therefore the flora and fauna will thrive in the buffer zone. Raw material will be transported in covered vehicles to market. Hence impact on surrounding flora will be minimal.*
- *The mined out area will be closed progressively along with reclamation of the land for the gainful use by developing green area. Thus, it is expected that the natural vegetation in the area will not be affected.*
- *A site reclamation plan will be developed that will addresses both interim and final reclamation requirements and that identifies vegetation, soil stabilization, and erosion reduction measures.*

4.10.3 Anticipated Impact on Fauna

- Noise from mining equipments, transportation, changes in land use may affect the migration of fauna.
- Mining may drive away the wild life from their habitat, and significantly affect wildlife.

4.10.4 Mitigation Measures

- *In core zone the land is non forest land which has vegetation and the mining activity will be carried out in that area. However, there is less biodiversity in the area hence mining will not adversely affect the fauna in the area.*
- *There is no wild life sanctuary in 25 km radius circle. As per forest working plans and records from*

MoEF reveals that there are no wildlife sanctuaries or national parks or biospheres/ tiger reserves in 10-km radius from mine lease area. Plant species observed are common in nature and there is no endangered, threatened, protected or rare plant species recorded during field surveys and also from forest department records.

- *Thus, the impact on the flora and fauna will be insignificant and addition of greenbelt may enhance the local aesthetic value in the region.*
- *To protect the fauna protective measures for reclamation and green belt development will be done. Emphasis will be given to local species & plants of economic importance.*
- *Measures for protection and conservation of wildlife species will be done by organizing awareness campaigns and vigilance program by involvement of community youth against poaching of animals.*
- *To check/reduce the impact of dust and noise, thick plantation cover will be developed which will provide acoustic buffer and therefore will dampen sound.*

4.11 SOCIO- ECONOMICENVIRONMENT

The impact of mining industry on socio-economic scenario has both the facets. On one hand it may degrade the fertile land leading to reduced agriculture income besides causing displacement. On the other hand being a commercial activity it provides opportunity for both direct & indirect employment. As mentioned earlier, there will be around 42 personnel, 80% staff will be employed from the local villages.

Impact of Mining:

- Socio Economic scenario of the study area should be done.
- Increase in dust generation due to transportation of the material by tippers and uncovered trucks.
- Increase in employment opportunities is a positive impact from the project.
- Impact on nearby habitat due to dust generation and mining activity
- Falling of children in mining pits
- Impact on agricultural fields due to mining activity

Mitigation Measures:

Results of Socio economic study: *Total 104 villages fall in the buffer zone. The study has been conducted by primary survey and secondary data source from Census of India 2011. The results are discussed below:*

- ***Core Zone:*** *There is no habitation in the core zone*
- ***Buffer Zone****:* The total number of Households of the study area in rural village area is 9032 as per Census of India, 2011 data. The details are given below.
- **Population:**

  The total population of the study area is 45789 constituting 9032 households, implying that there are average 5.06 members per house. The average sex ratio of the study area is 989 as per census 2011.
- **Social Structure**

  The proportion of Scheduled Caste (SC) population within the study area is 2.39 % and the percentage of schedule Tribe (ST) is 83.77%.
- **Literacy**

  The total proportion of literate within the study area is 63.70% of total population. In percentage the male literacy 32.22% and the female literacy is 31.48% respectively within study area.
- The project will generate employment for total 42 people. In which apart from the statutory employment mostly the local people will be hired.
- Regular sprinkling of water in the roads will be undertaken to arrest the dust. Besides plantation around the mine area has been proposed which will help minimizing ill effect from dust.
- A separate transportation route is proposed which will not pass through the villages.
- Regular maintenance of vehicles will be undertaken.
- Green barrier of native species along existing Road passing through the lease area will be developed.
- Truck will be covered by Tarpaulin.
- Wire fencing for mining pits.
- Barricading by using wire fencing to restrict the children to go towards the mine site.
- The area of agricultural fields will not be disturbed by mining.

SOCIAL IMPACT ASSESSMENT

- There are various social impacts of mining which should be identified before starting any developmental activity. The mining is one of the activity for which if pros and cons are not properly assessed may not only result in deterioration of local environmental scenario but also may have long term affects on the socio economic status of the locals such as loss of agriculture land, degradation of water quality, contamination of ground water and soil quality. Therefore to prevent above problems following measures shall be undertaken:
- Ensuring developments contribute to economic growth and social development. The project will provide skill based training to the locals and will generate chance of indirect employment in the area.
- During operation phase, there will be small influx of about 42 workers to the locality with ready income in cash. This work force will come from the surrounding areas. With the increased population and money supply, there will be need for daily consumption items as well as services, which have to be provided by suppliers from nearby locality. These developments will have both positive and negative impacts on the local socio-economic environment.

4.11.1 Impact on Occupational Health:

Impact on health:

Mining activity often leads to Respiratory disorders are occupational lung disease to miners, due to the inhalation of dust. There respiratory disorder that may happen to the miners in proposed case is Silicosis: This takes place due to breathing crystalline silica dust, which in severe cases can be disabling, or even fatal. When silica dust enters the lungs, it causes the formation of scar tissue, which makes it difficult for the lungs to take in oxygen. Miners may also suffer with occupational respiratory ailments, skin allergies etc, but the same are preventable if exposure is minimized. PP will take all the precautions as much possible to ensure healthy and safe environment for the mine workers. The chances of occurrence of disease due to dust generation can be minimized by providing Personal protective Equipments to the workers and by organizing regular health check-up of the miners. The detailed measures to be followed are given below:

Preventive measures

- *Personal Protective equipments (such as dust mask, gloves, goggles, boots, earmuffs) shall be provided to the mine workers especially to those who are working at high noise & dust generation points.*
- *They will be guided and informed about the health hazards and the measures to cope up with them by conducting informative sessions.*

- **Table 4.6: List of safety equipments**

S.No.	Item	Equipment
1.	Face protection	Face Shield
2	Eye protection	Different types of goggles used for different purposes.
3.	Ear protection	Ear Plug ,ear muff
4.	Leg Protection	Safely shoes , gum shoes
5.	Working at height	Safety belts
6.	Head Protection	Safety helmets
7.	Protection from Dust	Dust Mask
8.	Hand Protection	Rubber gloves

Medical Check-up*: Pre-employment and periodic medical examinations shall be conducted for all personnel, and specific surveillance programs instituted for personnel potentially exposed to health hazard.*

- *At the end of mining operation test will be conducted to assess health of workers.*
- *Workers will be informed and trained about occupational health hazards if identified.*
- *Any worker's health related problems will be properly addressed.*
- *The medical histories of all employees will be maintained in a standard format. Thereafter the employees showing symptoms of the diseases mentioned below will be subjected to medical examination. Mostly respiratory disorders are more likely therefore workers will be checked for respiratory diseases.*

4.12 PLANTATION/AFFORESTATIONPROGRAMME

Plantation of local thriving species will be done in the 7.5 m statutory boundary along the mine area. During the plan period about 0.18 Ha. area shall be planted whereas about 0.59 Ha i.e. the entire lease area will be planted at ultimate stage. Precautionary measures will be taken for carrying of the afforestation made by regular watering in the afforested area, to protect from grazing animals and proper manuring. The detail of afforestation scheme is given below:

Table 4.7; Proposed Plantation

Sl. No.	Year of Plantation	Target of Plantation	Assumed Survival (80%)	Area to be covered in Ha	Area of Plantation
1	First	58	46	0.036	Safety/Barrier Zone
2	Second	58	46	0.036	Safety/Barrier Zone
3	Third	58	46	0.036	Safety/Barrier Zone
4	Fourth	58	46	0.036	Safety/Barrier Zone
5	Fifth	58	46	0.036	Safety/Barrier Zone
TOTAL		**290**	**230**	**0.18**	

4.13 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF ENVIRONMENTAL COMPONENTS

For a mining project of this type there would be significant irreversible environmental impacts of following nature:

- The primary and secondary impacts of the project.
- The project may involve potential environmental accidents associated.
- Use of Natural resources.

There are following irreversible and irreparable changes associated to mining and mitigation measures:

- **Land Use change and degradation of soil quality:** Mining causes change in land use resulting in mining pit which alters land use. After conceptual period exhausted quarry area will be reclaimed to the extent possible.
- **Water Recharge Pit:** Till the conceptual period mining pit will be developed in the water recharge pit. During rains water will be collected in the pit and therefore result in overall development of water level of the area.

- **Loss of biodiversity:** Destruction or drastic modification of the original site and anthropogenic substances release can have majors impact on biodiversity in the area. Destruction of the habitat is the main component of biodiversity losses.
- **Green belt Development:** As per ultimate plan 7.5m of statutory boundary in the mining the area will be developed into green belt area and trees shall be planted. This will provide safe habitat for fauna and also provide fodder for the cattle's of the nearby village people. Extensive plantation will be done in the entire area at the ultimate stage.
- **Fencing of the mining area:** Sometimes big pits result in accidents and animal falls into the pit. To protect them there shall be fencing done around the mining pit.
- **Contamination of ground or surface water:** There will be no contamination of ground water as the mining will be carried out above ground water table. The runoff from the mine is negligible so there will be no contamination of surface water.

4.14 ASSESSMENT OF SIGNIFICANCE OF IMPACTS

The environmental attributes which are likely to have an impact due to the proposed mine at Sohmluh, Elaka Wahlong, East Khasi Hills District, Meghalaya. After taking proper measures the possible impacts are summarized below.

Table 4.8;Summary of Impacts and mitigation measures

S.No.	Proposed Activity/Parameters	Significance of Impacts
1	**Air Environment**	-
	PM_{10}	-
	SO_2	-
	NO_X	-
2	**Water Environment**	+ve
3	**Biological Environment**	
	Flora (Vegetation)	+ve
	Fauna (Wildlife)	-
	Plankton	-
4	**Noise Environment**	-
5	**Socio-economic Environment**	
	(a) Social Status	+ve
	(b) Economic Status	+ve
	(c) Generation of Employment	+ve
	(d) Infrastructure Resource Base	+ve
6.	**Traffic Environment**	No impact

4.15 SUMMARY OF MITIGATION MEASURESPROPOSED

A brief description of mitigation measures are given ahead —

Table 4.9; Summary of Mitigation Measures Proposed

Air Environment	*There shall be generation of dust due to point and non-point sources thus following measures shall be adopted:* • *Workers will be provided with protective gears such as dust masks and goggles etc.* • *Regular water sprinkling* • *Plantation of trees will be done at dust generating points* • *Vehicles shall have PUC certificate*
Noise Environment	*Ambient noise level in the core zone is likely to increases. To prevent noise pollution:* • *Optimum blasting parameters will be adopted.* • *Ear muffs will be provided to the workers.* • *Plantation will provide acoustic buffer therefore plantation shall be done along the periphery.* • *Regular maintenance of equipments shall be done to reduce noise pollution.*
Water Environment	*Possible impacts due to contamination on water quality due to runoff of storm water and mine seepage.* • *No effluent discharge from mine* • *No toxic chemicals in mineral to contaminate water.* • *Water collected during rains shall be used for sprinkling and plantation.* • *The mining will act as water recharge reservoir which will help in development of ground water in the area.* • *Mining will not intersect water table; hence there will be no impact on groundwater.*
Biological Environment	• *Mined out land reclamation shall be done by doing extensive plantation in the entire lease at the conceptual stage.*
Socio-Economic Environment:	*It is evident from social survey that population is mostly unemployed.* • *The project will generate employment for 42 people.* • *Regular medical examinations, schooling, better infrastructure etc. shall benefit employees as well as the locals in the area.*
Mine Waste Management	• *Mine waste, alluvial soil and overburden will be stacked at separate stack yard and will be use for road construction and plantation.*

	• *Alluvial soil generated shall be re used for plantation.* • *Mining shall not be done during rains and there shall be construction of retaining wall and garland drain to prevent surface runoff.* • *Hazardous waste such as used oil shall be stored properly and sold to registered-processor.* • *Domestic waste water due to daily human activities which shall be properly disposed off into septic tanks followed by soak pits. Other domestic solid waste such as Wrappers, foils, leftover food material etc shall be collected in separate bins.*

5.0 ANALYSIS OF ALTERNATIVES

5.1 GENERAL

Analysis of alternatives involves a thorough study of the possible future conditions in the project study of the possible future conditions in the project area in response to a set of alignment alternatives without the project or status quo condition. Consideration of alternatives to a project proposal is a requirement of EIA process.

5.2 ANALYSIS OFALTERNATIVES

1. **Project Alternative:** The project is for mining of limestone mineral. The mineral from the mine will be transported directly to the Market. There is a growing demand of quality limestone mineral in the local open market as well as for supply to the neighbouring state as building and construction material for various construction purposes as well as for supply to limestone kilns. There is a huge demand for the low grade Limestone boulder for construction purposes and to be use in lime burning both for domestic use within the state as well as for supply to other neighbouring town and villages. The supply of limestone boulder will meet the demand adequately when production is allowed by the concerned authorities.

   Site Alternatives: The mineral is site specific & the lessee has applied mining lease to mine stone for the specified lease area. Thus no alternatives site is proposed.
   Mining activities shall be carried out based on local geology and availability of the mineral. There are following causes due to which this site is most suitable:

i) The project is site specific in view of occurrence of mineral.

ii) The exiting road network is closer to the deposit and hence no additional land is required for road connectivity.

2. **Technology Alternative:**

   Mining shall be done by open cast semi mechanized method with drilling and blasting. Optimum blasting parameters will be adopted.

3. **Water Alternatives:** The water requirement in the mine will be for 3 heads namely Water requirement for Domestic activities, green belt development and sprinkling. The domestic demand of about 0.5 KLD Domestic will be sourced from nearby villages. For sprinkling & plantation water will be taken from Tharia River.
4. **Fuel & Power Alternatives:** Looking at the project requirements the best fuel High speed diesel is proposed to be used.
5. **Employment Alternatives:** Local workers will be employed as per availability and suitability and if required employment can be outsourced.
6. **Material Transportation**: Within the mine site the mineral can be transported through conveyor belts etc. However the lease is so small and production is very less therefore a conveyor belt will not be feasible.
7. **Road:** Metallic road can also be constructed in place of haul road for transportation of mineral from mine site to main metallic road.

5.3 ADVERSE IMPACT OF ALTERNATIVESTECHNOLOGY

The existing technologies for mining of mineral are most suitable hence no change in project technology is proposed.

Mitigation Proposed For Alternatives: There will be no change in the technology opted hence no mitigation is proposed.

5.4 SELECTION OFALTERNATIVE

There is no alternative technology proposed for the project as the mineral is found within the beds of the rocks. This is the safest and least expensive technology for the mining of limestone mineral from proposed mine.

6.0 ENVIRONMENTAL MONITORING PROGRAM

6.1 GENERAL

The monitoring programme is devised to ensure that the envisaged purpose of the project is achieved and results in the desired benefit to the target population. To ensure the effective implementation of the EMP, it is essential that an effective monitoring programme be designed and carried out. Broad objectives of the monitoring programme are:

- To evaluate the performance of mitigation measures proposed in the EMP
- To suggest improvements in the management plans, if required
- To satisfy the statutory and community obligations

The monitoring programme contains monitoring plan for all performance indicators, reporting formats and necessary budgetary provisions. Monitoring plan for performance indicators and reporting system is presented in the following sections. The company has a well-defined environmental policy.

Physical, biological and environmental management components identified as of particular significance in affecting the environment at critical locations have been suggested as Performance Indicators (PIs). The Performance Indicators shall be evaluated under three heads as:

- Environmental condition indicators to determine efficacy of environmental management measures in control of air, noise, water and soil pollution;
- Environmental management indicators to determine compliance with the suggested environmental management measures.
- Operational performance indicators have also been devised to determine efficacy and utility of the mitigation/enhancement designs proposed.

The objectives of monitoring are:

- To identify the state of pollution within the mining lease area.
- To verify the result of the impact assessment study in particular with regards to new developments.
- Generate data for predictive or corrective purpose in respect of pollution.
- To assess and monitor the environmental impacts.
- To establish a database for future Impact Assessment Studies for new projects.

Mining: Mining of limestone mineral will be done as per approved mining plan to ensure

safety of the workers and ambient environment.

- **Manual:** There shall be no manual mining.

Semi **Mechanized:** Mine shall be worked out by semi mechanized method with drilling and blasting. Shovels/Rock breakers, jack hammers, compressor and tippers will be used for mining operations.

Frequency & locations of environmental monitoring: Regular Monitoring of all the environmental parameters viz., air, noise, water and soil as per the formulated program based on CPCB and MoEF&CC guidelines will be carried out every year in order to cross check any changes from the baseline status. Monitoring program will be followed till the mining operations are continued. For implementation of the same Environment Monitoring Cell will be formed under control of the Mines manager. The job of this cell will be regular environmental monitoring and submission of environmental report, green belt development, etc. The plan for Monitoring is given in the following paragraphs:

6.2 PROPOSED MONITORINGPROGRAMME

The details of the proposed program are given below:

6.2.1 Monitoring of Mining Parameters

Slope failure: The project area around the block represents a rolling topography with gorges/scrap faces and with numerous streams. In the proposed block elevation difference is noted from 122 meters to 156 meters. However regular inspection (frequency and mechanism to be established) will be carried out to examine slope stability, mine faces, etc. A team constituting of Mines Manager will undertake monthly inspection.

Ground water drainage: The effectiveness of drainage system depends upon proper cleaning of all drains and sumps. Regular checking will be carried out to find any blockage due to silting or accumulation of loose materials. The drains will also be checked for any damage in lining / stone pitching etc. The environmental management cell defined will inspect the same and submit report to owner.

Blasting effect: Blasting is one of the most critical activities of mining operations. Therefore, Optimum drilling and blasting parameters have been developed taking into account different aspects generally adopted in similar cases to optimize the efficiency of blasting keeping the associated hazards at minimum.

6.2.2 Monitoring of Environmental Parameters:

The monitoring of environmental parameters will be undertaken as per guideline given in IBM CCoM's Circular Number 3/92.

Air Quality Monitoring: Air quality monitoring is essential for evaluations of the effectiveness of abatement program and to develop appropriate control measures. Particulate Matter (PM10 & PM2.5) will be monitored in continuation with Sulphur dioxide (SO_2) and Oxides of Nitrogen (NOx) monitoring in workplace and study area at 8 sampling locations.

Water Quality Monitoring: Water quality monitoring involves periodical assessment of quality of ground water and surface water. Parameters to be monitored are pH, Total Suspended solids, Chemical Oxygen Demand (COD), Oil & Grease, Phenolic compound, Copper, Fluoride, Manganese, iron, etc. Total collected samples 8; where 6 ground water samples and 2 surface water samples of nearby water bodies will be periodically studied to assess the impact of mining.

Noise Level Monitoring: Noise level monitoring is done for achieving the following objectives. To compare sound levels with the values specified in noise regulations. To determine the need and extent of noise control of various noise generating sources. Noise level monitoring will be done at 8 locations, the work zone to assess the occupational noise exposure levels and also at the noise generating sources like ore handling arrangements, maintenance workshop, nearby villages to assess the noise levels and their propagation for taking necessary control measures at the source.

Parameters: The noise level recordings are measured in dB(A) Leq values, where dB(A) denotes the time weighted average of the level of sound in decibels on scale A, which is related to human hearing.

Soil Quality: As a part of environmental monitoring soil sampling and analysis will be carried out from 5 no. of stations quarterly study shall be done.

6.2.3 Green Belt Development Monitoring

Monitoring of growth and survival rate of the plants planted for greenbelt development every year shall be done to replace the plants which are not grown. Following data shall be recorded every year:

- Area under plantation/vegetation
- Period of plantation
- Type of plantation: Trees, grass any other as seeds or saplings.
- Distance between plants

- Type & amount of fertilizer used
- Interval of watering
- Method and period of post plantation care
- Survival Rate
- Density of afforested land both pre & post plant condition

6.2.4 Occupational Health and Safety Monitoring

Concentration of Respirable dust in the workplace will be regularly measured as laid down by DGMS. Health check up of the workers will be conducted at regular intervals. The information will be furnished to the relevant authority.

Environment Management Cell will also coordinate with general public, regulatory authorities, local administration to appraise environmental performance of the mine.

The plan of environmental monitoring for selected important parameters will be worked out as per format. **Table 6.1.**

The other steps for giving paramount importance to the occupational health and safety of mine worker are discussed as ahead—

- Use of safety/protective gears like rubber gloves, safety shoes, helmet, dust mask etc. will be a must. Routine check-ups to develop habit will be made by environmental cell.
- Regular training and refresher follow-ups on this regards will be given continuously to build the capacities of the mineworkers.
- Monitoring of quality of water, air, noise, and occupational health status of project personnel and surrounding habitations.
- Planned monitoring program to evaluate the effectiveness of various /specific aspects of technological/ mitigation measures.
- Plantation monitoring programme to ensure survival and growth rate of plantations.
- A plan for monitoring health of workers and community in vicinity will be drawn and submitted along with financial allocation. The details of the plan are discussed below.

Plan for monitoring health of workers:

It is proposed that at the outset of mine, all the workers will be medically checked. The History report of each employee will be made by the environment cell. This will include the X-Ray films also. A regular check-up of all the workers will be made as given ahead-

- Once in a year for all the workers having their work place close to the dust producing sites like and loading and unloading.
- Once in 2 years for all other workers

Any deviation will immediately be reported to mines manager for taking necessary and corrective action.

6.3 FREQUENCY OF MONITORING

The mining will be done in the existing old quarry both laterally and at depth. The mining can be started within 3-4 months after obtaining statutory clearances. No construction will be required therefore no environmental monitoring during the commencement phase is suggested.

Measurement Parameters, Frequency, Location & Cost of Measurements

Methodology of Monitoring Mechanism: Environmental monitoring at various locations, within the ML area and in the study area of 10 km radius will be carried out on a periodic basis. A comprehensive network for monitoring has been prepared. Sampling locations have been identified by considering the source of pollution due to mining operations, drainage pattern and topography of the area.

EMP implementation & monitoring: An internal monitoring team shall be constituted for implementing the monitoring plan of Rs. **1,20,000** rupees is expected for monitoring cost.

Table 6.1Environment Monitoring Schedule Details

Monitoring	Frequency of Monitoring	Methodology	Cost (Rs.)
Ambient Air Quality	Annually	Particulate Matter (PM2.5):USEPA Quality Assurance Handbook (Vol II) Part II, Quality Assurance Guideline Document 2.12 Publication 1988) Particulate Matter (PM10): IS: 5182;Part 23 :2006 Sulphur dioxide (SO2): IS: 5182 (Part – 2) – 2001 ,Reaffirmed 2006 Nitrogen Oxides :IS: 5182(Part –6)-2006	48,000.00
Water Quality	Six Monthly	APHA 22nd Edition 2012:2120 B & C - 2012	30000.00
Noise Monitoring	Annually	As per IS: 9989(1986) reaffirmed 2001	20,000.00
Soil Monitoring	Annually	Texture, Electrical Conductivity, Bulk Density etc	22,000.00
		Total Costing	**120000.00**

- **Biological Environment Monitoring:** Monitoring shall be done regularly on the plantation and the records shall be maintained. The survival rate of trees will be checked and regular water sprinkling shall be done. There is provision of gardener to take care of the plantation in the area. There shall be fencing of pit done to avoid accidents to the nearby fauna.

- **Socio-economic Environment Monitoring:** Once in a year through physical survey for cross checking any adverse variation and prompt correctives. Health issues will be regularly addressed by organization of heath checkup camps shall be done.

Reporting Schedules of monitored data: The monitored data on air quality, water quality, soil quality and noise levels, will be periodically examined for taking necessary corrective measures. The monitored data will be submitted to State Pollution Control Board (SPCB). The post-project data will be submitted in half- yearly monitoring reports to the same.

6.4 INFRASTRUCTURE FOR ENVIRONMENTALPROTECTION

A full-fledged environmental cell with qualified and experienced personnel established at the company's beneficiation plant, which is located close by, will supervise and implement the environmental issues. This environmental cell is supported by a fully equipped laboratory to carry out the analysis. The proposed organization of the environmental cell should have manpower on regular basis.

6.5 ENVIRONMENTAL MONITORING CELLDETAILS

Environmental data shall be monitored initially by using an outside agency.

Environmental Monitoring System & Methodology: Based on the results of improvements of adversity in the environmental parameters, monitoring schedules and duration will be restricted, if necessary, after consulting with SPCB and MoEF&CC.

6.6 FUNCTIONS OF THE MONITORING CELL

To carry out environmental monitoring at site for various environmental parameters as required either departmentally or through outside agencies. This will ensure that the environmental status of the core and buffer zone of the mine will be preserved in good status as per rules.

1. To observe the environmental control measures to be implemented.

2. To keep a watch on the flow patterns of drainage and surveillance on the efficiency of water management system.

3. To study the effects of project activities on the environment.
4. To ensure implementation of plantation programme. Regular monitoring of survival rate of plants should also be carried out to achieve the desired result, for five years.
5. To keep records of monitoring etc. in a systematic way, so as to facilitate easy access, when needed by statutory agencies, etc.
6. Conducting environmental studies and reporting to SPCB.
7. To interact and liaise with State and Central Government Departments.
8. To ensure the availability of the necessary spares for the pollution control equipment all the time so as to keep the pollutants of the environment within the stipulated limits.
9. To identify the source of pollution and to take immediate action to prevent further pollution.
10. Conducting safety audits and programmes to create safety awareness in workers/staff.
11. Conducting regular health audits to detect any health problems promptly to the workers/ staff. This will reduce occupational health problems.
12. Parting training on safety and conducting safety drills to educate employees.
13. Carrying out socio-economic study once in three years in the surrounding areas to find out the benefits derived by the society due to the project and also to fulfill the deficiency, if any, immediately.
14. The recorded data from monitoring of air, water and noise will be submitted half yearly by project proponent to Ministry of Environment and Forests (Regional office) and the SPCB, respectively.

6.7 REPORTINGSCHEDULE

The recorded data from monitoring of air, water and noise will be submitted half yearly by project proponent to Ministry of Environment and Forests (Regional office) and the SPCB, respectively.

6.8 EMP BUDGETARY COSTESTIMATE

The cost estimates give only the indication of the likely cost. The estimated environmental i.e. mainly monitoring and green belt development, cost of the project is as follows.

Table 6.2; Cost of Environmental Protection Measures

Sl. No.	Particulars	Annual Recurring Cost
1.	Pollution Monitoring	120000.00
2.	Green Belt Development	29000.00
3.	Reclamation of Degraded land	150000.00
4.	Staff wedges	250000.00
5.	Construction of Garland Drain And Sedimentation Tank	40000.00
	Total	**589000.00**

6.9 PROCUREMENTSCHEDULE

There shall be monitoring during operation phase. The sampling locations have already been mentioned in the report and a monitoring schedule has been proposed. Monitoring of the ambient environment shall be duly done. The P.P. will engage NABL accredited agency for carrying out regular monitoring as detailed in report.

7.0 ADDITIONAL STUDIES

7.1 GENERAL

The report has been prepared on the basis of ToR granted. All the studies proposed in the TOR of the mining project have been complied with and the same has been covered in the EIA report. We have included the additional studies covered for the proposed project such as risk assessment (RA), Disaster Management Plan (DMP), Social Impact Assessment in connection with mining and allied operations of the proposed project. It also covers dangers/ risks/ explosions/ accidents etc likely to arise from the project operations, including onsite and offsite emergency plans to meet the disastrous situations.

7.2 PUBLIC CONSULTATION

Public hearing is very significant part of the process of public participation envisaged under the guidelines issued by MoEF&CC, Government of India. The public hearing for the project was conducted on 13.03.2019 under the chairmanship of Shri F.M. Dopth, IAS, Deputy Commissioner, East Khasi Hills. Shri S. Syiem, Asst. Environmental Engineer, Meghalaya State Pollution Control Board (MSPCB), Shillong was also present during Public Hearing. Public Hearing Minutes along with its Compliance is attached as Annexure 12 of EIA report. The compliance of Public Hearing is given below:

S.No.	Name & Address	Questions asked/Comments/Suggestions from the Public	Reply and Commitment/ Action Plan along with budgetary provision made by Project Proponent
1	Shri Sibren Sumer, General Secretary, Elaka Narpuh	He supported the project and urged the company to adhere to the rules and regulation of the Government. He suggested that compensatory reclamation /afforestation should be carried out within the mining area.	Thanks for the support. Plantation will be carried out in 0.447 ha. Of the mine lease during plan period in 7.5 m statutory boundary. Budgetary provision for plantation has already been made in the EIA report.
2	Shri Minot Sympli, Waheh Shnong, Chiehruphi	He supported the project and requested the project proponent to do plantation around the mining site before mine operation.	Thanks for the support. Phase-wise plantation will be carried out in 7.5 m statutory boundary of the mine lease after commencement of the project. Budgetary provision for plantation has already been made in the EIA report.
3	Shri Teilang Suting, General Secretary, Chiehruphi	He supported the project and expresses that any development of the project should go hand in hand with protection to the environment.	Thanks for the support. Adequate environment protection measures like regular water sprinkling on haul road, plantation in 7.5 m boundary, construction and maintenance of parapet wall etc. will be taken during mining operations. Capital cost of Rs 8.0 lakhs and recurring costofRs16.31lakhsisearmarkedtowards Environment Protection Measures.
4	Shri Phai Sympli, Ex-Waheh Shnong, Chiehruphi	Extended his support to the Mining project.	Thanks for the support.
5	Shri Andronicus Sychiang, Chiehruphi	Extended his support to the Mining project.	Thanks for the support.
6	Shri Sailen Singh Sutnga, Boundary Secretary, ElakaNarpuh	Extended his support to the Mining project.	Thanks for the support.

7	Shri Jerimaiah Dhar, Finance Secretary, Elaka Narpuh	Extended his support to the Mining project and requested the office of the SEIAA, Meghalaya for grant of EC to the company.	Thanks for the support.
8	Shri Stingson Siangshai, Executive Member, Chiehruphi Durbar	He supported the mining project as agreed in the executive committee of the Dorbar Shnong, Chiehruphi	Thanks for the support.
9	Shri Winel Suting, Chiehruphi	He supported the mining project as agreed in the executive committee of the Dorbar Shnong, Chiehruphi	Thanks for the support.
10	Mr. Wanshwa Nongtdu, Mynkre	Extended his support to the project and requested the company to take preventive measure for safety of the labour and environment. He urged that the company should create job opportunity to many unemployed youths of the region and requested the MSPCB to regularly monitor the industries in this region.	Labours at the mine site will be provided with adequate Personal Protective equipments. Mining will be done as per the approved mine plan taking all the measures to conserve environment. Project will create direct employment for 19 personnel and many more people will be employed through indirect employment. Regular monitoring will be carried out for the project and six-monthly compliance of the same will be submitted to MSPCB.
11	Shri Elsing Tongper, Kuliang	He supported the project.	Thanks for the support.
12	Shri Loveyou Bareh, Pyrta Kuna	He strongly supported the project.	Thanks for the support.
13	Shri Shibun Shylla, Thangskai Village	He supported the project.	Thanks for the support.
14	Shri Baining Suja, Nongsning	He supported the proposed project.	Thanks for the support.
15	Shri Klip Muksor,	He supported the proposed project.	Thanks for the support.

	Nongsnig		
16	Shri Prim Nongtdu, Nongrim hill	He supported the proposed project.	Thanks for the support.
17	Shri Phailok Dkhar, Nongsning	He supported the project.	Thanks for the support.
18	Shri Dupring Sutong, Nongsning	He supported the proposed project. Requested the company to provide good roads to minimize the pollution level.	Thanks for the support. Haul road will be regularly maintained. Capital cost of Rs 1.0 lakhs and annual recurring cost of Rs 1.0 lakh has been earmarked for haul road maintenance.
19	Shri Living StonePaslein, Nongsning	He supported the proposed project.	Thanks for the support.
20	Shri Preshose Suja, Umrasong	He supported the proposed project.	Thanks for the support.
21	Shri Risbai Sympli, Headman Nongsning	He supported the proposed project.	Thanks for the support.
22	Shri Net Lamare, Secretary, Nongsnig	He supported the proposed project.	Thanks for the support.
23	Dr. Pher Nongtdu, Khliehriat	He supported the proposed project and requested the cement industries in the region to extend their help and support beyond the region and to the whole of the state as well.	Thanks for the support.
24	Dr. D.S. Diengdh, Khliehrit	He supported the proposed project and requested the Board of the company to promote the name of village i.e. origin of the cement in every advertisement for further publicity. He also requested the company to provide better education for the	Thanks for the support and noted the concern and suggestions. Company will take all measures to support education for the local youths. Towards this an amount of Rs 1.0 lakhs as annual recurring cost has been allocated.

		local villagers.	
25	Mr. P.H. Nongtdu, Chiehruphi	He didn't fully support the proposed project. He said that there is no limit in issuance of NOC to the factories. He raised his concerns about the presence of Cement industries in every kilometer in the region and questioned on how pollution can be tackled & controlled. He fears there will be more destruction than development. He also voices his concern about the impact of immigration problem faced by the local people of the region and North East region due to industrial development which taken place in this region. He requested the people to be wise and think future of their children.	The complaint and suggestion have been made against all cement industries and industries in the area and not specific to this project.
26	Shri Jony Suchiang, Nongsning Village	He supported the project and requested the company to continue their support to the local people.	Thanks for the support.
27	Shri Elnathan Pale, Chief Advisor, AJSY/JSU	He supported the project and asked the company to comply with the Mining Plan and requested the company to provide more job opportunity to the unemployment youth.	Mining will be done as per the approved mining plan. Direct employment will be given to 19 people and indirect employment to many more people in the area. Local unemployed youths will be preferred.
28	Shri Phaibiang Syrti, Thangskai	He supported the proposed project.	Thanks for the support.

29	Shri Phasbon Son Nongtdu, Khliehriat	He supported the proposed project and requested the company to get authentic documents/permission from the State Government and to retain the top soil.	As per approved mine plan, 32,609 cum alluvial soil will be generated during the plan period which will be properly stacked within the cement plant and will be used for plantation at mine site. Mining will be undertaken only after obtaining the NOC from MPCB.
30	Shri Kmenlang Sympli, Nongsning	He supported the project and requested the Government Department to accord permission to the company.	Thanks for the support.
31	Shri Lambha Dhar, Ex-headman, Nongsning	He supported the project and requested the Government Department to accord permission to the company.	Thanks for the support.
32	Shri Condrik Lamare, Sonapur	He supported the proposed project and requested the cement industries in the region to extend their help and support beyond theregion.	Thanks for the support. He has requested cement industries to extend the support beyond the regions too. On the part of our company our cement plant is extending all help in the area. This mine will extend its help and support to the local villagers through CER. Though as per OM F.No.22-65/2017-IA.III dated 1st May 2018, CER cost comes out to be Rs 2.32 lakhs but company has allocated budget on higher side i.e. Rs 5.5 lakhs as capital cost and Rs 4.5 lakhs as recurring cost.
33	Shri Kamphor Biam, Chiehruphi	He supported the proposd project	Thanks for the support.
34	Shri Shaniah Suchiang, Umrasong	He supported the proposed project	Thanks for the support.

Written Representations: Total 37 written representations were received by MSPCB which are detailed below:			
S.No.	**Name of the person & Village**	**Questions asked/Comments/Suggestions from the Public**	**Reply and Commitment/ Action Plan made by Project Proponent**
1.	Western Ribhoi Organisation Border Area, Assam Meghalaya	The organization supported the project.	Thanks for the support.
2.	Poor People Conference Organization	The organization supported the project.	Thanks for the support.
3.	All North East India Trucks Driver Association, Assam Guwahati	The organization supported the project and requested the GVIL company to provide night stay and food preparation facility to the truck drivers who stay over night in the cement plant for loading of cements.	Noted. Necessary assistance will be provided to the drivers as requested.
4.	Jowai Citizenship Association, Jaintia Hills District, Meghalaya	The organization supported the project.	Thanks for the support.
5.	Thadlaskein Sub Area Marketing Society, West Jaintia Hills, Regn No.1962 And Cement Dealer	The organization supported the project.	Thanks for the support.
6.	North East India Environment Association, Jaintia Hills, Meghalaya	The organization supported the project with a suggestion that company should strictly follow the rules & regulation act of the Government and also forest Conservation Act, 1980. It also suggested to plant more	Mining will be carried out as per approved mining plan and Company will follow the rules & regulation act of the Government including forest Conservation Act, 1980. Company will carry out plantation as per plan given in the EIA/EMP report and as per directions of MoEF&CC.

		trees for protecting the environment.	
7.	Khasi Jaintia Truck Owner Association, Meghalaya	The organization supported the project.	Thanks for the support.
8.	Cement Dealers Association, Jowa Distt: West Jaintia Hills,	The organization supported the project.	Thanks for the support.
9.	Phra Shnong Association, West Jaintia Hills, Khliehtyrshi, Mukhla, Ummulong, Wahajer, Moodymmai andothers	They said that people of their village gets employment opportunities in the cement plant of the company as drivers. Also plant has provided financial support to the villagers especially in their agricultural activities. They supported the limestone mine for the cement plant. Also, they suggested that cement plant should set up mining plan for coal mine as they did for Limestone mine so that the business and livelihood of the locals in Jaintia Hills won't be affected or disturbed.	Thanks for the support. Mining plan for coal is not in the domain of Company. It can be done only by State/Central Government.
10.	Official Member Forest (And) Environment, Deptt: JHADC, Jowai	The organization supported the project and suggested the company to strictly follow all the rules and regulation of Forest & Environment Act and rules of Pollution Control Board.	The company will follow all the rules and regulations of Forest & Environment Act and rules of Pollution Control Board.

11.	Cement Dealer Association, Nongstoin, West Khasi Hills	They supported the project and suggested that the govt and the management of Green Valliey Company should fix the exact rate for both summer and winter and not to raise the price frequently and it should not exceed more than Rs 400 per bag in NongstoinArea.	Thanks for supporting the project. Fixing of cement rates is a commercial decision taken by the Company based on several factors including national and local and also depends on the input cost and rates fixed by other companies.
12.	Land Owner And Forest Owner Association, East Jaintia Hills, Meghalaya	The organization supported the project requesting the management of the company to employ more local people and follow the Forest Conservation Act, 1980. It also suggested to reclaim the area by backfilling and plantation after mining of limestone.	Mining will be carried out as per approved mining plan and company will follow the Forest Conservation Act 1980. Project will provide direct employment for 19 personnel and many more people will be employed through indirect employment. Local people will be preferred for employment. Since the entire mining lease is mineralized hence backfilling is not proposed at this stage. However, plantation will be carried out on the mined-out benches as detailed in the EIA/EMP.
13.	Labour Association, West Jaintia Hills, Meghalaya	The organization supported the project with a condition to appoint locals 60 % of tribal people and 40% of Non-Tribals and also to follow all the rules and act of the Government to control Pollution.	Thanks for the support. Company is already giving preference to locals and tribal in the employment. Company will carry out mining as per approved mine plan and will also follow all the act, rules and terms and conditions as laid down by MoEF&CC.
14.	Youth and Unemployment Organisation, West Jaintia Hills, Meghalaya	The organization supported the project with a condition to appoint locals 60 % of tribal people and 40% of Non-Tribals and also to follow all the rules and act of the Government to control Pollution.	Thanks for the support. Company is already giving preference to locals and tribal in the employment. Company will carry out mining as per approved mine plan and will also follow all the act, rules and terms and conditions as laid down by MoEF&CC.
15.	Khasi Jaintia Fermers Association,	They supported the project, and said that the company helps them in selling of their	Thanks for the support.

	Meghalaya	agricultural products.	
16.	Cement Dealer Association, Ribhoi District, Nongpoh	The organization supported the project.	Thanks for the support.
17	All Jaintia Students' Union, Central body, West Jaintia Hills, Meghalaya	The organization supported the project.	Thanks for the support.
18	Office of the East Jaintia National Council, Khliehriat	The organization supported the project.	Thanks for the support.
19	Office of the Hynniewtrep Youths' Council (HYC), Shillong, Jaintia Unit	The organization supported the project.	Thanks for the support.
20	Dorbar Shnong Umkiang, JaintiaHills, Meghalaya	The organization supported the project.	Thanks for the support.
21	Office of the Elaka Narpuh, East Jaintia Hills, Meghalaya	The organization supported the project with hope that company	Thanks for the support.
22	Jaintia Students' Union, Jaintia Hills, Meghalaya	The organization supported the project.	Thanks for the support.
23	Chdooh Ri Jaintia Wa Ma Maia, Jowai, Jaintia Hills, Meghalaya	The organization supported the project.	Thanks for the support.

24	Indigenous Biodiversity & Social Welfare Organisation, East Jaintia Hills, Meghalaya	The organization supported the project with a hope that GVIL will take care of environment and will do mining as per law and will maintaineco-balance.	Mining will be carried out as per approved mining plan and Company will follow all the act, rules & regulation of the Government keeping all the aspects for conserving environment.
25	Confederation of Hynniewtrep People(COHP), Jowai, West Jaintia Hills, Meghalaya	They supported the project with a hope that Green Valliey Industries Limited (GVIL) will work in the benefit of the local people.	Thanks for the support.
26	Ri Jaintia Youth Federation, Jowai, West Jaintia Hills, Meghalaya	The organization supported the project.	Thanks for the support.
27	Jaintia People Welfare Organisation, Khliehriat, ElakaNarpuh, Jaintia Hills, Meghalaya	The organization supported the project.	Thanks for the support.
28	Office of the All Hynniewtrep People United Front (AHPUF), H.O.-Jowai, Distt: West Jaintia Hills, Meghalaya	The organization supported the project and requested GVIL to employ maximum number of local people and develop them, also requested to maintain and preserve the environment.	Thanks for the support. Direct employment will be given to 19 peoples and many more peoples will be employed through indirect employment. Local people will be preferred for employment and training for skill development will be given to the locals under CER. Scientific method of mining will be adopted and plantation will be carried out during mining operation which will help in maintaining and preserving the environment.
29	All Northeast People United Front Meghalaya Unit	The organization supported the project.	Thanks for the support.

30	Society for Environment Protection and Sustainable Development	The organization supported the project.	Thanks for the support.
31	Hynniew Trep United Front (HUF), HQ: Jowai,	The organization supported the project.	Thanks for the support.
32	Confederation of RI Jaintia Movement, HQ: Jowai, Distt: West Jaintia Hills, Meghalaya	The organization supported the project.	Thanks for the support.
33	Jaintia National People Organisation, HQ: Jowai, Distt: West Jaintia Hills, Meghalaya	The organization supported the project.	Thanks for the support.
34	Jaintia Students' Movement Central Body, Jaintia Hills District, Meghalaya	The organization supported the project.	Thanks for the support.
35	Jaintia Youth Federation (JYF) Central Body	The organization supported the project.	Thanks for the support.
36	Hynniew Trep National Youth Front HQ: Shillong, Meghalaya	The organization supported the project.	Thanks for the support.
37	Jaintia National Council, HQ: Khliehriat	The organization supported the project.	Thanks for the support.

7.3 RISKASSESSMENT

Human health and Environmental risk from developmental activities is mainly due to occurrence of some accident consisting of an event or sequence of events explosion, fire and toxic hazards. Risk analysis provides a numerical measure of the risk that a particular facility poses to the public. It begins with the identification of probable hazardous events at an operational area and categorization as per the predetermined criteria. The consequences of major events or accidents are calculated for different combinations of weather conditions to stimulate worst possible scenario. These predictions of consequences are combined to provide numerical measures of the risk for the entire facility. Risk assessment should be done on the basis of past accident analysis at similar projects, previous judgments and expertise in the field of risk analysis especially in accident analysis.

The possible risks in the case of mining projects are erosion, inundation/floods, accidents due to vehicular movement and accidents during mineral loading and transporting etc. Mining and allied activities are associated with several potential hazards to both the employees and the public at large. A worker in a mine should be able to work under conditions, which are adequately safe and healthy. At the same time the environmental conditions should be such as not to impair his working efficiency. This is possible only when there is adequate safety in mines.

7.3.1 Risk Management:

The following precautionary measures shall be taken to prevent any accident

- Elimination of the source of hazard.
- Substitution of hazardous process and materials by those which are less hazardous.
- Geographical/ physical isolation of hazards from vulnerable communities.
- Use of engineering controls to reduce the health risk.
- Adoption of safe working practices such as regular equipment maintenance.
- Use of Personal Protective Equipment should be mandatory.
- Top edge of opencast workings shall be kept properly fenced.
- Regular dressing of bench sides to ensure safety of workers employed within 5m or working face.
- Provision of safety belt or rope while persons are at work at the quarry sides or benches from where there are chances of falling down for more than1.8m.
- Drafting and implementation of preventive maintenance schedule for various kinds of machinery deployed in opencast workings.

- Provision of maintenance of properly laid haul roads with parapet wall fencing or guards and road signs at strategic points.
- Precautions against danger while traversing dumpers, excavators etc. by installing audio-visual alarms and appointment of spotters.
- Transportation of mineral within mine workings by vehicles under the direction, supervision and control of Mine Management only.
- Proper maintenance of vehicles and weekly examination by an engineer and daily examination by a competent person.
- Training and retraining (at specified interval) of the machinery operators.
- Adequate maintenance of electrical equipments.
- Adequate illumination after daylight.

7.3.2 Hazard Identification

It is a mining project which may have the following types of hazards associated with it.

Natural Hazards

- Earthquake
- Flooding – Heavy Rainfall/ Water Bodies
- Landslide

Man-Made Hazards

- Bench Slope Failure
- Vehicles and Machinery
- Loading and Excavation of Mineral
- Drilling and Blasting
- Fugitive Emissions from Mining Operations

7.3.3 Assessment of Risks involved during Mining and Mitigation Measures:

Factors of risk involved due to natural calamities and human induced activities in connection with mining operations are as under:

1. Earthquake

2. Floods

Risk Involved: There is always a risk of flash floods due heavy rain during rainy season.

Mitigation Measures: Limited mining will be done during rainy season**.**

3. Landslide

4. Open Cast Bench Slope Failure Risk Involved:

Reasons for failure are -

- Inadequate nos. of competent persons for carrying out statutory inspections.
- Lack of supervision.
- Failure to make and keep the quarry sides secure by proper benching, sloping and keeping benches of adequate height and width.
- Undercutting so as to cause dangerous covering.

Mitigation Measures:

- Bench height and width will be maintained as per approved Mine Plan so that not only slope of individual benches are maintained but over all safe pit slope be maintained.
- For determining factor of safety, the bench slopes will be monitored regularly by sensitive instruments at precise level at regular intervals to check for any possible ground movement.
- A well-developed drainage system over the lease hold area is to be ensured to check the water flow out of the lease area during rainy season.
- Adequate competent persons for carrying out statutory inspections will be deployed
- Monitoring and supervision of active mine benches and also exhausted benches will be made mandatory.
- Inspection report of the benches with suggested corrective measures to be place before the higher management from time to time.

5.Vehicular Movement

Risk Involved:

- Possibilities of road accidents are possible due to rash driving/brake failure/lack of visibility.
- Possibility of overloading may injure the passer-by public.
- Vehicles moving in a steep gradient or on benches of inadequate width.
- Accidents are common due to reversing of vehicles.

Mitigation Measures

- All transportation within the mining lease working will be carried out directly under the supervision and control of the management.
- The vehicles will be maintained in good condition and checked thoroughly at least once a month by the competent person authorized for the purpose by the management.
- Road signs will be provided at each and every turning point up to the main road (wherever

required).

- To avoid danger while reversing the equipments/ vehicles especially at the working place/loading points, stopper should be posted to properly guide reversing/spotting operating, otherwise no person should be there within 10m radius of machine.
- The maximum permissible speed limit shall been sured.
- Overloading of material will be avoided.
- A statutory provision of the fences, constant education, training etc. will go a long way in reducing the incidents of such accidents.
- Unauthorized persons will not be allowed to ride on vehicles
- Strict code of conduct will be put in place to avoid driving in intoxicated condition by drivers

6. Mineral Loading, unloading and Transportation/Use of machinery:

Risk Involved:

- Use of substandard equipment.
- Accident due to generation of fly rock.
- Attempt to clean moving parts of machinery.
- Non provision or removal of guards for moving parts of machinery.
- Mitigation Measures
- All the equipments deployed at the mine will be of highest standard
- All the loading and operating machines will have horns and proper maintenance of mining machinery shall be done
- Height of the bench will be maintained as per approved mining plan to avoid over hanging of rocks.
- The mineral will be loaded in trucks mechanically and in safe manner to avoid fly rocks
- There shall be fencing of the mined out area to prevent any accident of mine nearby habitants of nearby village and their livestock.
- The complete mining operation will be carried out under the Management and control of experienced and qualified Mines Manager having Certificate of Competency to manage the mines granted by DGMS.
- All the provisions of Mines Act 1952, MMR 1961 and Mines Rules 1955, RMMCR 1986 and other laws applicable to mine will strictly be complied with.
- During heavy rainfall the mining activities will be closed.
- Strict code of conduct will be put in place so that no one goes near the moving part of machines for maintenance.
- Secured cabin will be provided to all operators to shield them from any fly rocks.

7. Drilling and blasting:

Risk Involved:

The mining will be done with semi mechanized method. The operations like drilling of shot holes, sorting of stone and breaking of large sized boulders will be excavated using hydraulic rock breakers and excavators with deploying of Jack hammer drilling (39 to 34 mm dia) will be practice in this area, having burden and spacing of 1.6 m x 2.0 m in stagger grid pattern. To avoid fly rock problem at the edge of the hill, light charged muffle blasting shall be under taken. Following risks are involved during drilling and blasting operation.

- During the movement of drill machines from one place to other place and during change of drill rods and bits
- Improper handling of explosives
- Improper burden and spacing resulting in to fly rocks and excessive noise and vibration
- Misfires during blasting
- Lack of statutory staff during blasting operation

Mitigation Measures

- Drilling manual will be put in place which will have detailed procedure for shifting of drill machines and its operation
- Explosives will be stored in the Magazine approved by Controller of Explosives
- Transportation of explosives from Magazine to place of blasting will be undertaken by an approved explosive vehicle under statutory supervision
- Burden and spacing will be kept as per the study conducted by the expert agency for designing the blasting parameters
- Misfires during blasting will be handled as per procedures laid down by DGMS
- All the persons working in the mine will be provided safety shoes and helmet to prevent them from fly rock.
- Explosives will be used and handled under strict vigilance of the Mining Engineer/ Assistant Mining Engineer.

8.Fugitive emissions:

Fugitive emissions take place during mining from following activities:

- Drilling and blasting of mineral using explosives.
- Excavation of mineral with the help of excavators results in fugitive emission.

Risk Involved:

Respiratory disorders on workers.

Mitigation Measures

- Regular water sprinkling will be done at dust generation points and on the haul road to control dust.
- Controlled drilling and blasting based on study conducted for the purpose shall be carried out to avoid excessive dust generation.
- Secondary drilling and blasting will be kept bare minimum.
- During loading and unloading workers involved in the activity will wear dust masks.
- Loaders will have closed cabins.
- Transportation in covered dumpers will be done.

7.3.4 Vulnerability Analysis

A vulnerability assessment is performed for the hazards associated with the project. The natural hazards cannot be prevented. However, vulnerability to the hazards can be substantially reduced by preparedness and mitigation measures.

Table7.1; Vulnerability Analysis

S.NO	HAZARD IDENTIFICATION	Severity (1-5)	Likelihood (1-5)	Severity x Likelihood (1-25) (Hazards scoring 1-9 are less serious hazards &9-25 are very serious hazards &require risk assessment)	Proposed General Mitigation Measure/ Control
	Natural hazard				
1	Flood	4	2	8	• Limited mining will be done during rainy season. • Pre-warning signs on possible heavy rains or floods or cyclones from the meteorological department will be followed. Hence during any such case the project site will be evacuated. Or if possible the excavated site will be fenced. • To prevent inadvertent entry of people near the excavated pits, long poles will be grouted as a sign of excavated site. • Warning signs in local language will be erected at the site to avoid any mishappening. Nearby villagers will be informed.
	Man-made hazards				

2	Opencast bench Slope Failure	2	2	4	• The depth of mining will be 30 m during Plan period and bench height will be maintained at 5 m with overall pit slope will be kept at 45^0 as per mining plan. Hence, it is less likely that any slope failure will take place in this mine. However, slope failure study will be conducted through an accredited agency and an ongoing assessment of the stability of these slopes will be regularly done. • There shall be adequate supervising staff and mining operation will be done under strict supervision of the Mining Engineers and Asst. Mining Engineer to avoid any mishap. • For determining factor of safety, the bench slopes shall be monitored regularly by sensitive instruments at precise level at regular intervals to check for any possible ground movement. • Stability of benches and slope shall be ensured by full compliance of the mine plan duly approved by Director of Mineral Resources, Meghalaya.
3	Vehicular Movement	4	4	16	• All transportation within the mining lease working shall be carried out directly under the supervision and control of the management. • The vehicles will be maintained in good condition and checked thoroughly at least once a month by the competent person authorized for the purpose by the management. • Road signs will be provided at each and every turning point up to the main road (wherever required). • To avoid danger while reversing the equipment's/ vehicles especially at the working place/loading points, stopper shall be posted to properly guide reversing/spotting operating, otherwise no person shall be there within 10m radius of machine. • Reverse horns will be fitted in all

					vehicles. • The maximum permissible speed limit shall be ensured. • Overloading of material will be avoided. • A statutory provision of the fences, constant education, training etc. will go a long way in reducing the incidents of such accidents. • Edge protection will be done to prevent inadvertent movement. • Visibility defects can be eliminated by the use of visibility aids such as closed circuit television and suitable mirrors.
4	Fugitive Emissions during mine operations such as excavation and loading.	2	5	10	• Regular sprinkling shall be done with operations generating dust emission. • Dumpers shall be covered with tarpaulin during transportation of material and waste. • Dust masks shall be provided for operations involving high fugitive emissions or when required.

5	Mineral Loading and Excavation/ Machinery Operation/Slip and Trip of Workers in Working Areas	4	4	16	• Regular safety audit shall be carried out. • Only authorized personnel will be allowed in the operation area. • Vocational training shall be given to all operators and workers of the mine. Mining operations shall be carried out under proper supervision. • All the trucks loading and operating machines will have horns. • The mineral will be loaded in trucks mechanically *i.e.* by JCB during mining. There is least possibility of injury to the person during loading operation at mine. • Complete mining operation will be carried out under the Management and control of experienced and qualified Mines Manager. • During heavy rainfall the mining activities will be closed. • All persons in supervisory capacity will be provided with proper communication facilities. • Competent persons will be provided first aid kits which they will always carry. • Mobile Fencing shall be installed during Operation at the bench. • Signage shall be installed for all movement areas of machines and everyone on site will be made to wear PPE in these areas. • All machines and vehicles shall be maintained by the maintenance in charge.
6	Drilling & Blasting	4	3	12	• Drilling and blasting will be carried out intermittently. • Training shall be given for proper drilling operation • Proper PPE shall be used for drilling operation • Signage and restricted entry shall be done in areas of drilling operation • Blasting shall be done with proper safety measures and warnings.

7.4 DISASTER MANAGEMENT PLAN:

Safety of mine and the employees is taken care of by the mining rules & regulations as per Metalliferous mines regulations 1961, which are well defined with laid down procedure for safety, which when scrupulously followed safety is ensured not only to manpower but also to machines & working environment. Disaster Management Plans are prepared as proactive measures which help reduce effect of the accident/disaster and enable quicker recovery.

Plans for Disaster Management Onsite emergency planning:

An onsite emergency is caused by an accident or hazard that takes place within the plan area and the effects are confined to the plant area.

The onsite emergency plan consists of following key elements:

- Planning as per hazard analysis
- Preventive measures
- Emergency response procedure
- Recovery procedure

On Site plan shall be in place which includes the following:

a. Regular safety audit/inspection
b. Incident Response team and role and responsibility of each member
c. Procedures for taking care of incidents/emergencies
d. Mock drills
e. Assembly point
f. Communication system/arrangement with administrative and regulatory agencies, media and public etc.
g. Siren for declaring/closing emergency.
h. Regular training on first aid and evacuation etc.

Flood

- A training plan will be prepared for mine workers to cope up with the disaster.
- Limited Mining will be done during rainy season.
- Warning from meteorological department on possible heavy rains or floods or cyclones will be checked.
- There will be warning signs in local language will be erected at the site to avoid any mishappening.

Waste Dump Management

The entire product of Limestone will be used in kilns for manufacturing of lime used as

building materials. During Plan period some quantity of gritty soil will be removed and will be dumped at southern portion of the applied area with suitable precautions. Some quantity of the generated gritty soil would also be used for road maintenance and plantation program

Fire Management

There shall be provision of mobile fire extinguishers at the mine office.

Explosive Handling

Explosives will be stored and handled as per standard method.

Training

Following training shall be provided to the workers from time to time:

- Safety Education &Awareness
- Holding annual safety weeks
- Imparting basic and refresher training to new and old employees respectively.

Communication

Supervisor will be provided with wireless/mobile phones to communicate in case of any abnormality.

Offsite Emergency Planning:

Offsite emergency plan defines the various steps to tackle any offsite emergencies which may affect surrounding areas of the project has to be prepared after due final discussion with local panchayat and revenue officials.

Offsite emergency planning mainly consists of –

a. Contact details of fire brigade, local police, hospitals, local district administration, factory inspector, state pollution control board, state electricity board etc.

b. Demographic details and topography map of the surrounding area.

c. Communication system/arrangement with above mentioned agencies, media and public.

Communication

The telephone numbers and addresses of adjoining mines, rescue station, police station, fire service station, local hospital, electricity supply agency and standing consultative committee members are also maintained for any emergency requirement.

Disaster Management Team

A standing consultative committee will be formed under the head of mines manager. The

members consist of safety officer/medical officer/Asst. manager/ public relation officer/ Foreman/ and environmental engineer.

Roles and responsibilities of the team shall be-

- The management shall make cordial relations with the local authorities, hospitals etc. to help them during crisis.
- There will be communication facilities provided by the management at the mining site.
- A doctor and supporting staff will be there to provide first aid facilities to the workers in case of any mishap.
- Provision of Ambulance at the site with first aid facilities.

Detailed Disaster management plan is prepared with respect to the following accidents at **Annexure-7**

7.5 SOCIAL IMPACT ASSESSMENT:

There are various social impacts of mining which should be identified before starting any developmental activity. The mining is one of the activity for which if pros and cons are not properly assessed may not only result in deterioration of local environmental scenario but also may have long term affects on the socio economic status of the locals such as loss of agriculture land, degradation of water quality, contamination of ground water and soil quality. Therefore to prevent above problems following measures shall be undertaken:

- Ensuring developments contribute to economic growth and social development. The project will provide skill based training to the locals and will generate chance of indirect employment in the area.

- Reducing project risks and providing greater certainty to the society by doing regular environmental monitoring, prediction of risks and hazards and their mitigation, etc.

- Planning for social and physical infrastructure; in proposed project CSR budget ensures provision of proper infrastructure with the help of local authorities such as, providing scholarship to students in nearby schools, organizing health awareness camps and medical camps, emphasis on use of clean toilets, plantation of trees etc.

- Proposed project will improve the quality of life of employees and retention of skilled workers; there is provision for providing training to workers and locals to have better health keeping, and organizing health check up camps for them to lead a healthy life.
- The project shall enhance competitive advantage and reputation, by implementing innovative approaches, setting high standards for other businesses and leaving a positive legacy beyond the life of the project;

- The proposed project shall comply with principles and standards.

7.6 REHABILITATION& RESETTLEMENTACTIONPLAN:

The lease area comprises of 4.5 ha which is non forest land. There is no habitation within the mine area. Hence no R&R is applicable.

7.7 CORPORATE SOCIAL RESPONSIBILITY:

As mentioned earlier, the scale of operations are too small to produce significant impact excepting providing employment to few local residents. However, corporate social responsibility, welfare activities will be taken up. The social welfare activities will include assistance in-

Education

In order to improve the educational activities in the area, following assistance will be provided.

- School infrastructure including furniture, books, sports kit to Ichamati RMSA Secondary School.
- School dress to students of Ichamati RMSA Secondary School;

Sanitations & drinking water facilities

- Installation/ Repair of Hand Pumps/ Tube Wells
- Water quality monitoring of wells and tube wells
- To educate people regarding proper use of drinking water

Medical Assistance: Assistance will be provided in organizing health camps

Medical camps –Medical camps will be organized from time to time in nearby village with free medicines and free health checkup.

Budgetary Provisions for CSR: 5% of project cost shall be spent under CSR. Total Project cost is 30.45 Lakhs and 5 % of Project Cost is 1, 52,250. Total 1, 60,000 Rs will be spent on CSR

Cost breakup is given below:

Table7.2 Proposed CSR Budget

ACTIVITIES	COST (In Rs)
School infrastructure including furniture, books, Computer, sports kit to Ichamati RMSA Secondary School.	60,000.00
School dress to 30 students of Ichamati RMSA Secondary School	30,000.00
Maintenance & Construction of village roads of Ichamati	30,000.00
Medical camp & free medicines to poor	10,000.00
Water supply arrangement & sanitation for local villagers	30,000.00
Total	**1,60,000.00**
Total for five years i.e. 5%of project cost	**1,52,250.00**

7.8 OCCUPATIONALHEALTH

Occupational health and safety deals with the safety and health of the persons employed at the work zone. Working in mines has harmful effects on the health of those employed and there are numerous diseases arising from employment in opencast mines such as various respiratory disorders like silicosis, manganese poisoning, hearing impairment, asthma etc. Some of the hazards are dust, vibration, noise, ergonomics etc.

The personnel employed in the mine are also exposed to a number of hazards at work which may cause them to be involved in an accident due to material handling, machinery etc. as mentioned in Risk Assessment. Accidents cause injuries and can be life-threatening to personnel. Thus occupational health and safety is a crucial aspect to be considered in mines for the well-being of the personnel involved. Proper measures will be taken for injury prevention decrease probability and severity of accidents.

7.8.1 Safety Audits and Accident Prevention

Regular safety audits shall be carried out at site to decrease possibilities of hazards causing accidents or injury. All mining activities shall be carried out under proper supervision of mining engineers and safety officers. All personnel involved in mining shall undergo training for mine safety.

7.8.2 Occupational Disease

The reported figures and surveys conducted by Directorate General of Mines Safety (DGMS) and other organizations like National Institute of Occupational Health (NIOH) etc. revealed that there have been some new trends in the occupational health scenario other than the conventional diseases like Respiratory disorders.

Following areas of occupational diseases are emerging with the changes in the mining industry:

- Noise induced hearing losses
- Health impact due to diesel particulates from emission of diesel operated vehicles and equipment
- Hand-arm vibration, whole body vibration due to use of drills, HEMM etc
- Presence of snakes and other reptiles in the mining area
- Polluted drinking water
- Excess working load and overtime
- Presence of mosquitoes in the lease area
- Sudden accident in the mining area causing personal injury

7.8.3 Health measures to be considered

- Sanitary facilities shall be well equipped with suppliers and employees shall be encouraged to wash frequently, particularly those exposed to dust.
- In the event of temporary closer, approaches will be fenced off and cautionary notice displayed in English and regional language.
- Rotation of workers exposed to dusty and noisy areas.
- First aid facilities in the mining areas.
- Provision of personal protection devices to the workers. The personal protection equipment being provided are–

Table7.3: List of safety equipments

S.No.	Item	Equipment
1.	Face protection	Face Shield
2.	Eye protection	Different types of goggles used for different purposes.
3.	Ear protection	Ear plugs, ear muffs
4.	Leg Protection	Safely shoes, gum shoes
5.	Working at height	Safety belts
6.	Head Protection	Safety helmets
7.	Protection from Dust	Dust Mask

- Periodic medical examinations shall be conducted for all personnel, and specific surveillance programs instituted for personnel potentially exposed to health hazard. The medical examination required to carry out at the time of appointment of every employee. Provided that in case any dust related disease, test shall be conducted more frequently as the examination authority deems necessary.
- Medical camp will be organized for the worker every year.
- At the end of mining operation, test will be conducted to assess health of workers.
- Workers will be informed and trained about occupational health hazards, if identified.
- Any worker's health related problems will be properly addressed.
- The personnel working in dust prone areas will be examined every year as per the DGMS circular No.01 of 21.01.2010.
- Quick-Fix designed by OSHA's ergonomics standards will be followed to reduce work-related musculoskeletal disorders (MSDs).
- Rotation of workers exposed to high noise areas will be carried out.
- Lyophilized Polyvalent Anti snake venom serum will be available at the mine site for snakebites.

7.8.4 Activities posing risks during mining

1. Loading and Excavation of Mineral

Affected Personnel: All operators of machinery for loading and excavation are at high risk. All helpers and other personnel in the mine are at moderate to low risk.

S.no.	Hazard Identified	Severity (1-5)	Likelihood (1-5)	Severity x Likelihood (1 x 25)	Proposed Mitigation
1	Injury due to Falling of rock from the boom of excavators	4	2	8	• Cabin shall be provided on all excavators/ other machinery so that no rocks hit the operator. • All operators and other workers in close proximity shall be trained in their jobs and wear all PPE.
2	Accidents due to bench Collapse Due to undercutting of Benches	1	2	2	• Undercutting shall be avoided by mine supervisor.
3	Accidents due to movement and operation of Heavy Machinery	4	4	16	• Signage in all movement areas of machines • Areas of movement of vehicles shall be marked and everyone in the site will be made to wear PPE at all times when present in these areas. • Only authorized/ designated personnel shall be allowed in the operation area • Reverse horn shall be installed on all machines prior to their deployment for operation • Vocational training to all operators and workers of the mine. Awareness programme for health effects on exposure to mineral dust will be organized for employed person a well as for nearby villagers.
4	Dust Exposure	2	5	10	• Personal Protective Equipment (Dust masks) shall be provided to workers • Dust suppression measures such as usage of dust collectors and water sprinkling shall be carried out in working areas.

5	Exposure to Noise	2	5	10	• Mining operation do not include any major source of generation of noise in the working area, drilling & blasting will be involved which will be intermittent thus noise levels are not of significant levels. However, ear plugs will be provided to all workers in the area. • Audiometry test of the workers shall be done regularly & medical health provided wherever required.

2. Transportation of Material

Affected Personnel: Drivers and operators of machinery are at high risk from this activity. All other personnel working in the mine are at moderate risk by this activity.

S.No.	Hazard Identified	Severity (1-5)	Likelihood (1-5)	Severity x Likelihood (1 x 25)	Proposed Mitigation
1.	Injury due to falling of minerals from truck	4	2	8	• It shall be ensured by senior personnel that trucks are not overloaded. • Material outside the mine shall go in a covered truck; covering shall be done by tarpaulin.
2.	Accidents due to movement of vehicles	3	3	9	• Signage of vehicular movement areas. • PPE shall be worn by operators and Workers in these designated areas.
3.	Injury due to falling of machines/ vehicles from bench and in the working area	4	3	12	• Use of helpers during reverse operation of the machine • Working bench width shall be kept adequate to the width and turn of the vehicles/machines • Overcrowding of vehicles shall be avoided near loading areas.
4.	Brake Failure	3	1	3	• All vehicles/machines shall be maintained by the maintenance in charge.
5.	Speed control	3	2	6	• Speed of vehicles will be restricted below 25 km/hr to mitigate dust generation while transporting of

					mineral.

3. Drilling

Affected Personnel: Two Operators in close proximity are at high risk due to the activity. Exposure area of 10m around the operation is at moderate risk due to drilling.

S.No.	Hazard Identified	Severity (1-5)	Likelihood (1-5)	Severity x Likelihood (1 x 25)	Proposed Mitigation
1.	Accidents due to movement of Drilling Machine	4	3	12	• Personal Protective Equipment (PPE) shall be worn by operators at all times • Signage shall be put in all areas of operation • Designated areas are identified for movement of drilling machine and the drilling is restricted to these areas
2.	Inhalation of Dust	2	5	10	• PPE shall be worn by the operators at times of drilling operation. • Dust Collector is installed by the crawler manufacturer to collect coarse dust particles • If necessary, wet drilling might be used for the activities. This shall be decided as per the personal exposure levels (PEL).
3.	Falling off the edge of the bench	3	3	9	• Mobile Fencing shall be installed during operation at the bench • Proper training is given to all personnel involved for the drilling operation Working bench width shall be kept adequate to the width and turn of the vehicles/machines

4. Blasting

The operations like drilling of shot holes, sorting of stone and breaking of large sized boulders will be excavated using hydraulic rock breakers and excavators with deploying of Jack hammer drilling (39 to 34 mm dia) will be practice in this area, having burden and spacing of 1.6 m x 2.0 m in stagger grid pattern.

S.no.	Hazard Identified	Severity (1-5)	Likelihood (1-5)	Severity x Likelihood (1 x25)	Proposed Mitigation
1.	Accidents during blasting such as Sudden blast shock to workers, Dangerous rock conditions after blast, presence of undetonated explosives, and/or initiators, fly rock etc.	4	4	16	• Drillers & blasters will be given protective gears eg. Helmets, goggles, gloves, boots, ear muffs and dust masks to avoid negative impacts of drilling and blasting. • Except for the crew other people's entry will be banned for at least 30 minutes before the blast initiation. • Pre-blast warnings will be given out loudspeaker. • All misfires will be safely removed, and other hazardous condition corrected or secured. • First-aid will be provided at the time.
2.	Injury due to Falling of rock from the boom of excavators	1	2	2	• Cabin shall be provided on all excavators/ other machinery so that no rocks hit the operator • All operators and other workers in close proximity shall be trained in their jobs and wear all PPE
3.	Accidents due to bench Collapse due to				• Undercutting shall be avoided by mine

	undercutting of Benches				supervisor
4.	Accidents due to movement and operation of Heavy Machinery				• Signage in all movement areas of machines • Areas of movement of vehicles shall be marked and everyone in the site will be made to wear PPE at all times when present in these areas. • Only authorized/ designated personnel shall be allowed in the operation area • Reverse horn shall be installed on all machines prior to their deployment for operation. • Vocational training to all operators and workers of the mine.

5. Slope stability

Affected Personnel: All workers in the mine are at high risk with respect to this activity

S.No.	Hazard Identified	Severity (1-5)	Likelihood (1-5)	Severity x Likelihood (1 x 25)	Proposed Mitigation
1.	Accidents due to slope stability	1	2	2	• Prior to start of mining operation there shall be a study carried out for fixing of parameters with respect to mining to maintain stability of slope • For determining factor of safety, the bench slopes shall be monitored regularly by sensitive instruments at precise level at regular intervals to check for any possible ground movement. • Stability of benches and slope shall be ensured by maintaining optimum overall slope of 45^0 and by full compliance of the mine plan duly approved by Director of Mineral Resources, Meghalaya.

6. Plan for Accidents

Mining site shall arrange for /provide at least the following to mitigate any accident that occurs due to operation:

1. First Aid facilities at site
2. Ambulance
3. Tie up with primary health center for immediate treatment
4. Strict implementation and training of a detailed on-site emergency plan. The Plan shall be prepared by a competent agency.

7. Monitoring Mechanism

Following Activities shall be done by the proponent as a proactive measure for mitigation of Occupational Risks:

- Six monthly monitoring of Exposure levels (Total Suspended Particulate, Fraction of Fine Dust {$PM_{2.5}$}, of high risk workers of all activities. In case necessary a onetime chemical speciation of the dust shall be done to measure levels of Sulphates, Lead, Nickel, Arsenic, Silicates in the dust collected etc.
- Six Monthly Health check-ups for all workers which includes Chest X-Ray, Lung Function Test, ENT Check-ups, Vision Check-ups, Audiometric Tests, Liver and Kidney Function Tests, ECG, Blood Sugar etc.
- Six Monthly Check-up of Drinking water for the site workers to ensure compliance to IS 10500:2012 standards.

7.8.5 Separate budget of Occupational Health

Table 7.4; Capital and Recurring Budget for Occupational Health

S.No	Description	Amount (Rupees In Lakhs)
1	Workers will be subjected to primary health check-up before they are employed to ascertain their health conditions. Thereafter, Regular Medical check-up will be organized for workers & villagers to evaluate the adverse impact if any on these persons due to proposed mining activity.	0.25
2	Workers will be provided with masks, gloves, goggles & ear muffs will be provided.	0.50
3	First Aid facility and training to workers.	0.10
4	Insurance for worker	1.00
	Total	**Rs. 1.85 Lakh**

7.8.6 Public Health Measures:

The mine is in the Sohmluh Village and the nearby habitant might get affected due to the working of mine hence a sum of Rs 0.25 Lakhs has been dedicated towards the betterment of local people.

Table 7.5 Recurring Budget for Public Health and Safety

Sr. No	Impact	Mitigation	Amount (In Lakhs)
1.	Health and Safety	• Health Check-up camps shall be organized.	Rs 0.25
Total			**0.25 Lakhs**

8.0 PROJECT BENEFITS

8.1 IMPROVEMENTS IN THE PHYSICALINFRASTRUCTURE

The roads connecting to lease area will be maintained by lessee. The community member of surrounding community especially the residents of Sohmluh village will have advantage in this regard. Improved road, communication facilities and provision of community development programmes such as health programme, communicable disease awareness and family welfare programmes will elevate the socio- economic conditions of the locals.

8.2 IMPROVEMENTS IN THE SOCIAL INFRASTRUCTURE

The project activities will create awareness with the local people for preferring permanent services than periodical agricultural activities. The activities will help them to analyze the importance of education. With the increased amount of income people can send their children to nearby schools and colleges. These schools are taking care of the local students for their studies. The Project proponent has decided to improve the literacy level of the local elders also. The implementation of this project shall naturally augment the education status of the local people.

Social welfare measures

The social welfare measures will always strengthen the bond between the project proponent and the local population/ communities. The proposed mining project would contribute in implementing social welfare activities in collaboration with local bodies for better development within the study area. Following schemes shall benefit locals:

1. Approach roads will be developed at par with the mining site.
2. There shall be water supply arrangements and sanitation for the villagers.
3. The proponent will make provisions for contributions to the local schools, dispensaries for the welfare of the villagers.

8.3 EMPLOYMENT POTENTIAL

The project will contribute direct employment scope for about 42 persons including Managerial, skilled, semi-skilled and Maintenance personnel. The project will create indirect employment scope for many other persons.

8.4 SOCIO ECONOMIC BENEFITS ARISING OUT OF MININGACTIVITY

It would be apt to reiterate here that no human settlements will be disturbed due to proposed mining activity; consequently, no negative impacts will be applicable in this case. The benefits of mining activity will be similar to any industrial set-up. There will be opportunities of direct and indirect employments. However, the operations being semi mechanized will not generate large scale direct employment. As mentioned earlier there will be around 42 personnel, most of them will be skilled & semi-skilled. Total 80% staff will be employed from the local villages. The indirect employment will be far reaching. It can create indirect employment scope for about 20 persons. The jobs, from which local community can be benefited, will be –

- ✓ Providing tippers for raw material transport from mine to the consumers.
- ✓ Maintenance services

- All personnel in worksites shall have protective gears like helmets, boots etc. so that injuries to personnel are minimized.
- Children and pregnant women shall not be allowed to work under any circumstances.
- Working will be carried out in one shift only and no personnel shall be allowed to work at site for more than 8 hours per day
- Materials pertaining to archeological / historical importance, Department of Archeology, Meghalaya Govt. shall be immediately informed.
- Any coins, artifacts or any other chance find will be notified by the workers. The work will be stopped and instruction will be taken from archeological department.

8.5 OTHER TANGIBLE BENEFITS

Environmental Benefits: Plantation will be carried out in the 7.5 m statutory boundary of the mine area which will not only increase the aesthetic beauty of the area but will also prove to be a hub of native bird's species. Mining will be carried out in a scientific manner which will not cause harm to the environment.

Other Benefits:

This project, on implementation shall help in increasing the overall income pattern of the neighboring people which shall indirectly help them to improve their living standards. Facilities like electricity and telephone are available in these interior/remote areas. No village people reside in them. However, barricading will be done to prevent any accident.

9.1 ENVIRONMENTAL MANAGEMENT PLAN

An Environmental Management Plan (EMP) is a site-specific plan developed to ensure that all necessary measures are identified and implemented in order to protect the environment and comply with environmental legislation. The Environment Management Plan (EMP) is required to ensure sustainable development in the study area. This chapter covers the genesis of pollution, the principal sources of pollution, the nature of pollution, the proposed measures required for meeting the prevailing statutory requirements of dust & gaseous emissions, waste water discharge characteristics, noise levels etc. for environmental management purpose in connection with the mining and mining related activities in the study area. For attaining the desired objective of good environmental quality in the study area, several management strategies in different phases are proposed and evaluated.

- Planned improvements including additional control measures
- Fugitive dust reduction on roads and internal roads for ore transport
- Progressive planning for the closure of mines

This section discusses the management plan for mitigation/abatement impacts and enhancement of beneficial impacts due to mining. The Environmental Management Plan (EMP) has been designed within the framework of various Indian legislative and regulatory requirements on environmental and socio- economic aspects. Environmental Management plan giving the environmental protection measures at mine to meet the stipulated norms of IBM/MoEF are detailed below.

9.2 MANAGEMENT OF LAND & POST MINING LANDUSE

The mine area is 4.5 ha of Non forest land. Initially as the mine is not functioning, the land use pattern is mainly negligible with few shrubs and small trees in patches. However, later due to mining operations, the landscape of the area changes. But this can be taken care of by developing a green belt on the safety barrier and afforestation of the mined out area.

The periphery/safety barrier of the mines will have green belt/plantation at interval of 2.5 m between one sapling planted and the next one. Also, saplings will be planted after back filling the periphery/safety belt sufficiently with soil. The saplings shall be of species of local variety which will have better growth and survival. Thus this will help in improving the environment and also the aesthetic beauty of the area post mining operations.

Proposed land use pattern after the plan period and conceptual land use is given below in the table:

LAND USE (EXISTING):

Category	Area (Hectares)
Quarry	0.00
Road	0.01
Total area in use	**0.01**
Balance unused area	4.49
Total	**4.50**

LAND USE (AFTER FIVE YEARS PLAN PERIOD):

Category	Area (Hectares)
Quarry including road	2.11
Greenbelt in safety barrier	0.18
Dump with Parapet Wall and Garland Drain	0.40
Total area in use	**2.69**
Balance unused area	1.81
Total	**4.50**

LAND USE (AFTER LIFE OF THE MINE):

Category	Area (Hectares)
Quarry including reclamation	3.91
Greenbelt within safety barrier	0.59
Total area in use	**4.50**
Balance unused area	0.00
Total	**4.50**

The entire product of Limestone will be used in kilns for manufacturing of lime used as building materials. During Plan period some quantity of gritty soil will be removed and will be dumped at southern portion of the applied area with suitable precautions. Some quantity of the generated gritty soil would also be used for road maintenance and plantation program.

9.2.1 Mine Closure

Mining will be carried out as per approved mining plan and Progressive Mine Closure Plan. The accumulated rain water in the pit will help in recharging the ground water. At present land is covered with patches of grass, soft broom and one or two standing 'tarew' trees which usually grow in limestone bearing lands. Usually in such lands, especially having heavy seasonal rainfall, there is very little soil cover. The soil is formed only in cavities and between limestone blocks. No trees would grow and flourish in such areas except the 'tarew' tree which has no value and cannot be used as firewood nor as timber because the wood of the 'tarew' is fibrous and soft. However, in the mined out spaces which have been backfilled with soil, hardwood trees and fruit trees can be planted.

The soil that is available during mine development and is stored in stack yards shall be used for backfilling the mined out spaces. On these backfilled areas, planting of saplings of local variety or suitable varieties shall be done to raise a plantation.

9.3 PROPOSED GREEN BELT DEVELOPMENT PLAN

- It is proposed to develop green belt in the 7.5 m boundary of the mine area. Precautionary measures will be taken for carrying of the afforestation by regular watering in the afforested area.
- Wire fencing will be done around trees to protect from grazing animals and proper manuring.
- The species survival will be monitored and dead plants will be replaced. The green belt development plan has been given below:

Table 9.1; Proposed Plantation

Sl. No.	Year of Plantation	Target of Plantation	Assumed Survival (80%)	Area to be covered in Ha	Area of Plantation
1	First	58	46	0.036	Safety/Barrier Zone
2	Second	58	46	0.036	Safety/Barrier Zone
3	Third	58	46	0.036	Safety/Barrier Zone
4	Fourth	58	46	0.036	Safety/Barrier Zone
5	Fifth	58	46	0.036	Safety/Barrier Zone
TOTAL		**290**	**230**	**0.18**	

9.4 IMPACT ON HYDROLOGY OF THE AREA

The district of East Khasi Hills is covered mainly by crystalline rocks with Tertiary sedimentary rocks. The secondary porosity in consolidated formation e.g. fractures; joints, etc developed due to major, minor tectonic movements, prolonged physicochemical weathering, form the conduits as well as reservoirs of ground water. The weathered mantle varies from 10 to 30 m bgl. Ground water occurs under water table condition in the top weathered quartzite and in semi-confined condition in the fractured and jointed rocks. At hydro geologically feasible locations, well drilled down to the depth of about 80 -150 m below ground level may yield a moderate discharge of 5-15m3/hr in Archaean and Pre-Cambrian Group of rocks. Depth to water level is found to occur between 2 and 15 m bgl. The valley areas are found to be favourable for the construction of dug wells and bore wells in other steep areas. It should be borne in mind that the zones are not uniform in characteristics as the aquifer material, fracture density and distribution and hydro geological characteristics vary widely over short distances. Consequently, their water yielding capabilities vary considerably.

Ground water development in the district is mainly through dug /open well tapping the water in the weathered zone and bore wells are constructed to tap ground water from the fractures/joints in the hard rocks. In the shallow aquifer, the depth to water level ranges from less than 2 m bgl to 6 m bgl.

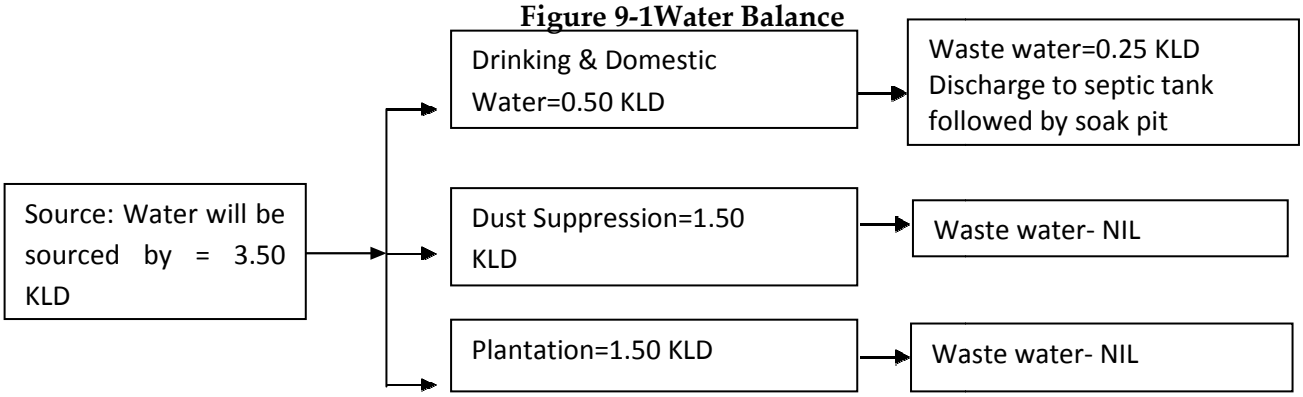
Springs play a major role to cater water requirement of the people throughout the year. Most of the springs are gravity springs. It is observed that discharge of most of the springs lie within the range of 5000-25000 lpd in pre- & post monsoon period.

The water table in East Khasi hills widely ranges; since the mine is on an altitude and mining will be done from 154 m RL to 124 m RL i.e. 30 m. The area is highly sloping and working will be kept restricted above Ground Water table. Hence, water table will not been intersected in the mine. However, in case water table is likely to be intersected during future mining approval from CGWA shall be obtained.

9.5 MEASURES FOR CONTROLLING WATER POLLUTION AND CONSERVATION OFWATER

- Water pollution from the mine can be mainly due to runoff during rainy season. Therefore to restrict the runoff into any surface water body precautionary measures will be taken up and no water from the quarry will be discharged to any natural water course directly.
- The accumulated rain water will partly be used for dust suppression and afforestation and limestone being pervious in nature much of the water will percolate below the quarry surface.
- Potable drinking water shall be sourced from the nearby villages. It is estimated that daily drinking /domestic water requirement will be about 0.50 KLD. Besides for sprinkling & green belt development water requirement will be 1.50 KLD and 1.50 KLD respectively.

Figure 9-1Water Balance



- To prevent silt being carried during monsoon period, series of plants would be planted.
- **Conservation of Ground Water:** Mining will be restricted up to a depth of 30 m. Water stored in the mined out area will act as water recharging source in the area. Therefore, mining activity in the lease hold area will have positive impact on ground water.
- To avoid contamination of ground water from the open defecation by workers, toilets will be provided for the workers at site with septic tank followed by soak pit.

9.6 MEASURES FOR CONTROLLING AIRPOLLUTION

Major pollution in air quality is expected due to drilling, blasting, transportation, loading, unloading of mineral. Dust is likely to be generated during transportation for which water sprinkling shall be done. The mining area, due to its very nature and scale of operation is likely to marginally contribute towards air pollution in the area. The effect is analyzed and this effect is mostly due to fugitive emission. For the mine, the only pollution occurs from dust during vehicular traffic and loading of mineral. There is no other source for SO_2 and NOx except a little contributed by the vehicular traffic, which is well below the prescribed limits. Still, the following different control measures are proposed.

- Construction of well-compacted roads.
- Regular water spraying on roads by tankers.
- Drilling machines will be equipped with dust collector arrangement and wherever required wet drilling arrangement will be used to prevent generation and spreading of dust.
- Optimum blast design parameters will be adopted after study. Optimum stemming in blast holes will be done to minimize generation of dust and fly rocks.
- Blasting will be done during favorable atmospheric conditions and will be avoided during high windy periods, night times and temperature inversion periods.
- To avoid secondary blasting rock breaker will be used.
- Optimum bucket size loading equipment will be used which will reduce the number of bucket passes to fill the dumper and thus comparatively less dust will be generated during loading. This will also reduce the chances of spillage from the bucket.
- Plantation of local thriving species will be done in the 7.5 m statutory boundary for arresting dust.

9.7 NOISE ABATEMENT

Noise will be generated due to drilling and blasting operation which will be done intermittingly, transportation and machineries. The results of ambient noise are within the permissible limits of industrial area. However, following measures will be adopted to abate noise effects.

- Proper and regular maintenance of excavators, tippers and other vehicles will be done. Green Belt will be developed (thick foliage) along the lease boundary.
- Drilling equipments will be regularly maintained as per maintenance manual. Anti-vibration mounts for compressors will be provided.
- Optimum parameters for drilling and blasting will be designed to have controlled blasting which will reduce noise and vibrations.
- Blasting will be carried out when the wind conditions are favorable (i.e. when wind is blowing in opposite directions of inhabitated areas or in low velocity).
- Mufflers will be provided to the exhaust of wagon drills to minimize the noise level.
- Blasting operations will be carried out during the noon time when the temperature inversions are not likely to occur.
- Proper stemming will be done to reduce air blast.
- To check vibration, values of peak particle velocity will be maintained within the prescribed limit by DGMS.
- The excavators which will be used for loading will have noise proof cabin to avoid adverse effect to the operator. The helpers working near the excavators will be provided ear plugs and muffs. The maintenance of the excavators will be carried out as per manual.
- Proper free face will be maintained for optimal blasting which will also reduce noise and vibration.
- Periodical monitoring of noise and vibrations will be done.
- The dumpers, trucks and other transportation vehicles will be maintained in good running condition so that noise will be reduced to minimum possible level.
- Each blast will be carefully planned, checked and executed under the supervision of statutory personnel.

9.8 SOIL CONSERVATION

At present land is covered with patches of grass, soft broom and one or two standing 'tarew' trees which usually grow in limestone bearing lands. Usually in such lands, especially having heavy seasonal rainfall, there is very little soil cover. The soil is formed only in cavities and between limestone blocks. No trees would grow and flourish in such areas except the 'tarew' tree which has no value and cannot be used as firewood nor as timber because the wood of the 'tarew' is fibrous and soft. However, in the mined out spaces which have been backfilled with soil, hardwood trees and fruit trees can be planted.

The soil that is available during mine development and is stored in stack yards shall be used for backfilling the mined out spaces. On these backfilled areas, planting of saplings of local variety or suitable varieties shall be done to raise a plantation.

9.9 SOLID WASTEMANAGEMENT

The entire product of Limestone will be used in kilns for manufacturing of lime used as building materials. During Plan period some quantity of gritty soil will be removed and will be dumped at southern portion of the applied area with suitable precautions. Some quantity of the generated gritty soil would also be used for road maintenance and plantation program.

- Domestic Solid waste will be generated due to 42 workers who will be working at the site. This waste will be properly collected in coloured bins. The green bin waste or biodegradable waste will be composted by pit management and manure will be used in plantation. The blue bin waste will be sold to authorized recycler.
- Hazardous waste generation will be due to used oil which will be stored in HDPE drums and shall be sent to authorized re-processor.
- Other waste such as plastic waste E-waste will be separately stored and sent to authorized vendor.
- There will not be generation of any other type of waste from the mine site.

9.10 SOCIO ECONOMIC MEASURES

Social benefits will be anticipated from the proposed mining project in the surrounding villages includes; Employment generation and improve standard of living through welfare activities; Development of health, education, economy, and agriculture in 10 km study area w.r.t. project site for local community and welfare of tribal through implementation of social developments. Improvement in infrastructure like road etc. and activities through CSR will have positive impact.

Social benefits will also be anticipated by enhancing skill development, employee ability and rise in income level. The overall impact of the project on the socio-economics of the region has been discussed in Chapter – 4. Apart from overall beneficial impact of the project on the local people of the region, it is felt necessary to augment facilities in the fields of education, health and social awareness including concern for ecology. These are presented in an analyzing form in the following statement:-

Sl. No.	Environmental Attributes	Nature of Impact
a	Employment	Beneficial
b	Service, trade/commerce	- do -
c	Public utility/education, social awareness	Augmentation
d	Health care facilities	- do -

It is necessary to create awareness among the people. The beneficial aspects of the following measures that would be taken up by the mine as a periphery development project

- Family planning
- Abandonment of shift cultivation
- Planting of trees and social forestry
- Reduction in the consumption of fuel wood and encourage use of alternative fuels
- Use of clean and boiled water
- Reducing the consumption of alcohol
- Saving from earnings
- Personal hygiene
- Regular health check

In implementation of these measures, the mine management can contribute a lot on the overall socio- economic scenario of the region.

9.11 OCCUPATIONAL HEALTH & BUDGETALLOCATION

The proposed mining will be operated by fully mechanized methods with drilling and blasting by deploying man and machines. Hence, it is envisaged to take up the following precautionary measures.

Safety Audits and Accident Prevention

Regular safety audits shall be carried out at site to decrease possibilities of hazards causing accidents or injury. All mining activities shall be carried out under proper supervision of mining engineers and safety officers. All personnel involved in mining shall undergo training for mine safety.

Occupational Disease

The reported figures and surveys conducted by Directorate General of Mines Safety (DGMS) and other organizations like National Institute of Occupational Health (NIOH) etc. revealed that there have been some new trends in the occupational health scenario other than the conventional diseases like Respiratory disorders.

Following areas of occupational diseases are emerging with the changes in the mining industry:

- Noise induced hearing losses
- Health impact due to diesel particulates from emission of diesel operated vehicles and equipment
- Hand-arm vibration, whole body vibration due to use of drills, HEMM etc
- Presence of snakes and other reptiles in the mining area
- Polluted drinking water
- Excess working load and overtime
- Presence of mosquitoes in the lease area
- Sudden accident in the mining area causing personal injury

9.11.1 Health measures to be considered

- Sanitary facilities shall be well equipped with suppliers and employees shall be encouraged to wash frequently, particularly those exposed to dust.
- In the event of temporary closer, approaches will be fenced off and cautionary notice displayed in English and regional language.

- Rotation of workers exposed to dusty and noisy areas.
- First aid facilities in the mining areas.
- Provision of personal protection devices to the workers. The personal protection equipment being provided are–

S.No.	Item	Equipment
1.	Face protection	Face Shield
2	Eye protection	Different types of goggles used for different purposes.
3.	Ear protection	Ear plugs, ear muffs
4.	Leg Protection	Safely shoes, gum shoes
5.	Working at height	Safety belts
6.	Head Protection	Safety helmets
7.	Protection from Dust	Dust Mask

- Periodic medical examinations shall be conducted for all personnel, and specific surveillance programs instituted for personnel potentially exposed to health hazard. The medical examination required to carry out at the time of appointment of every employee. Provided that in case any dust related disease, test shall be conducted more frequently as the examination authority deems necessary.
- Medical camp will be organized for the worker every year.
- At the end of mining operation, test will be conducted to assess health of workers.
- Workers will be informed and trained about occupational health hazards, if identified.
- Any worker's health related problems will be properly addressed.
- The personnel working in dust prone areas will be examined every year as per the DGMS circular No.01 of 21.01.2010.
- Quick-Fix designed by OSHA's ergonomics standards will be followed to reduce work-related musculoskeletal disorders (MSDs).
- Rotation of workers exposed to high noise areas will be carried out.
- Lyophilized Polyvalent Anti snake venom serum will be available at the mine site for snakebites.

9.11.2 Activities posing risks during mining

The activities have been detailed in Chapters 7, heading 7.8.4

1. Plan for Accidents

Mining site shall arrange for /provide at least the following to mitigate any accident that occurs due to operation:

- First Aid facilities at site
- Ambulance
- Tie up with primary health center for immediate treatment
- Strict implementation and training of a detailed on-site emergency plan. The Plan shall be prepared by a competent agency.

2. Monitoring Mechanism

Following Activities shall be done by the proponent as a proactive measure for mitigation of Occupational Risks:

- Six monthly monitoring of Exposure levels (Total Suspended Particulate, Fraction of Fine Dust {$PM_{2.5}$}, of high risk workers of all activities. In case necessary a onetime chemical speciation of the dust shall be done to measure levels of Sulphates, Lead, Nickel, Arsenic, Silicates in the dust collected etc.
- Six Monthly Health check-ups for all workers which includes Chest X-Ray, Lung Function Test, ENT Check-ups, Vision Check-ups, Audiometric Tests, Liver and Kidney Function Tests, ECG, Blood Sugar etc.
- Six Monthly Check-up of Drinking water for the site workers to ensure compliance to IS 10500:2012 standards.
- Under Occupational Health and safety, the mine workers will be subjected to primary health check-up before they are employed to ascertain their health conditions. There will be provision of First Aid Facility and Medical Insurance for workers
- The mine is in the Sohmluh and the nearby habitant might get affected due to the working of mine hence a sum of Rs. 0.25 Lakhs has been dedicated towards organizing Health Check-up camps for local people and Supporting Public health care center in the nearby village.

9.12 TRANSPORTATION:

Proposed production from the mine will be 162478 TPA. As the daily production from the mine will be 542 T. OB will be stacked separately at stack yard and mineral will be transported to market. There will be deployment of 2 no. of tippers of capacity 10 tonnes. The lease area has no habitation in close proximity so traffic on the roads is minimal. Steps will be taken to coordinate and organize traffic in the mining area and the mining trucks route, road repairing in coordination with govt. officials. Awareness campaign among dumper/truck drivers will be generated for clearance of road and lower down the pollution load due to transportation.

Traffic Management: Details of traffic due to mining project:
Total Capacity of Mine: Approx.542 TPD

Number of Working Days : 300 Days Tipper Capacity: 10 Tonnes
Number of Tipper Deployed: 2 Tippers
Working Hours per day: 8 Hours (8 hours of 1shift)
The results of the traffic Study are given below:
The study is given below:

Traffic vehicle	**No. of vehicles per day**	
	TD I	TD 2
H.M.V.	60	150
L.M.V.	25	74
Two/three wheelers	50	85
Grand Total	**135**	**309**

Hence it is concluded that since carrying capacity of Road between ML and approach Road & Sohra-Shella Road (SH-5) and is much higher than proposed traffic volume.

Therefore, the traffic to & fro of proposed "**Sohmluh Limestone Quarry**" will not create any traffic congestion.

9.13 IMPLEMENTATION AND MONITORING

As the major attributes of environment are not confined to the project area alone, implementations of the proposed control measures and monitoring thereof have to be undertaken on a regional basis. The mine management will implement the control measures and monitor the efficacy within the lease area relating to the following specific areas as per the action plan.

- Collection of air and water samples at strategic locations with appropriate frequency and testing thereof. If the parameters exceed the permissible tolerance limits, corrective measures should be taken to arrest the pollution.
- Collection of soil samples at strategic location at least once in every year and testing thereof with regards to deleterious constituents, if any.
- Desiltation of drainage system and check dams.
- Measurement of water level fluctuation in the nearby dug wells and bore wells periodically.
- Plantation/ afforestation as per programme, regular watering of plants and fencing to protect them from animals.
- Measurement of noise levels at the mine site, stationery and mobile sources, mine office, canteen would be taken during day time only as mining operation will be carried out in one long day shift.

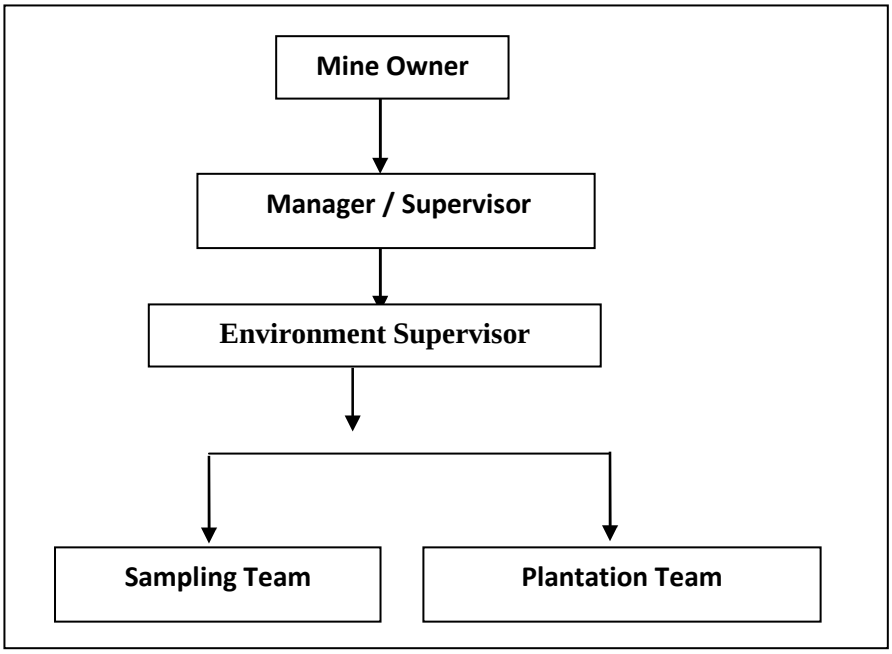
9.14 PLANS TO MAINTAIN BETTER ENVIRONMENT IN THE AREA

The environmental Policy has been prepared for better management of the environment. For maintaining better environment in the area the components relevant to the project that need to be taken into account include:

- Afforestation/plantation details of plantation/afforestation programme
- Reclamation of degraded land and quarries. Maintenance of haul roads etc.
- Monitoring of environmental parameters.

Organizational Chart (Environmental Management)

Organizational chart for environmental monitoring in the mining lease area, fiscal estimates for year-wise expenditure (both capital and recurring) and action plan to maintain better environment and to augment the environmental development, the following measures are suggested.



Organizational Structure of Environment Monitoring Cell (EMC)

9.15 EMP BUDGETARY COSTESTIMATES

The cost estimates presented in this section are for the recommendations made these cost estimates give only the indication of the likely cost. The estimated environmental cost of the project is as follows. The total cost of the project will be Rs. 30.45 Lakh. A fully fledged environmental cell will comply with the all the environmental monitoring jobs.

Table 9.2, Cost of Environmental Protection Measures as Annual Recurring Cost

Sl. No.	HEAD	ANNUAL EXPENDITURE
1	Environmental Monitoring of Atmospheric Air, Water ,Noise & Soil	1,20,000.00
2	Greenbelt Development and maintenance	29,000.00
3	Reclamation of degraded land	1,50,000.00
4	Staff salary	2,50,000.00
5	Construction of garland drain and siltation tank	40,000.00
	Total	**5,89,000.00**

9.16 CSR ACTIVITIES AND BUDGETARY ALLOCATION

Corporate Social Responsibility: For social sustainability of any project, attentions need to be paid to the development of the society that existed before or builds up around the project area. The Corporate Social Responsibility is the internalization of the social and environmental effect of its operations through proactive pollution prevention and social impact assessment so that it is anticipated and avoided and benefits are optimized.

The concept is about companies seizing opportunities and targeting capabilities that they have built up for competitive advantages to contribute to sustainable development goals in ways that go beyond traditional responsibilities to shareholders, employees and the law. It is the active partnership of the company which defines the voluntary works with local communities as well as with regional and national Government and reciprocity based on trust and openness to reach agreed objectives and shared involvement.

Budgetary Provisions for CSR: 5 % of project cost i.e. Rs 30.45 lakhs is 1,52,250. Total Rs 1.60 lakhs shall be spent under CSR. However, higher amount is earmarked for CSR which is given below:

Table 9.3; Proposed CSR Budget

ACTIVITIES	COST (In Rs)
School infrastructure including furniture, books, Computer, sports kit to Ichamati RMSA Secondary School.	60,000.00
School dress to 30 students of Ichamati RMSA Secondary School	30,000.00
Maintenance & Construction of village roads of Ichamati	30,000.00
Medical camp & free medicines to poor	10,000.00
Water supply arrangement & sanitation for local villagers	30,000.00
Total	**1,60,000.00**
Total for five years i.e. 5%of project cost	**1,52,250.00**

CHAPTER-10 SUMMARY AND CONCLUSION

Introduction: The proposed project is for mining of limestone mineral from lease area of 4.5 ha. The maximum production from the mine will be 162478 MT/annum. Mining of mineral will be done by opencast semi mechanized method. The applicant of the project is Shri Shembhalang K Rymmai. Shri. Shembhalang K. Rymmai, owner of Sohmluh Limestone Mine is the authorized signatory. The Government of Meghalaya has issued Letter of Intent for mining lease of limestone (minor mineral) mining in favour of Shri. Shembhalang K Rymmai on dated Shillong 23.03.2019 vide letter no. KH/8/ML/Limestone/68/7734. He has applied for an Environment Clearance after obtaining the necessary approval of the Mining Plan and Progressive Mine Closure Plan from the Directorate of Mineral Resources, Meghalaya vide letter no. DMR/MM/34/2019/128, dated Shillong, the: 02nd May 2019. The project area is of private land category. No forest area is involved. The mine will be in operation as per the Mining Plan approved by Directorate of Mineral Resources, Meghalaya vide letter no. DMR/MM/34/2019/128, dated Shillong, the: 02nd May 2019.

The project has been granted ToR by SEIAA vide Letter NO. ML/SEIAA/MIN/EKH/P-41/2020/1482 dated27TH August, 2020.

The latitude of the project area N 25°10'42.19" TO N 25°10'50.5"and longitude is E 91°43'00.2" TO 91°43’09.39" E with maximum contour of 156 mRL and minimum contour of 122 mRL. The area falls in the Survey of India Topo-sheet no. 78O/12 (Restricted topo sheet). The lease area forms a part of the individual owned land taken on lease. The proposed land is a Non forest Land according to Divisional Forest Officer, Khasi Hills Ri- Bhoi (T) Division, Shillong (Ref No. KH/8/NOC/Limestone/41/pt.IV/7610, Dated 20.03.2019.

Reserves & Life of Mine: Resource has been divided into two categories such as Proved Reserve Probable Reserve. Up to an average depth of 60 metres (from ground level) has been taken as Proved Reserve category on the basis of Limestone exposed in the quarry face of the nearby mines and also from the exposure on hill top and slope as well as from the nala cutting section around the applied area and further up to a depth of 5 meters has been taken as Probable Reserve category.

Mineable reserve is based on the mineable part of the reserve. Mineable mineral (Limestone) reserve has been calculated from the geological in the area considering the stone which is to be left out and maintained as Safety Barrier of 7.5 meters within ML boundary and in consideration of ultimate pit limit as calculated from the Geological Plan & section.

Category of Resource	Mineable Reserves in Tonnes	Non Mineable in Tonnes	
Proved (111)	3238191	**Feasibility Mineral Resources (211)**	3785360
Probable (122)	10476	**Pre Feasibility Mineral Resources (222)**	613724
TOTAL	**3248667**		**4399084**

The mineable reserve of the mine area is 3248667 tonnes. Taking the average annual production target of 162433 tonnes and taking 300 as the average no. of working days per annum, the life of mine is estimated to be about 20 years (5 years in Plan period + Fifteen years in Conceptual period.

Mining Method:

- Semi Mechanized open cast mining will be undertaken with drilling and blasting.
- The width of each bench shall always be maintained to be not less than the height which is 6 m.
- Since the deposit in this area is massive and compact in nature, it is proposed to carry out only opencast semi-mechanized mining during this plan period, i.e. five years.
- The operations like drilling of shot holes, sorting of stone and breaking of large sized boulders will be excavated using hydraulic rock breakers and excavators with deploying of Jack hammer drilling (39 to 34 mm dia) will be practice in this area, having burden and spacing of 1.6 m x 2.0 m in stagger grid pattern.
- To avoid fly rock problem at the edge of the hill, light charged muffle blasting shall be under taken.

Raw Material Required:

Inputs	Approx Quantity required per day
High Speed Diesel Requirement	
Diesel	100 Liters (at peak production)
Water Requirement	
Water for Drinking	0.50 KLD
Water for Sprinkling	1.50 KLD
Water for green belt development	1.50 KLD

Description of the Environment: The baseline data has been collected from December 2019 to February 2020. The details area given below:

i. **Temperature:** Temperature of the area varied from 11.0^{0}C to 36.3^{0}C.

ii. **Relative Humidity:** Humidity of the area varied from 13.0 % to 95.0%.

iii. **Wind Speed:** Wind speed was in the range of 0.0 Km/hr to 7.0Km/hr.

Ambient Air Quality Results: Samples were collected from 8 sampling locations during Baseline season from December 2019-February 2020. The results are given below:

Core Zone: The value of $PM_{2.5}$ is ranging from 22-31 µg/m^3 and mean value is 30.5 µg/m^3 against standard limit of 60 µg/m^3. Value of PM_{10} is ranging from 52.0 -78.0 µg/m^3 and mean value is 77.1 µg/m^3 against standard limit of 100 µg/m^3. The mean value of SO_2 is 7.5 µg/m^{3}against standard limit of 80 µg/m^3 & mean value of NOx is 7.7 µg/m^3 against standard limit of 80 µg/m^3.

Buffer Zone: : The results of the Buffer Zone shows that PM10 was maximum at Bholaganj Bazar (within prescribed standard limits) and Mawbang Village were minimum. The PM2.5 is ranging from 25.6-28.8µg/m3. PM10 is ranging from 61.87-74.9µg/m3.The SO2 is ranges from 5.2-6.8 against standard limit of 80µg/m3& NOx ranges from 5.2-7.0 µg/m3 against standard limit of 80 µg/m3. These are within standard limits of National ambient air quality standards. The values of both the parameters are well within prescribed limits.

Noise Quality results: Samples were collected from 8 locations.

Core Zone: The ambient noise level during day time at the proposed project site was 53.8 dB (A) which are within the standard limit of Industrial area~75 dB (A). During night the noise level at the project site ranges from 38.7 dB (A) which is within the night-time noise standard limit of 70dB (A).

Buffer Zone: Buffer The ambient noise level during day time are maximum at Bholaganj Bazar 55.8 dB(A) as per the standard limit of Commercial area are ~ 65 dB (A). The night time noise

result at the location is 40.7 dB (A) which is within the standard limits of commercial area ~ 55 dB (A). At rest all locations Noise Level is within the standard limit.

- **Ground Water Quality Results**: The samples were collected from 6 ground water locations and 2 surface water sources:

- **Core Zone: (Lease Area, Hand Pump Water)** shows that parameters like Total Hardness (69.80 mg/l); Total dissolved solids (107.0 mg/l), Magnesium (3.90 mg/l), & Alkalinity (61.10 mg/l) are well within drinking water standards (IS: 10500).
- **Buffer zone: Ground Water results:** All results were found within standard drinking water standards (IS: 10500).
- **Surface Water results:** The Surface water quality of the Upstream and Downstream water of Tharia River is within prescribed CPCB Water Quality Criteria Class of water.

Soil Quality Results: The samples were collected from 5 locations:

Core Zone: The result shows that pH is 7.80. The availability of many plant nutrients in the soil changes as a result of reactions in the soil, which are largely controlled by soil pH. Amount of primary nutrients like Total Organic Carbon 0.70 %, the available nitrogen 0.96% is lower in range, the available Potassium 236.30 mg/kg is moderate in range while available Phosphorous 0.20% is higher in range, Primary nutrient profile shows that soil is low in fertility due to the availability of low amount of nitrogen and potassium.

Buffer Zone: Data collected shows as below:

The result shows that texture of soil has clay loam texture. Colour varies from 4/4 Dull Reddish Brown to 4/6 Brown and 5/6 Yellowish Grey, pH ranges from 7.70 to 7.90. Amount of primary nutrients like Total Organic Carbon 0.71% to 0.79%, the available nitrogen 0.94% to 0.99%, the available phosphorus 0.21%- 0.22% is higher in range while Available Potassium 238.20 mg/kg to 265.20mg/kg is lower in range, Primary nutrient profile shows that soil is low in fertility due to the availability of low amount of nitrogen, available potassium.

Ecology and Biodiversity Results:

Flora: Core Zone: The density of the plant in core zone in general is very low due to rocky terrain and low soil content. In the core zone, place where mining is to be done is vacant land with patches of Tetrameles nudiflora, Toona, Alstonia Scholaris, Garuga gamblei which often reach up to the height of 20 m characterize the unmined core zone.

Buffer Zone: In the Buffer Zone varieties trees, shrubs, herbs, Ornamental plants, weed and grasses such as Bombax ceiba, Castanopsis indica, Citrus sp., etc..

Fauna Core zone: During study, it was found that the faunal diversity in the core site was limited to Butterflies, insects, some species of mammals & reptile. The core site has avifauna species like crow, pigeon, sparrow parrot, etc.

Buffer Zone: Common fauna was reported in buffer zone.

Dust generation during mining and transportation may impact vegetation.

Socio Economic Study Results: Results of Socio economic study: Total 104 villages fall in the buffer zone. The study has been conducted by primary survey and secondary data source from Census of India 2011. The primary socio economic study has been conducted in 4 villages. The results are discussed below:

- ***Core Zone:*** *There is no habitation in the core zone*
- ***Buffer Zone****:* The total number of Households of the study area in rural village area is 9032 as per Census of India, 2011 data. The details are given below.
- **Population:**

  The total population of the study area is 45789 constituting 9032 households, implying that there are average 5.06 members per house. The average sex ratio of the study area is 989 as per census 2011.
- **Social Structure**

  The proportion of Scheduled Caste (SC) population within the study area is 2.39 % and the percentage of schedule Tribe (ST) is 83.77%.
- **Literacy**

  The total proportion of literate within the study area is 63.70% of total population. In percentage the male literacy 32.22% and the female literacy is 31.48% respectively within study area.
- **Traffic**

  Proposed production from the mine will be 162478 TPA. As the daily production from the mine will be 542 T. OB will be stacked separately at stack yard and mineral will be transported to market. There will be deployment of 2 no. of tippers of capacity 10 tonnes. The lease area has no habitation in close proximity so traffic on the roads is minimal. Steps will be taken to coordinate and organize traffic in the mining area and the mining trucks route, road repairing in coordination with govt. officials.

  Therefore, the traffic to & fro of proposed "**Sohmluh Limestone Quarry**" will not create any traffic congestion.

Anticipated Impact and Mitigation Measures:

- **Land Environment:** Mining may cause land degradation. Hence, Green belt development shall be done from the top soil excavated during mining in the 7.5m statutory boundary and at ultimate stage whole area will be planted.

- **Water Environment:** Total water requirement in the proposed mining project is 3.50 KLD. Water for drinking purpose will be met from nearby villages. For sprinkling & plantation water will be taken Tharia River.

- **Air Environment:** The air borne particulate matter is the main air pollutant contributed by opencast mining with drilling and blasting. Various emission sources are identified from the proposed mining operations. Therefore, sprinkling shall be done and workers will be given protective gears such as goggles, dust masks, gloves, and helmets.

- **Noise Environment:** The proposed mining operations will be carried by using latest equipments by open cast semi mechanized mining method. Hydraulic excavator will be used in excavation. Hence workers will be given protective gears such as goggles, dust masks, gloves, helmets and earmuffs. Plantation will be done to create cover from high noise.

- **Biological Environment:** Lease area is in Non Forest Land. There will be no impact on flora and fauna due to the proposed project.

- **Socio- Economic environment:** The project will enhance direct and indirect employment in the area. Therefore overall economic development is much likely after the commencement of the project.

- **Mine Waste:** The entire product of Limestone will be used in kilns for manufacturing of lime used as building materials. During Plan period some quantity of gritty soil will be removed and will be dumped at southern portion of the applied area with suitable precautions. Some quantity of the generated gritty soil would also be used for road maintenance and plantation program.

- **Impacts due to transportation:** The entire mineral will be transported to the market through trucks. Transportation shall be done by 2 no. of 10 tonner trucks. As per study done there will not be any congestion due to proposed project on the road.

Environmental Monitoring Programme: Environmental monitoring at various locations, within the mining lease area and in the study area of 10 km radius will be carried out on periodic basis. A comprehensive network for monitoring has been prepared. Sampling locations have been identified by considering the source of pollution due to mining

operations, drainage pattern, topography of the area and biological environment.

Risk Assessment & Disaster Management Plan: Mining will be carried out by semi mechanized opencast mining, with mining equipments as hydraulic excavator, dumpers etc involving drilling and blasting. Mining will be done under strict supervision hence the rate of operational risks is minimal.

Rehabilitation and Resettlement- There will be no rehabilitation and resettlement on account of mining. There is no human habitation at the project site and the land is deemed forest land.

Project benefits: The proposed mining project has a significant positive impact on the socio-economic environment and it will help sustain the overall development of the area.

The proposed project significantly contributes the economic development by providing direct employment to 42 people and indirect employment to many more people in the area.

Environmental Management Plan: Preparation of Environmental Management Plan (EMP) is required for formulation, implementation and monitoring of environmental protection measures during and after commissioning of the proposed mining project. The project cost is Rs.30.45 Lakh and the EMP capital cost Rs. 5.89 Lakh (Annual recurring cost).

Budget towards Corporate Social Responsibilities (CSR) will be Rs.1.6 Lakh as capital budget.

Green belt development has been initiated by the proponent 0.18 ha will be planted during plan period. However as per conceptual plan entire lease area will be planted. Locally thriving species will be planted in consultation with forest department.

Among other environmental protection following measures are listed below:

- Sprinkling of water for dust suppression on mine haul roads.
- Regular Compaction & grading of haul roads and service roads to clear accumulation of loose material.
- Avoid overloading of dumpers and consequent spillage on the roads.
- Good maintenance of vehicles & machinery.
- Water sprinklers of fixed type will be provided at the mine approach roads from mine face / benches to crush hopper to prevent the generation of dust.

CHAPTER-11 DISCLOSURE OF CONSULTANTS

About Environmental Consultant

INTRODUCTION

Indian Mine Planners & Consultants, established by experienced environmental and related experts, provides specialized services in the field of Environment and Pollution Control for all types of **Mining of Minerals including opencast / underground mining**. Our transparent and professional approach, commitment to excellent quality and service, timely deliveries have contributed to create a name in the field of environment. A group of advisors from various disciplines with over 40 years of experience from organizations like Geological Survey of India, Various subsidiaries of Coal India Limited (CIL) including Central Mine Planning and Design Institute Limited (CMPDIL) & Indian School of Mines etc.

Indian Mine Planners & Consultants management, experience, excellence, professionalism and ultimate satisfaction has helped in achieving the heights of success in their specialized field of environment.

IMPCON also delivers advisory services in all aspects of geological exploration, geo-technical services, hydro-geology, mine planning and detailed design, electrical installations and maintenance, possible improvement area of mechanical performance of the high capacity mining machineries, civil and infrastructural job planning, choice of equipment for mining, manpower planning and finally total economics for project viability.

CORE TEAM

Sl. No.	Name of Key Personnel	Qualification	Designation	Experience	Experience in No. of years
1	Dr. N. B Chanda	B.Sc Hons. (Applied Geology), M.Sc. Geology, Ph.D. , IIT (ISM, Dhanbad)	Managing Partner	Retired DGM, CMPDI/ CIL, Advisor (Geology, Mine Planning & Environment), Member Australian Institutes of Geo-scientist (AIG), Life Member MGMI, Competent person of Joint Ore Reserves Committee (JORC), RQP (IBM),	40 years
2	Pramode Prasad Gupta	B.Sc (Hons), IIT(ISM, Dhanbad)	Executive Officer	Former General Manager, BCCL, HoD ((Mining) CMPDIL, RI-V, Bilaspur,	35 Years
3	Dr Prabir Sanyal	M.Sc (Applied Geology), Ph.D (Geology), IIT, Kharagpur	General Manager (Geo-Systems)	Retired HoD (Geology & Geo Systems) CMPDIL, RI-I, Asansol, WB,	40 years
4	Premashish Patra	M.Sc. (Geology), IIT, Benaras Hindu University UP State	Sr Exploration Geologist	Former Sr Executive (Geology) EGCIPL, Geologist , BGR (Mining and Infra (P)Ltd. Geologist, Coal Resources, Pt Solid Black Gold /PT Victor , 23 Mega, Indonesia, Geologist, RMML, Mine Geologist, VSL Mining, Junior Manager, Reshmi Metallics Ltd, Sr Exploration	8 years
5	Subhas Chandra Biswas	BE (Mechanical Engg) Bengal Engineering & Science University, Shibpur	Technical Manager (Mech. Engg)	Former Technical lead (Design & site services) Raychem RPG (P) Ltd. Former Sr Engineer Fives Stein India Project Pvt. Ltd Former Sr Executive, Siements India Ltd.	16 Years
6	Bipasha Banerjee	M.Sc. (Applied Geology), Bengal Engg. & Science University	Sr .Geologist	Geological Documentation, Mine Planning,	6 years
7	Shubhadip Chatterjee	M.Sc. (Geology), Burdwan University	Geologist	Exploration Geologist,	5 years

8	Pradip Kumar Yadav	M.Sc. (Applied Geology), Pondicherry University, Pondicherry.	Geologist	Exploration Geologist,	2 years
9	Hrishikesh Sinha	Diploma in Land Survey , A R Technical Institute, Jamshedpur, Jharkhand State Surveyor Certificate of Competency Examination (Restricted)	Mine Surveyor	Former Surveyor (T) CCL, Mine Surveyor , BLAPL, Bokaro, Autocad Teacher KCC, Bokaro, Dy Manager (Survey & Planning), IMCPL, Kolkata, Dy Manager (Plg) GCL, Kolkata, Manager (Survey) Suraj Construction, Ranchi,	13 years

ACCREDITATIONS OBTAINED:

ISO-9001:2015 Certification

QCI – NABET Scheme for Accreditation of EIA Consultant Organizations

Declaration by Experts contributing to the EIA for proposed Pirtimai Limestone Mine (MLA: 4.5 ha.) located at Village Sohmluh, Elaka Wahlong, East Khasi Hills District.

I, hereby, certify that I was a part of the EIA team under the capacity of EIA coordinator from that prepared the above EIA.

Signature

Dr. Nirode Behari Chanda (EIA Coordinator)

Indian Mine Planners & Consultants
GE-61, Rajdanga Main Road, EM- Bypass, Kolkata- 700107

Team for EIA

	Name	Involvement (Period of task)
EIA Coordinator	Dr. Nirode Behari Chanda	I had visited the site and was involved in preparation of EIA. **Period of Involvement: December 2019– September 2020**
EIA Coordinator	Pramode Prasad Gupta	I had visited the site and was involved in preparation of EIA. **Period of Involvement: December 2019– September 2020**
EIA Coordinator	Dr Prabir Sanyal	I had visited the site and was involved in preparation of EIA. **Period of Involvement: December 2019– September 2020**

CERTIFICATE OF ACCREDITATION

Quality Council of India

National Accreditation Board for Education & Training

CERTIFICATE OF ACCREDITATION

Indian Mine Planners and Consultants

GE-61, Rajdanga Main Road, Behind Gateway Hotel, EM-Bypass, Kolkata 700107

Accredited as Category - A organization under the QCI-NABET Scheme for Accreditation of EIA Consultant Organizations: Version 3 for preparing EIA/EMP reports in the following sectors:

Sl. No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1.	Mining of minerals including opencast/ Underground mining	1	1 (a) (i)	A

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in IAAC minutes dated July 06, 2018 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/18/0727 dated August 13, 2018. The accreditation needs to be renewed before the expiry date Centre for Sustainable Development following due process of assessment.

Sr. Director, NABET
Dated: August 13, 2018

Certificate No.
NABET/EIA/1821/IA0037

Valid till
June 13, 2021

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website.

National Accreditation Board for Education and Training
(Member - International Accreditation Forum & Pacific Accreditation Cooperation)

Ref. No. -QCI/NABET/ENV/ACO/18/0727 August 13, 2018

To,

Indian Mine Planners and Consultants
GE-61, Rajdanga Main Road, Behind Gateway Hotel
EM-BYPASS, Kolkata 700107

Sub: Accreditation of EIA Consultant Organizations under NABET Scheme

Ref.: Your application dated Nov 17, 2017, subsequent correspondence on subject and office assessment at your premises on Feb 27-28 and supplementary assessment date June 14, 2018.

Dear Sir

QCI-NABET is hereby pleased to accredit Indian Mine Planners and Consultants as Category-A organization. Details of sectors mentioned in the Certificate of Accreditation.

The validity of accreditation is subject to continued compliance to the Scheme and the terms & conditions mentioned in **Annexure I to IV.**

NABET look forward for your association and continued support.

With best regards,

13/08/2018

A K Jha
Senior Director
QCI- NABET

Institute of Town Planners India, 6th Floor, 4-A, Ring Road, I.P Estate, New Delhi-110 002, India
Telefax : +91-11-233 23 416, 417, 418, 419, 420 E-mail : ceo.nabet@qcin.org Fax : +91-11-233 23 415 Website : www.qcin.org

STATE ENVIRONMENT IMPACT ASSESSMENT AUTHORITY
:: SEIAA : MEGHALAYA ::

'Silviculture Building' (Adjacent Sylvan House),
Lower Lachumiere, Shillong - 793 001
Email :ms.seiaamegh@gmail.com.

No. ML/SEIAA/MIN/EKH/P-41/2020/ 1482 **Dated, Shillong, the** 27th **Aug., 2020.**

From The Member Secretary,
State Environment Impact Assessment Authority
Meghalaya.

To Shri Shembhalang K. Rymmai,
Mawthang Sohkhyllung village,Wahlong, East Khasi Hills.

Subject : Grant of Term of Reference (TOR) to Online application Proposal No. SIA/ML/MIN/53444/2020 for mining of limestone for an area of 4.50hectare located at Sohmluh, Elaka Wahlong East Khasi Hills District, Meghalaya.

Sir,

This has a reference to your TOR online application proposal No. SIA/ML/MIN/53444/2020 for mining of limestone for an area of 4.50hectare located at Sohmluh, Elaka Wahlong East Khasi Hills District, Meghalaya. Liimestone will be used as building and construction materials for various construction purposes as well as for supply to limestone kilns.

The project falls under Schedule 1(a) of category B2 of EIA Notification 2006, but as per the Cluster certificate vide letter No.DMR/MM/34/2019/1779 date Shillong, the 24th January, 2020 issued by Divisional Mining Officer, Mineral Resources, Government of Meghalaya, there are four limestone other mines of different owners lying within 500 metres radius from the applied lease and the cluster area of all the five mines is 14.6242 hectares i.e more than 5ha., hence PP applied for Term of Reference (TOR) as required in the Ministry of Environment, Forest and Climate Change MoEF&CC vide O.M.No.L-11011/175/2018-IA-II (M) dated 12.12.2018,

relating to compliance to Hon'ble National Green Tribunal Order dated 13th September 2018 in O.A. No. 186 of 2016 (Satendra Pandey Vs Ministry of Environment, Forest & Climate Change & Anr.).

The applied area is a Non Forest Land, vide Divisional Forest Officer, East Khasi Hills & Ri Bhoi Territorial Division, Shillong letter No.KH/8/ NOC/ Limestone/41/Pt. IV /7610, dated Shillong, the 20th May 2019.

The proposed land measuring for 4.50 hectare is on lease for 30 years which was executed on 24th January 2019 and certified by Notary.

The mining lease area as per the documents viz, the approved Mining Plan, the Non Forest Land Certificate ,etc. including the Kml file duly examined by SEAC, falls under toposheet Survey of India No.78O/12within the following GPS Coordinates:

GPS Coordinates

Pillar No.	Latitude	Longitude
1	25° 10' 50.5"N	91 ° 43' 07.7"E
2	25° 10' 48.7"N	91 ° 43' 03.4"E
3	25° 10' 48.5"N	91 ° 43' 00.2"E
4	25° 10' 46.0"N	91 ° 43' 00.2"E
5	25° 10' 42.19"N	91 ° 43' 02.86"E
6	25° 10' 44.37"N	91 ° 43' 09.39"E

The project proponent submitted the Mining Plan with Progressive Mine Closure Plan approved by the Director of Mineral Resources, Government of Meghalaya, Shillong vide letter No.DMR/MM/34/2019 /128, dated Shillong, the 2nd May 2019. The Mining Plan has been prepared to extract Lime stone at an average annual production of 1,62,433 TPA with a project cost of Rs.30.15 lakhs and the operations will be open cast, semi-mechanized method of mining.

As per the Mining Plan, the mineable reserves of the lime stone is 32,48,667 tonnes and the production during the plan period of 5 years will be around 8,07,946 tonnes. Hence, the balance of reserves after plan period is 24,40,721tonnes of which with the rate of production of 1,64,715TPA, the reserves is suff1cient for another 15 years.

As per Ministry of Environment, Forest and Climate Change Notification No. S.O. 3977(E) dated New Delhi, the 14th August 2018 in Appendix -XI, the project proponent needs to prepare Environment Management Plan.

The SEAC, Meghalaya in its meeting held on 21st& 22nd July,2020 in which the Minutes was uploaded on 03/08/2020, as per Agenda 8, after due screening and examination of all the documents submitted by the Project Proponent and site cross checking and deliberation by using kml file through Google earth, SEAC unanimously recommended for a Standard Term of Reference as TOR to this project.

The State Environment Impact Assessment Authority, Meghalaya, in its meeting held on 10th August, 2020 noted the recommendation in the above said SEAC's Minutes relating to this project and accepted the recommendation of the SEAC. Then the SEIAA in the said Meeting, unanimously approved Standard Terms of Reference (sTOR) as recommended by the SEAC as a TOR to the project, as follows :-

1. Year-wise production details since 1994 should be given, clearly stating the highest production achieved in any one year prior to 1994. It may also be categorically informed whether there had been any increase in production after the EIA Notification 1994 came into force, w. r. t. the highest production achieved prior to 1994.
2. A copy of the document in support of the fact that the Proponent is the rightful lessee of the mine should be given.
3. All documents including approved mine plan, EIA and Public Hearing should be compatible with one another in terms of the mine lease area, production levels, waste generation and its management, mining technology etc. and should be in the name of the lessee.
4. All corner coordinates of the mine lease area, superimposed on a High Resolution Imagery/ Topo-sheet, Topographic sheet, Geomorphology and Geology of the area should be provided. Such an Imagery of the proposed area should clearly show the land use and other ecological features of the study area (core and buffer zone).
5. Information should be provided in Survey of India Topo-sheet in 1:50,000 scale indicating geological map of the area,

geomorphology of land forms of the area, existing minerals and mining history of the area, important water bodies, streams and rivers and soil characteristics.

6. Details about the land proposed for mining activities should be given with information as to whether mining conforms to the land use policy of the State; land diversion for mining should have approval from State land use board or the concerned authority.

7. It should be clearly stated whether the proponent Company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be spelt out in the EIA Report with description of the prescribed operating process/procedures to bring into focus any infringement/deviation/ violation of the environmental or forest norms/ conditions? The hierarchical system or administrative order of the Company to deal with the environmental issues and for ensuring compliance with the EC conditions may also be given. The system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the Company and/or shareholders or stakeholders at large,may also be detailed in the EIA Report.

8. Issues relating to Mine Safety, including subsidence study in case of underground mining and slope study in case of open cast mining, blasting study etc. should be detailed. The proposed safeguard measures in each case should also be provided.

9. The study area will comprise of 10 km zone around the mine lease from lease periphery and the data contained in the EIA such as waste generation etc. should be for the life of the mine / lease period.

10. Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary, national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated. Land use plan of the mine lease area should be prepared to encompass preoperational, operational and post operational phases and submitted. Impact, if any, of change of land use should be given.

11. Details of the land for any Over Burden Dumps outside the mine lease, such as extent of land area, distance from mine lease, its land use, R&R issues, if any, should be given.

12. A Certificate from the Competent Authority in the State Forest Department should be provided, confirming the involvement of forest land, if any, in the project area. In the event of any contrary claim by the Project Proponent regarding the status of forests, the site may be inspected by the State Forest Department along with the Regional Office of the Ministry to ascertain the status of forests, based on which, the Certificate in this regard as mentioned above be issued. In all such cases, it would be desirable for representative of the State Forest Department to assist the Expert Appraisal Committees.

13. Status of forestry clearance for the broken up area and virgin forestland involved in the Project including deposition of Net Present Value (NPV) and Compensatory Afforestation (CA) should be indicated. A copy of the forestry clearance should also be furnished.

14. Implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 should be indicated.

15. A study shall be got done to ascertain the impact of the Mining Project on wildlife of the study area and details furnished. Impact of the project on the wildlife in the surrounding and any other protected area and accordingly, detailed mitigative measures required, should be worked out with cost implications and submitted.

16. Location of National Parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, Ramsar site Tiger/ Elephant Reserves/(existing as well as proposed), if any, within 10 km of the mine lease should be clearly indicated, supported by a location map duly authenticated by Chief Wildlife Warden. Necessary clearance, as may be applicable to such projects due to proximity of the ecologically sensitive areas as mentioned above, should be obtained from the Standing Committee of National Board of Wildlife and copy furnished.

17. A detailed biological study of the study area [core zone and buffer zone (10 km radius of the periphery of the mine lease)] shall be carried out. Details of flora and fauna, endangered, endemic and RET Species duly authenticated, separately for core and buffer zone should be furnished based on such primary field survey, clearly indicating the Schedule of the fauna present. In case of any scheduledI fauna found in the study area, the necessary plan alongwith budgetary provisions for their conservation should be prepared in consultation with State Forest and Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost.

18. R&R Plan/compensation details for the Project Affected People (PAP) should be furnished. While preparing the R&R Plan, the relevant State/National Rehabilitation & Resettlement Policy should be kept in view. In respect of SCs /STs and other weaker sections of the society in the study area, a need based sample survey, family-wise, should be undertaken to assess their requirements, and action programmes prepared and submitted accordingly, integrating the sectoralprogrammes of line departments of the State Government. It may be clearly brought out whether the village(s) located in the mine lease area will be shifted or not. The issues relating to shifting of village(s) including their R&R and socio-economic aspects should be discussed in the Report.

19. One season (non-monsoon) [i.e. March-May (Summer Season); October-December (post monsoon season) ; December-February (winter season)]primary baseline data on ambient air quality as per CPCB Notification of 2009, water quality, noise level, soil and flora and fauna shall be collected and the AAQ and other data so compiled presented date-wise in the EIA and EMP Report. Sites pecific meteorological data should also be collected. The location of the monitoring stations should be such as to represent whole of the study area and justified keeping in view the pre-dominant downwind direction and location of sensitive receptors. There should be at least one monitoring station within 500 m of the mine lease in the pre-dominant downwind direction. The mineralogical composition of PM10, particularly for free silica, should be given.

20. Air quality modeling should be carried out for prediction of impact of the project on the air quality of the area. It should also take into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input parameters used for modeling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any, and the habitation. The wind roses showing pre-dominant wind direction may also be indicated on the map.

21. The water requirement for the Project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh water requirement for the Project should be indicated.

22. Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the Project should be provided.

23. Description of water conservation measures proposed to be adopted in the Project should be given. Details of rainwater harvesting proposed in the Project, if any, should be provided.

24. Impact of the Project on the water quality, both surface and groundwater, should be assessed and necessary safeguard measures, if any required, should be provided.

25. Based on actual monitored data, it may clearly be shown whether working will intersect groundwater. Necessary data and documentation in this regard may be provided. In case the working will intersect groundwater table, a detailed Hydro Geological Study should be undertaken and Report furnished. The Report inter-alia, shall include details of the aquifers present and impact of mining activities on these aquifers. Necessary permission from Central Ground Water Authority for working below ground water and for pumping of ground water should also be obtained and copy furnished.

26. Details of any stream, seasonal or otherwise, passing through the lease area and modification / diversion proposed, if any, and the impact of the same on the hydrology should be brought out.

27. Information on site elevation, working depth, groundwater table etc. Should be provided both in AMSL and bgl. A schematic diagram may also be provided for the same.

28. A time bound Progressive Greenbelt Development Plan shall be prepared in a tabular form (indicating the linear and quantitative coverage, plant species and time frame) and submitted, keeping in mind, the same will have to be executed up front on commencement of the Project. Phase-wise plan of plantation and compensatory afforestation should be charted clearly indicating the area to be covered under plantation and the species to be planted. The details of plantation already done should be given. The plant species selected for green belt should have greater ecological value and should be of good utility value to the local population with emphasis on local and native species and the species which are tolerant to pollution.

29. Impact on local transport infrastructure due to the Project should be indicated. Projected increase in truck traffic as a result of the Project in the present road network (including those outside the Project area) should be worked out, indicating whether it is capable of handling the incremental load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered. Project Proponent shall conduct Impact of Transportation study as per Indian Road Congress Guidelines.

30. Details of the onsite shelter and facilities to be provided to the mine workers should be included in the EIA Report.

31. Conceptual post mining land use and Reclamation and Restoration of mined out areas (with plans and with adequate number of sections) should be given in the EIA report.

32. Occupational Health impacts of the Project should be anticipated and the proposed preventive measures spelt out in detail. Details of pre-placement medical examination and periodical medical examination schedules should be incorporated in the EMP. The project specific occupational health mitigation measures with required facilities proposed in the mining area may be detailed.

33. Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocations.

34. Measures of socio economic significance and influence to the local community proposed to be provided by the Project Proponent should be indicated. As far as possible, quantitative dimensions may be given with time frames for implementation.

35. Detailed Environmental Management Plan (EMP) to mitigate the environmental impacts which, should inter-alia include the impacts of change of land use, loss of agricultural and grazing land, if any, occupational health impacts besides other impacts specific to the proposed Project.

36. Public Hearing points raised and commitment of the Project Proponent on the same along with time bound Action Plan with budgetary provisions to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project.

37. Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the Project should be given.

38. The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.

39. A Disaster management Plan shall be prepared and included in the EIA/EMP Report.

40. Benefits of the Project if the Project is implemented should be spelt out. The benefits of the Project shall clearly indicate environmental, social, economic, employment potential, etc.

41. The Action Plan on the compliance of the recommendations of the CAG as per Ministry's circular No. J-11013/71/2016-IA. I (M) dated 25.10.2017 need to be submitted at the time of appraisal of the project and included in the EIA/EMP Report.

42. Compliance of the Ministry's Office Notification No. GSR-94(E) dated 25.01.2018 – mandatory implementation of Dust mitigation measures for construction and demolishing activities.

43. The activities and budget earmarked for Corporate Environmental Responsibility (CER) shall be as per Ministry's O.M. No.22-65/2017-IA.II (M) dated 01.05.2018 and the action plan on the activities proposed under CER shall be submitted at the time of the project included in the EIA/EMP Report.

44. Compliance of the Ministry's Office Memorandum No.F: 3-50/2017-IA.III (Pt), dated 30.05.2018 on the Judgement of Hon'ble Supreme Court, dated the 2nd August,2017 in Writ Petition (Civil) No.114 of 2014 in the matter of Common Cause versus Union of India needs to be submitted and included in the EIA/EMP Report.

45. Besides the above, the below mentioned general points are also to be followed:-

(i) All documents to be properly referenced with index and continuous page numbering.

(ii) Where data are presented in the Report especially in Tables, the period in which the data were collected and the sources should be indicated.

(iii) Project Proponent shall enclose all the analysis/testing reports of water, air, soil, noise etc. using the Mo EF & CC/NABL accredited laboratories. All the original analysis/testing reports should be available during appraisal of the Project.

(iv) Where the documents provided are in a language other than English, an English translation should be provided.

(v) The Questionnaire for environmental appraisal of mining projects as devised earlier by the Ministry shall also be filled and submitted.

(vi) While preparing the EIA report, the instructions for the Proponents and instructions for the Consultants issued by MoEF vide O.M. No. J-11013/41/2006-IA.II(I) dated 4th August, 2009, which are available on the website of this Ministry, should be followed.

(vii) Changes, if any made in the basic scope and project parameters (as submitted in Form-I and the PFR for securing the TOR) should be brought to the attention of the SEIAA, Meghalaya with reasons for such changes and permission should be sought, as the TOR may also have to be altered. Post Public Hearing changes in structure and

content of the draft EIA/EMP (other than modifications arising out of the P.H. process) will entail conducting the PH again with the revised documentation.

(viii) As per the circular no. J-11011/618/2010-IA.II(I) dated 30.5.2012, certified report of the status of compliance of the conditions stipulated in the environment clearance for the existing operations of the project, should be obtained from the Regional Office of Ministry of Environment, Forest and Climate Change, as may be applicable.

(ix) The EIA report should also include (i) surface plan of the area indicating contours of main topographic features, drainage and mining area, (ii) geological maps and sections and (iii) sections of the mine pit and external dumps, if any, clearly showing the land features of the adjoining area.

(x) The PP should submit the EIA/EMP report as per the generic structure prescribed in Appendix-III of the EIA Notification, 2006, after incorporating the details of public hearing already conducted and covering the above mentioned issues, to take further necessary action for obtaining environmental clearance in accordance with the procedure prescribed under EIA Notification,2006.

The prescribed TOR shall be valid for a period of 4(four) years from the date of issue, for submission of the EIA/EMP reports, as per S.O. 751(E) dated 17.02.2020.

Member Secretary,
State Environment Impact Assessment Authority
Meghalaya, Shillong

Memo. No. ML/SEIAA/MIN/EKH/P-41/2020/ **Dated, Shillong, the Aug., 2020.**

Copy to :-

1) The Principal Chief Conservator of Forests and HoFF, Meghalaya, Shillong for information.
2) The Principal Secretary to the Govt. Meghalaya, Forests & Environment Department, Shillong for information.
3) The Jt. Secretary, IA Division, MoEF&CC, Paryavaran Bhavan, CGO Complex, Lodhi Road, New Delhi – 110 003 for information.
4) The Principal Chief Conservator of Forests, Territorial, Forests & Environment Department, Sylvan House, Lower Lachumier, Meghalaya, Shillong for information.

5) The Secretary to the Govt. of Meghalaya, Mining and Geology Department, Shillong, for information.
6) The Deputy Director General of Forests (C), Regional Office,N.E.Z, Ministry of Environment, Forests & Climate Change (Mo EF & CC), Law-u-sib, Lumbatngen, Sawlad, Near M.T.C. workshop, Shillong- 793 021, for information.
7) The Deputy Commission, East Khasi Hills District, Shillong, Meghalaya for information.
8) The Divisional Forest Officer, Territorial, East Khasi Hills and Ri Bhoi District (T) Division, Shillong for information.
9) The Member Secretary, State Experts Appraisal Committee, Meghalaya for information.
10) The Director, Mineral Resources, Govt. Meghalaya, Shillong for information.
11) The Member Secretary, Meghalaya Pollution Control Board, 'Arden', Lumpyngngad, Shillong – 793 014 for information.
12) Guard File.

Member Secretary,
SEIAA, Meghalaya

Annexure –2
Letter of Intent

GOVERNMENT OF MEGHALAYA
THE DEPARTMENT OF FORESTS AND ENVIRONMENT
OFFICE OF
THE DIVISIONAL FOREST OFFICER:: EAST KHASI HILLS & RI-BHOI (T) DIVISION::
SHILLONG

No.KH/8/ML/Limestone/68/ 7734, Dated Shillong, the 23rd May/2019.

To,

Shri. Shembhalang K. Rymmai,
Mawthang Sohkhyllung,
Wahlong village,
East Khasi Hills District.

Subj: *Letter Of Intent (LOI) for granting of mining lease under Meghalaya Minor Mineral Concession Rules, 2016 for Limestone at Sohmluh, Elaka Wahlong, East Khasi Hills District.*

Ref: Your application dated 22.03.2019.

APPROVED

Sir,

With reference to the above mentioned subject, I do hereby issue Letter of Intent (LOI) for granting mining lease under Meghalaya Minor Mineral Concession Rules 2016 for Limestone mining on area of 4.5 hectares at Sohmluh, Elaka Wahlong, East Khasi Hills District. On receipt of this Letter of Intent, you shall within a period of six months furnish the following documents for grant of mining lease :

1) Mining Plan duly approved by Director of Mineral Resources.
2) Environmental clearance under the Environmental (Protection) Act, 1986.
3) Consent to establish under the Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution)Act, 1981.
4) Clearance from Revenue and Disaster Management Department.
5) Clearance from Labour Department for occupational Health and Labour Laws including Child Labour.

This is for your information and necessary action.

Yours faithfully,

(Shri. T. Wanhiang, I.F.S)
Divisional Forest Officer,
East Khasi Hills
&
Ri Bhoi (T) Division,
Shillong.

Mining Engineer
Directorate of Mineral Resources
Meghalaya, Shillong

Forest Management Building, Lower Lachumiere, Shillong-793001
Phone No. 0364-2226375 email- dfokhasihills@gmail.com

Annexure –3
Mining Plan approval letter

GOVERNMENT OF MEGHALA
DIRECTORATE OF MINERAL RESO
SHILLONG.

No.DMR/MM/34/2019/ 128 Dated Shillong, the 2/5/ 2019

To

Shri. Shembhalang K.Rymmai,
Mawthang Sohkhyllung, Wahlong vill.
East Khasi Hills

Sub: Approval of Mining Plan in respect of Limestone of Shri. Shembhalang K.Rymmai over an area of 4.5 ha. at Sohmluh, Elaka Wahlong, East Khasi Hills District, Meghalaya submitted under Rule 19 (1) of Meghalaya Minor Mineral Concession Rules, 2016.

Madam,

In exercise of the power conferred under Rule 10 (a) & 19 (1) of Amended Meghalaya Minor Mineral Concession Rules, 2016 along with Govt. Notification No.MG.49/2011/Pt-I/58 dt. 01.03.2019, I hereby approve the above said Mining Plan with following conditions.

(i) The Mining Plan is approved without prejudice to any other law applicable to the mine area from time to time made by the Central Government, State Government or any other authority and without prejudice to any order or direction from any court of competent jurisdiction.

(ii) The proposals shown on the plates and/or given in the document is based on the lease map/sketch submitted by the applicant/lease and is applicable from the date of approval.

(iii) It is clarified that the approval of Mining Plan does not in any way imply the approval of the State Government in terms of any other provision of the Meghalaya Minor Mineral Concession Rules, 2016 or Acts and Rules relating to Mines and Minerals framed by Central Government and any other laws including Forest and Labour Laws.

(iv) The Approving authority does not undertake verification of the mining lease boundary on the ground and does not undertake any responsibility regarding the correctness of the boundaries of the precise area as furnished by the applicant/lessee.

(v) At any stage, if it is observed/found that the information furnished data incorporated in the document are incorrect or misrepresent facts, the approval of the document shall be revoked with immediate effect.

(vi) If this approval conflicts with any other law or court order/direction under any statute, it shall be revoked immediately.

(vii) The granting authority may verify the Mining Lease boundary of the applied area.

(viii) The granting authority may ensure that the Limestone raised from the above proposed Mining Lease is used only for the purpose indicated in the end use incorporated in the approved Mining Plan.

Encls: As above
3 (three copies of approved Mining Plan)

Yours faithfully,

(P.C.R.Marak)
Mining Engineer
Directorate of Mineral Resources
Meghalaya:::Shillong.

Annexure –4
Cluster Report from DMR

GOVERNMENT OF MEGHALAYA
DIRECTORATE OF MINERAL RESOURCES
SHILLONG

No. DMR/MM/34/2019/ 1779 Dated Shillong, the 30th January 2020

TO WHOM IT MAY CONCERN

It is hereby certified that as on date, the approved mining plans indicated below are located within a distance of 500 meters from the periphery of the approved mining plan on Limestone over an area 4.5 hectares located at Sohmiuh, Elaka Wahlong, District- East Khasi Hills, Meghalaya, of Shri Shemphalang K Rymmai r/o Mawthang Sohkhyllung, Wahlong Village, District- East Khasi Hills Meghalaya:

S. No.	Approved mining plan	Area (hectares)	Mineral	Distance from the approved mining plan of Shri Arjust Nongtraw (metres)
1	Shri Arjust Nongtraw	0.7162	Limestone	310
2	Youroin Enterprise	4.94	Limestone	183
3	Shri Jrop Singh Nongkhlaw	4.1	Limestone	380
4	Shri Debren Nongthraw	0.368	Limestone	302

Yours faithfully,

(P. Ch. Marak)
Mining Engineer,
Directorate of Mineral Resources
Meghalaya::Shillong

Ambient Air quality results of $PM_{2.5}$, PM_{10}, SO_x & NO_x

Name of project: Arjust & Sohmluh Limestone Mine
Khlieh Parmaw, Tyngwai Area & Wahlong Area (Resp.),
Sohbar Sirdarship & Wahlong Sirdarship,
District- East Khasi Hills,
State- Meghalaya

Location of Sampling: Core Zone of Arjust Limestone Mine

Details of client: Indian Mine Planners & Consultants
GE-61, Rajdanga Main Road, EM- Bypass,
Kolkata- 700107

Dated	PM10 (µg/m3)	PM2.5 (µg/m3)	SO2 (µg/m3)	NOx (µg/m3)
02.12.2019	62	29	6.2	8.1
03.12.2019	65	27	5.3	8.4
09.12.2019	69	35	6.1	8.3
10.12.2019	72	34	7.7	9.4
16.12.2019	74	32	7.5	9.2
17.12.2019	79	31	7.2	9.5
23.12.2019	68	28	5.6	8.4
24.12.2019	61	29	5.4	8.4
06.01.2020	63	26	6.1	9.6
07.01.2020	67	23	5.5	8.2
13.01.2020	69	24	5.4	8.5
14.01.2020	72	28	6.2	8.2
20.01.2020	75	33	7.6	10.2
21.01.2020	81	29	6.9	10.0
27.01.2020	79	27	7.5	10.6
28.01.2020	72	34	7.6	10.4
03.02.2020	73	26	7.5	9.3
04.02.2020	77	30	5.9	10.0
10.02.2020	75	33	6.0	9.7
11.02.2020	73	27	7.3	9.3
17.02.2020	68	25	6.5	8.9
18.02.2020	62	29	6.1	8.7
24.02.2020	66	25	5.5	8.7
25.02.2020	69	23	5.2	8.5

Name of project: Arjust & Sohmluh Limestone Mine
Khlieh Parmaw, Tyngwai Area & Wahlong Area (Resp.),
Sohbar Sirdarship & Wahlong Sirdarship,
District- East Khasi Hills,
State- Meghalaya
Location of Sampling: Core Zone of Sohmluh Limestone
Details of client: Indian Mine Planners & Consultants
GE-61, Rajdanga Main Road, EM- Bypass,
Kolkata- 700107

Dated	PM10 (µg/m3)	PM2.5 (µg/m3)	SO2 (µg/m3)	NOx (µg/m3)
02.12.2019	63	25	7.4	9.5
03.12.2019	60	29	7.2	9.7
09.12.2019	62	24	6.8	9.2
10.12.2019	61	28	7.4	8.8
16.12.2019	57	30	6.9	8.7
17.12.2019	57	31	6.9	9.0
23.12.2019	59	30	6.4	6.7
24.12.2019	56	25	6.8	6.4
06.01.2020	62	24	6.3	7.5
07.01.2020	76	26	5.7	7.7
13.01.2020	78	27	5.0	8.0
14.01.2020	74	29	5.8	7.9
20.01.2020	58	28	4.9	8.3
21.01.2020	52	30	4.5	8.5
27.01.2020	68	29	6.1	8.7
28.01.2020	61	25	5.1	9.2
03.02.2020	63	24	6.0	9.3
04.02.2020	62	22	6.4	9.3
10.02.2020	55	26	6.4	8.3
11.02.2020	56	29	6.2	8.2
17.02.2020	59	30	6.5	8.2
18.02.2020	56	27	6.9	7.3
24.02.2020	61	28	7.2	8.1
25.02.2020	57	29	7.4	8.1

Name of project: Arjust & Sohmluh Limestone Mine
Khlieh Parmaw, Tyngwai Area & Wahlong Area (Resp.),
Sohbar Sirdarship & Wahlong Sirdarship,
District- East Khasi Hills,
State- Meghalaya
Location of Sampling: Bholaganj Bazar
Details of client: Indian Mine Planners & Consultants
GE-61, Rajdanga Main Road, EM- Bypass,
Kolkata- 700107

Dated	PM10 (µg/m3)	PM2.5 (µg/m3)	SO2 (µg/m3)	NOx (µg/m3)
02.12.2019	83	25	5.6	8.9
03.12.2019	81	29	5.6	8.7
09.12.2019	68	32	6.0	8.9
10.12.2019	69	34	6.4	9.5
16.12.2019	72	31	6.5	9.6
17.12.2019	78	30	6.9	9.6
23.12.2019	81	29	7.1	10.4
24.12.2019	84	27	7.3	10.3
06.01.2020	80	25	7.5	10.6
07.01.2020	78	22	7.5	10.7
13.01.2020	77	29	6.3	9.7
14.01.2020	73	33	6.8	9.9
20.01.2020	71	32	7.0	9.7
21.01.2020	69	30	7.0	10.3
27.01.2020	63	29	6.6	10.4
28.01.2020	61	27	7.0	10.6
03.02.2020	67	25	7.4	10.6
04.02.2020	69	24	7.4	10.0
10.02.2020	73	22	7.6	9.6
11.02.2020	76	25	7.4	9.9
17.02.2020	78	26	7.5	9.6
18.02.2020	83	28	6.6	10.3
24.02.2020	81	25	6.3	10.7
25.02.2020	83	31	6.4	10.7

Name of project: Arjust & Sohmluh Limestone Mine
Khlieh Parmaw, Tyngwai Area & Wahlong Area (Resp.),
Sohbar Sirdarship & Wahlong Sirdarship,
District- East Khasi Hills,
State- Meghalaya

Location of Sampling: Mawbang Village
Details of client: Indian Mine Planners & Consultants
GE-61, Rajdanga Main Road, EM- Bypass,
Kolkata- 700107

Dated	PM10 (µg/m3)	PM2.5 (µg/m3)	SO2 (µg/m3)	NOx (µg/m3)
04.12.2019	65	29	5.5	9.6
05.12.2019	69	28	5.6	9.1
11.12.2019	68	25	6.2	9.3
12.12.2019	61	26	6.7	9.0
18.12.2019	52	27	6.5	9.1
19.12.2019	51	25	6.9	8.9
25.12.2019	50	29	4.7	8.7
26.12.2019	59	27	4.9	8.5
08.01.2020	61	26	5.1	9.5
09.01.2020	65	23	7.0	9.5
15.01.2020	62	26	6.8	9.5
16.01.2020	66	29	6.4	8.5
22.01.2020	63	26	5.2	8.5
23.01.2020	64	27	5.0	8.7
28.01.2020	67	29	5.6	8.6
29.01.2020	68	26	4.9	8.4
05.02.2020	60	28	4.6	9.0
06.02.2020	56	29	4.6	8.5
12.02.2020	55	26	4.8	8.5
13.02.2020	59	30	4.9	9.3
19.02.2020	61	26	4.9	9.6
20.02.2020	64	28	6.3	9.3
26.02.2020	68	29	7.0	8.7
27.02.2020	71	25	6.7	8.9

Name of project: Arjust & Sohmluh Limestone Mine
Khlieh Parmaw, Tyngwai Area & Wahlong Area (Resp.),
Sohbar Sirdarship & Wahlong Sirdarship,
District- East Khasi Hills,
State- Meghalaya

Location of Sampling: Diengken Village
Details of client: Indian Mine Planners & Consultants
GE-61, Rajdanga Main Road, EM- Bypass,
Kolkata- 700107

Dated	PM10 (µg/m3)	PM2.5 (µg/m3)	SO2 (µg/m3)	NOx (µg/m3)
04.12.2019	69	29	6.1	7.6
05.12.2019	65	24	5.9	7.5
11.12.2019	74	26	6.1	7.6
12.12.2019	76	33	6.2	7.9
18.12.2019	77	32	6.4	8.3
19.12.2019	79	30	6.5	8.2
25.12.2019	75	31	6.1	8.4
26.12.2019	74	29	6.1	7.6
08.01.2020	71	32	5.9	7.3
09.01.2020	73	28	5.8	9.2
15.01.2020	70	26	6.1	9.2
16.01.2020	71	27	5.8	9.0
22.01.2020	73	29	5.8	9.2
23.01.2020	69	31	5.7	9.2
28.01.2020	66	33	5.7	8.5
29.01.2020	57	30	5.7	8.2
05.02.2020	61	33	5.8	8.2
06.02.2020	59	32	5.7	7.8
12.02.2020	65	26	5.3	7.2
13.02.2020	63	27	5.8	7.4
19.02.2020	61	25	6.0	7.2
20.02.2020	72	24	6.3	7.6
26.02.2020	76	27	6.2	8.1
27.02.2020	71	28	5.9	8.1

Name of project: Arjust & Sohmluh Limestone Mine
Khlieh Parmaw, Tyngwai Area & Wahlong Area (Resp.),
Sohbar Sirdarship & Wahlong Sirdarship,
District- East Khasi Hills,
State- Meghalaya
Location of Sampling: Ichamati Village
Details of client: Indian Mine Planners & Consultants
GE-61, Rajdanga Main Road, EM- Bypass,
Kolkata- 700107

Dated	PM10 (µg/m3)	PM2.5 (µg/m3)	SO2 (µg/m3)	NOx (µg/m3)
04.12.2019	65	28	4.6	7.4
05.12.2019	66	26	4.9	7.8
11.12.2019	69	27	5.2	7.3
12.12.2019	71	25	5.9	7.7
18.12.2019	69	26	5.9	7.5
19.12.2019	68	29	5.3	7.3
25.12.2019	64	24	6.3	7.6
26.12.2019	55	22	6.2	7.1
08.01.2020	61	25	6.6	7.4
09.01.2020	65	28	6.3	7.5
15.01.2020	67	23	6.3	7.8
16.01.2020	69	27	6.0	7.4
22.01.2020	71	26	5.6	7.7
23.01.2020	66	29	6.2	7.5
28.01.2020	56	31	6.0	7.5
29.01.2020	59	29	5.1	7.3
05.02.2020	61	28	5.3	7.2
06.02.2020	65	26	5.1	7.3
12.02.2020	69	27	4.8	7.4
13.02.2020	68	25	4.6	7.3
19.02.2020	70	24	5.2	7.4
20.02.2020	66	23	6.1	7.5
26.02.2020	68	28	5.8	7.6
27.02.2020	70	29	6.5	7.5

Name of project: Arjust & Sohmluh Limestone Mine
Khlieh Parmaw, Tyngwai Area & Wahlong Area (Resp.),
Sohbar Sirdarship & Wahlong Sirdarship,
District- East Khasi Hills,
State- Meghalaya

Location of Sampling: Byrong Village
Details of client: Indian Mine Planners & Consultants
GE-61, Rajdanga Main Road, EM- Bypass,
Kolkata- 700107

Dated	PM10 (µg/m3)	PM2.5 (µg/m3)	SO2 (µg/m3)	NOx (µg/m3)
06.12.2019	67	28	6.5	7.3
07.12.2019	62	25	4.2	7.2
13.12.2019	63	27	5.6	7.4
14.12.2019	65	29	4.4	7.1
20.12.2019	67	25	4.5	7.3
21.12.2019	67	29	4.6	7.7
27.12.2019	69	26	5.0	7.6
28.12.2019	67	25	5.0	7.5
10.01.2020	64	23	4.2	7.1
11.01.2020	61	25	4.1	6.8
17.01.2020	62	22	4.7	7.4
18.01.2020	64	23	4.3	7.2
24.01.2020	70	29	6.8	9.5
25.01.2020	68	26	6.6	9.3
30.01.2020	66	24	6.3	8.9
31.01.2020	67	23	6.5	8.7
07.02.2020	63	22	6.1	8.1
08.02.2020	69	27	6.6	8.4
14.02.2020	68	28	6.1	7.9
15.02.2020	61	23	4.4	7.1
21.02.2020	67	28	6.3	8.3
22.02.2020	69	27	6.1	8.2
28.02.2020	66	26	6.3	9.5
29.02.2020	63	24	6.3	9.4

Name of project: Arjust & Sohmluh Limestone Mine
Khlieh Parmaw, Tyngwai Area & Wahlong Area (Resp.),
Sohbar Sirdarship & Wahlong Sirdarship,
District- East Khasi Hills,
State- Meghalaya

Location of Sampling: Khahumrin Village
Details of client: Indian Mine Planners & Consultants
GE-61, Rajdanga Main Road, EM- Bypass,
Kolkata- 700107

Dated	PM10 (µg/m3)	PM2.5 (µg/m3)	SO2 (µg/m3)	NOx (µg/m3)
06.12.2019	59	31	4.5	7.2
07.12.2019	65	29	4.4	6.7
13.12.2019	68	30	4.5	6.3
14.12.2019	59	28	5.3	8.3
20.12.2019	65	25	5.3	8.3
21.12.2019	64	25	5.2	7.4
27.12.2019	56	24	5.6	7.4
28.12.2019	59	29	5.5	7.5
10.01.2020	64	31	4.8	7.8
11.01.2020	73	29	4.5	8.3
17.01.2020	65	32	4.4	8.1
18.01.2020	69	29	4.9	8.0
24.01.2020	76	27	6.4	8.0
25.01.2020	71	25	6.3	8.0
30.01.2020	75	28	6.5	7.2
31.01.2020	69	30	6.5	7.5
07.02.2020	65	28	6.5	7.9
08.02.2020	59	26	5.4	8.3
14.02.2020	72	27	4.6	8.3
15.02.2020	64	30	4.4	7.7
21.02.2020	66	27	4.4	7.4
22.02.2020	69	30	4.6	7.2
28.02.2020	71	31	4.3	7.6
29.02.2020	67	27	4.7	7.4

Ground Water Quality Report of Arjust & Sohmluh Limestone Mine

Name of project: Arjust & Sohmluh Limestone Mine
Khlieh Parmaw, Tyngwai Area & Wahlong Area (Resp.),
Sohbar Sirdarship & Wahlong Sirdarship,
District- East Khasi Hills,
State- Meghalaya

Date of Sampling: 28.02.2020

Date of Analysis: 03.03.2020-07.03.2020

Details of client: Indian Mine Planners & Consultants
GE-61, Rajdanga Main Road, EM- Bypass,
Kolkata- 700107

SN	Parameter	Unit	IS:10500-93 Drinking Water Standards	Core Zone of Arjust (GW1)	Byrong Village (GW2)	Khahumrin Village (GW3)	ML Area of Sohmluh Limestone (GW4)	Mawbang Village (GW5)	Diengken Village (GW6)
1.	pH Value	-	6.5 to 8.5	7.20 at 23.7°C	7.10 at 23.7°C	6.90 at 23.7°C	7.10 at 23.7°C	7.20 at 23.7°C	7.10 at 23.7°C
2.	Turbidity NTU	NTU	5 (10)	0.6	0.4	0.6	0.5	0.4	0.4
3.	Electrical Conductivity at 25^0C	µS/cm	-	159	174	153	174	179	182
4.	Apparent Colour	Hazen	5	<1	<1	<1	<1	<1	<1
5.	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
6.	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
7.	Total Dissolved Solids (TDS)	mg/l	500 (2000)	106.00	102.00	108.00	107.00	106.00	103.00
8.	Total Hardness (CaCO3)	mg/l	300 (600)	63.20	64.80	64.20	69.80	67.60	99.10
9.	Iron (as Fe)	mg/l	0.3 (1.0)	0.19	0.22	0.19	0.21	0.22	0.20
10.	Chlorides (as Cl)	mg/l	250 (1000)	44.30	44.30	45.10	47.30	46.10	44.90
11.	Calcium (as Ca)	mg/l	75 (200)	23.10	22.40	24.30	24.10	25.20	24.60
12.	Magnesium (as Mg)	mg / l	30 (100)	3.14	3.25	3.20	3.90	3.60	4.10
13.	Sulphate (as SO4)	mg / l	200 (400)	10.10	9.70	11.20	9.90	10.30	12.10
14.	Nitrates (as NO3)	mg / l	45	1.02	0.85	1.05	0.89	0.94	1.30
15.	Fluoride (as F)	mg / l	1.0 (1.5)	0.04	0.06	0.04	0.08	0.07	0.08
16.	Total Alkalinity (CaCO3)	mg /l	200 (600)	58.00	56.10	61.40	61.10	64.20	61.80
17.	Free Residual	mg /l	Min0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

	Chlorine								
18.	Copper as(Cu)	mg /l	0.05 (1.5)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
19.	Manganese as (Mn)	mg /l	0.1 (0.3)	0.05	0.04	0.05	0.05	0.05	0.04
20.	Mercury as (Hg)	mg / l	0.001	< 0.0005	< 0.0004	< 0.0003	< 0.0003	< 0.0003	< 0.0003
21.	Cadmium as (Cd)	mg / l	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
22.	Selenium as (Se)	mg / l	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
23.	Arsenic as (As)	mg / l	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
24.	Lead as (Pb)	mg / l	0.05	< 0.005	< 0.004	< 0.005	< 0.005	< 0.005	< 0.005
25.	Zinc as (Zn)	mg / l	5 (15)	< 0.1	< 0.2	< 0.3	< 0.3	< 0.3	< 0.3
26.	Chromium as (Cr)	mg / l	0.05	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
27.	Aluminium as (Al)	mg / l	0.03 (0.2)	0.008	0.007	0.005	0.006	0.007	0.006
28.	Boron as (B)	mg / l	1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
29.	Cyanide as (CN)	mg / l	0.05	< 0.003	< 0.004	< 0.003	< 0.005	< 0.005	< 0.005
30.	Total Coliform	MPN/100 ml	Nil	< 1	< 1	< 1	< 1	< 1	< 1
31.	Phenolic Compounds	mg / l	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
32.	Anionic Detergents	mg / l	0.2(1.0)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
33.	Polynuclear aromatic Comp (as PAH)	µg / l	-	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
34.	Mineral Oil	mg / l	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Surface Water quality Report of Tharia River

Name of project: Arjust & Sohmluh Limestone Mine
Khlieh Parmaw, Tyngwai Area & Wahlong Area (Resp.),
Sohbar Sirdarship & Wahlong Sirdarship,
District- East Khasi Hills,
State- Meghalaya

Date of Sampling: 28.02.2020

Date of Analysis: 03.03.2020-07.03.2020

Details of client: Indian Mine Planners & Consultants
GE-61, Rajdanga Main Road, EM- Bypass,
Kolkata- 700107

S. No.	Parameters	Unit	As Per IS:2296: 1992 Category - C	SW1 (Upstream)	SW2 (Downstream)
1.	Colour	Hazen units	300	<1	<1
2.	Odour	-	Un - Objectionable	Agreeable	Agreeable
3.	Turbidity NTU	NTU	-	0.6	0.5
4.	pH Value	-	6.5 to 8.5	7.30 at 24°C	7.20 at 24°C
5.	DO	mg / l	≥ 4	7.2	7.4
6.	BOD (3d, 250C)	mg / l	3	1.20	1.10
7.	COD	mg / l	-	6.00	5.80
8.	Total Hardness (CaCO3)	mg / l	-	74.20	71.20
9.	Oil and Grease	mg / l	0.1	<1	<1
10.	Iron (as Fe)	mg / l	50	0.21	0.23
11.	Chlorides (as Cl)	mg / l	600	51.20	53.60
12.	Electrical Conductivity at 25^0C	µs/cm	-	198	191
13.	Total Dissolved Solids (TDS)	mg / l	1500	112.00	114.00
14.	Calcium (as Ca)	mg / l	-	27.20	26.50
15.	Magnesium (as Mg)	mg / l	-	4.25	4.70
16.	Sulphate (as SO4)	mg / l	400	13.40	12.70
17.	Free residual chlorine	mg / l	-	< 0.1	< 0.1
18.	Nitrates (as NO3)	mg / l	50	0.85	0.93
19.	Fluoride (as F)	mg / l	1.5	0.03	0.04
20.	Free Ammonia (as NH3)	mg / l	-		

21.	Copper as(Cu)	mg / l	1.5	< 0.02	< 0.02
22.	Manganese as (Mn)	mg / l	-	0.08	0.08
23.	Cadmium as (Cd)	mg / l	0.01	< 0.001	< 0.001
24.	Selenium (as Se)	mg / l	0.05	< 0.001	< 0.001
25.	Arsenic as (As)	mg / l	0.2	< 0.01	< 0.01
26.	Mercury as (Hg)	mg / l	-	< 0.0003	< 0.0003
27.	Lead as (Pb)	mg / l	0.1	< 0.005	< 0.005
28.	Zinc as (Zn)	mg / l	15	< 0.3	< 0.3
29.	Boron as (B)	mg / l	-	< 0.1	< 0.1
30.	Chromium as (Cr +6)	mg / l	0.05	< 0.03	< 0.03
31.	Cyanide as (CN)	mg / l	0.05	< 0.005	< 0.005
32.	Phenolic Compounds	mg / l	0.005	< 0.001	< 0.001
33.	Anionic Detergents as MBAS	mg / l	1	< 0.001	< 0.001
34.	Total Coliform	MPN/100 ml	5000	< 1	< 1
35.	Polynuclear aromatic Comp (as PAH)	ppb	-	< 0.03	< 0.03

Soil Quality Test report of Arjust & Sohmluh Limestone Mine

Name of project: Arjust & Sohmluh Limestone Mine
Khlieh Parmaw, Tyngwai Area & Wahlong Area (Resp.),
Sohbar Sirdarship & Wahlong Sirdarship,
District- East Khasi Hills, State- Meghalaya

Date of Sampling: 28.02.2020; **Date of Analysis:** 03.03.2020-10.03.2020

Details of client: Indian Mine Planners & Consultants
GE-61, Rajdanga Main Road, EM- Bypass, Kolkata- 700107

S.N.	Parameters	Unit	Core Zone (S1)	Byrong Village (S2)	Khahumrin Village (S3)	ML Area of Sohmluh Limestone (S4)	Mawbang Village (S5)
1	Particle size distribution	-	-	-	-	-	-
2	Texture	-	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand
3	pH	-	7.81	7.80	7.70	7.80	7.9
4	% Moisture	%	1.7	1.6	1.8	1.7	1.7
5	Total Alkalinity	mg/kg	280	265	280	282	265
6	Bulk Density	gm/cm^3	1.51	1.43	1.47	1.49	1.43
7	Infiltration Rates	cm/hr	43	55	52	42	55
8	Available Nitrogen	%	0.99	0.99	0.94	0.96	0.99
9	Available Phosphorus	%	0.21	0.21	0.22	0.20	0.21
10	Chloride	%	0.081	0.075	0.072	0.080	0.075
11	Sulphate	%	0.049	0.040	0.038	0.046	0.040
12	Carbonate	mg/100g	1.72	1.62	1.67	1.72	1.62
13	Electrical Conductivity	µs/sec	104.2	102.5	104.7	104.9	102.5
14	Salinity	PPT	0.051	0.049	0.044	0.052	0.049
15	Total Organic Carbon	%	0.71	0.79	0.76	0.70	0.79
16	Total Sulphur	%	0.017	0.011	0.011	0.018	0.011
17	Sodium Absorption Ratio		0.3592	0.3501	0.3525	0.3588	0.3501
18	Boron as B	mg/Kg	BDL	BDL	BDL	BDL	BDL
19	Available Potassium	mg/Kg	238.20	265.20	259.10	236.30	265.20
20	Calcium as Ca	mg/Kg	5621.74	5531.44	5536.22	5623.54	5531.44
21	Magnesium as Mg	mg/Kg	336.12	336.56	340.10	331.20	336.56

Annexure –10
Land Use Details

		POPULATION AND LANDUSE OF STUDY AREA, CENSUS 2011 (Ha.)																	
		PIRTIMAI LIMESTONE MINE, RI LAINGUT TYNGWAI AREA, MEGHALAYA																	
Town/ village code	**Town/village name**	**Population**	**Total area**	**Forest land**	**Area under Non-Agricultural Uses**	**Barren & Un-cultivable Land**	**Permanent Pastures and Other Grazing Land**	**Land Under Misc. Tree Crops etc.**	**Culturable Waste Land**	**Fallows Land other than Current Fallows**	**Current Fallows**	**Net Area Sown**	**Total Unirrigated Land**	**Area Irrigated by Source**		**Wells/ Tube Wells**	**Tanks/Lakes**	**Waterfall**	**Other Source**	
District	**East Khasi Hills**																			
Sub Distt.	**Khatarshnong Laitkroh**																			
278576	Mawtongreng	86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278577	Thangkyrta	37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278578	Jarain	135	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278579	Nongbah	307	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278588	Jalynteng	814	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278589	Wahtyngngai-Ummluh	748	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Sub total	**2127**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
Sub Distt.	**Shella Bholaganj**																			
278783	Mawkliaw	269	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278784	Kemrang	421	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278785	Nongpriang	299	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278786	Lynggar Temshun	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278787	Sohkhmie	267	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278788	Mawmluh MSEB	41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278789	Mawmluh MCCL	743	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278790	Mawmluh	1152	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278791	Pyndemdkhar	60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278801	Mynteng	43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278802	Nongriat	136	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278803	Lumsohphie	97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278804	Nongthymmai (Tyrna)	62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278805	Nongkroh	47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278806	Lumrynjang	25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278807	Mawshamok	183	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278808	Tyrna	742	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278809	Mawshar	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278810	Wah-U-Tim	236	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278811	Nongthynmmai	502	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278812	Mawsmai	475	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278813	Mawlatang	265	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278814	Tyrngei	171	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278815	Nongla	188	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278816	Mawblang	282	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

278817	Lad Ryngud	104	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278818	Khliehumlang	58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278819	Mawsiangei	316	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278820	Suktia Inc. Diengsiar	522	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278821	Rithymmai	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278822	Laittyra	439	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278823	Thangkharang	138	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278824	Lyngngar	72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278825	Ryngud	630	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278826	Laitiam	641	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278827	Umwai	546	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278828	Mawlong	721	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278829	Wahkhim(Sohsarat)	259	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278830	Wahkrem	177	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278831	Laitkynsew	474	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278835	Nongnong	79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278836	Mot	25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278837	Nongrum	81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278842	Jasir	148	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278843	Ramsongkatenor	148	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278844	Siej	23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278845	Khliehmawlong	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278846	Nongduh	424	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278847	Ri-ngur	134	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278848	Lad Sohbar	146	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278849	Sohbar	1072	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278850	Old Kamorah	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278851	Tharia	145	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278852	Umdud	150	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278853	Wahjain	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278854	Shnongkawar	180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278855	Mawthangsohkhyllung	660	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278856	Byrong	299	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278857	Diengsiar Mawlong	808	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278858	Khahumrin	824	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278859	Saikarap	262	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278860	Jatap	183	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278861	Jalba	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278862	Lum-U-Smon	101	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278863	Umdohmawpud	266	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278864	Sohlap	415	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278867	Lumpukri	52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278868	Saitsohphan	39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278869	Khahkangi	284	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278870	Ichamati	627	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278871	Lailad	111	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278872	New Kamorah	480	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278873	Bholaganj (Majai)	1225	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278874	Diengkain	101	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

278875	Khahmalai	258	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278876	Lummuri	219	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278886	Umtaru	801	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278888	Kalibari	674	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278889	Dhorom	681	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278890	Diengrai	448	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278891	Birsaw	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278892	Rangkamati	92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278893	Mawbang	483	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278894	Kurikhal	158	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278895	Chaklabasti	262	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278896	Nayabasti	680	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278897	Dhorombasti	679	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278898	Maskon	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278899	Umsawmaskon	427	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278900	Tyllap	230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278901	Cherrapunjee (CT)	11722	780.00	-	780.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Sub total	**39119**	**780.00**	**0.00**	**780.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
Sub Distt.	**Pynursla**																			
278995	Wahdop	86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278997	Dewsaw	223	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278998	Shiliang-Jali	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
278999	Weikian	218	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
279000	Rana	141	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
279001	Nongjri Tluh	1101	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
279002	Nongjri Bah	596	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
279034	Tishang	180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
279035	Nongjri War	680	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
279036	Mawpathaw	42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
279037	Nongjri Shkod	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
279038	Hat Nongjri	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
279039	Hat Umniuh	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
279040	Pakhria	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Sub total	**3267**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
	RESERVED/PROTECTED FORESTS																			
	Durgapur RF		0.00		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Kaliakata RF		0.00		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	RF Near Ramadihi		0.00		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Nisha PF		0.00		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Barakathia RF		0.00		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Brahmanabil RF		0.00		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Baihanali RF		0.00		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Similisahi PF		0.00		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

	Khalapal RF		0.00		-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Jaipur RF		0.00		-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Kosala PF		0.00		-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Chhendipada RF		0.00		-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Debinagar PF		0.00		-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Simuliapathr RF		0.00		-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Arishila Sulia PF		0.00		-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Parha RF		0.00		-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Sub total		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
	GRAND TOTAL	**44513**	**780.00**	**0.00**	**780.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
	%		**100.00**	**0.00**	**100.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#####**	**#DIV/0!**	

Noise Report of Arjust & Sohmluh Limestone Mine

Name of project: Arjust & Sohmluh Limestone Mine
Khlieh Parmaw, Tyngwai Area & Wahlong Area (Resp.),
Sohbar Sirdarship & Wahlong Sirdarship,
District- East Khasi Hills, State- Meghalaya

Date of Sampling: Given Below
Details of client: Indian Mine Planners & Consultants
GE-61, Rajdanga Main Road, EM- Bypass, Kolkata- 700107

S. No.	Locations	Class	L_{eq} noise level dB(A)	Maximum noise level dB(A)	Day time (6.00 A.M to 10.00P.M)	Night time (10.00 P.M to 6.00A.M)
					Standard (L_{eq} in dB(A)	Standard (L_{eq} in dB(A)
Core zone noise quality						
ANL1	**Core Zone Arjust**	**Project Area**	53.0	59.9	54.2	39.1
Buffer zone noise quality						
ANL2	**Byrong Village**	Residential	52.4	59.3	53.6	38.5
ANL3	**Khahumrin Village**	Residential	53.1	60.0	54.3	39.2
ANL4	**ML Area of Sohmluh Limestone**	-	52.6	59.5	53.8	38.7
ANL5	**Mawbang Village**	Residential	51.9	58.8	53.1	38.0
ANL6	**Diengken Village**	Residential	52.4	59.3	53.6	38.5
ANL7	**Bholaganj Bazar**	Market	54.6	61.5	55.8	40.7
ANL8	**Ichamati Village**	Residential	52.3	59.2	53.5	38.4

Noise Report of Arjust & Sohmluh Limestone Mine

Location	Core Zone Arjust (ANL1)	Byrong Village (ANL2)	Khahumrin Village (ANL3)	Sohmluh Lease Area (ANL4)	Mawbang Village (ANL5)	Diengken Village (ANL6)	Bholaganj Bazar (ANL7)	Ichamati Village (ANL8)
Date	**02 to 03 December 2019**	**20 to 21 December 2019**	**06 to 07 December 2019**	**02 to 03 December 2019**	**10 to 11 January 2020**	**22 to 23 January 2020**	**27 to 28 January 2020**	**05 to 06 February 2020**
Time	**Reading (In dB)**	**Reading (In dB)**	**Reading (In dB)**	**Reading (In dB)**	**Reading (In dB)**	**Reading (In dB)**	**Reading (In dB)**	**Reading (In dB)**
6.00	38.4	37.8	38.5	38.0	37.3	37.8	40.0	37.7
7.00	39.6	39.0	39.7	39.2	38.5	39.0	41.2	38.9
8.00	41.9	41.3	42.0	41.5	40.8	41.3	43.5	41.2
9.00	45.5	44.9	45.6	45.1	44.4	44.9	47.1	44.8
10.00	47.9	47.3	48.0	47.5	46.8	47.3	49.5	47.2
11.00	52.5	51.9	52.6	52.1	51.4	51.9	54.1	51.8
12.00	54.9	54.3	55.0	54.5	53.8	54.3	56.5	54.2
13.00	57.1	56.5	57.2	56.7	56.0	56.5	58.7	56.4
14.00	56.5	55.9	56.6	56.1	55.4	55.9	58.1	55.8
15.00	54.3	53.7	54.4	53.9	53.2	53.7	55.9	53.6
16.00	58.6	58.0	58.7	58.2	57.5	58.0	60.2	57.9
17.00	59.9	59.3	60.0	59.5	58.8	59.3	61.5	59.2
18:00	55.7	55.1	55.8	55.3	54.6	55.1	57.3	55.0
19:00	51.5	50.9	51.6	51.1	50.4	50.9	53.1	50.8
20:00	47.3	46.7	47.4	46.9	46.2	46.7	48.9	46.6
21:00	47.1	46.5	47.2	46.7	46.0	46.5	48.7	46.4
22:00	42.8	42.2	42.9	42.4	41.7	42.2	44.4	42.1
23:00	38.6	38.0	38.7	38.2	37.5	38.0	40.2	37.9
24:00	38.3	37.7	38.4	37.9	37.2	37.7	39.9	37.6
01.00	38.1	37.5	38.2	37.7	37.0	37.5	39.7	37.4
02.00	38.5	37.9	38.6	38.1	37.4	37.9	40.1	37.8
03.00	37.9	37.3	38.0	37.5	36.8	37.3	39.5	37.2
04:00	37.6	37.0	37.7	37.2	36.5	37.0	39.2	36.9
05:00	38.1	37.5	38.2	37.7	37.0	37.5	39.7	37.4

Annexure –12
Demography

		VILLAGE WISE POPULATION AND LITERACY WITHIN THE STUDY AREA (CENSUS 2011)											
		ARJUST LIMESTONE MINE, EAST KHASIHILLS DISTT., MEGHALAYA											
Town/	**Town/village**	**No. of**	**Population break-up**			**Population (0-6 years)**			**Schedule**	**Schedule**	**Literacy level**		
village	**name**	**house-**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Caste**	**Tribe**	**Total**	**Male**	**Female**
code		**holds**									**literates**	**literates**	**literates**
District	**East Khasi Hills**												
Sub Distt.	**Khatarshnong Laitkroh**												
278576	Mawtongreng	23	86	51	35	15	7	8	0	86	41	26	15
278577	Thangkyrta	10	37	19	18	6	3	3	0	37	6	1	5
278578	Jarain	26	135	69	66	43	24	19	0	135	54	24	30
278579	Nongbah	66	307	156	151	70	38	32	0	307	44	21	23
278588	Jalynteng	143	814	397	417	185	93	92	0	813	420	183	237
278589	Wahtyngngai-Ummluh	129	748	365	383	180	85	95	0	748	372	165	207
	Sub total	**397**	**2127**	**1057**	**1070**	**499**	**250**	**249**	**0**	**2126**	**937**	**420**	**517**
Sub Distt.	**Shella Bholaganj**												
278783	Mawkliaw	55	269	141	128	79	41	38	0	267	149	76	73
278784	Kemrang	92	421	218	203	91	45	46	0	420	269	144	125
278785	Nongpriang	80	299	159	140	69	40	29	0	298	172	85	87
278787	Sohkhmie	54	267	142	125	43	23	20	0	267	218	116	102
278788	Mawmluh MSEB	11	41	25	16	9	6	3	0	26	31	19	12
278789	Mawmluh MCCL	159	743	403	340	100	58	42	24	614	605	333	272
278790	Mawmluh	224	1152	544	608	163	76	87	0	1080	945	448	497
278791	Pyndemdkhar	17	60	33	27	14	9	5	0	60	46	24	22

278801	Mynteng	14	43	21	22	6	2	4	0	43	29	13	16
278802	Nongriat	31	136	73	63	29	16	13	0	136	100	55	45
278803	Lumsohphie	17	97	50	47	14	5	9	0	96	83	45	38
278804	Nongthymmai (Tyrna)	14	62	35	27	6	3	3	0	62	54	31	23
278805	Nongkroh	12	47	27	20	5	2	3	0	47	36	22	14
278806	Lumrynjang	6	25	14	11	4	2	2	0	25	20	11	9
278807	Mawshamok	38	183	87	96	26	10	16	0	181	153	76	77
278808	Tyrna	155	742	382	360	135	72	63	0	734	585	300	285
278810	Wah-U-Tim	49	236	120	116	38	19	19	0	235	180	91	89
278811	Nongthynmmai	103	502	239	263	95	40	55	0	502	364	181	183
278812	Mawsmai	98	475	230	245	85	36	49	0	471	350	175	175
278813	Mawlatang	54	265	131	134	60	30	30	0	264	50	25	25
278814	Tyrngei	37	171	93	78	33	19	14	0	170	5	3	2
278815	Nongla	41	188	99	89	45	26	19	0	186	81	34	47
278816	Mawblang	59	282	140	142	44	19	25	0	278	210	106	104
278817	Lad Ryngud	22	104	53	51	21	9	12	0	104	51	29	22
278818	Khliehumlang	10	58	28	30	12	8	4	0	58	34	11	23
278819	Mawsiangei	55	316	166	150	72	37	35	0	316	168	81	87
278820	Suktia Inc. Diengsiar	109	522	265	257	113	56	57	0	516	292	153	139
278822	Laittyra	104	439	222	217	56	32	24	6	430	346	172	174
278823	Thangkharang	36	138	77	61	15	8	7	0	138	109	60	49
278824	Lyngngar	18	72	36	36	10	6	4	0	72	39	16	23

278825	Ryngud	135	630	339	291	129	77	52	0	625	349	173	176
278826	Laitiam	114	641	329	312	104	52	52	0	639	358	165	193
278827	Umwai	122	546	285	261	96	49	47	0	544	427	223	204
278828	Mawlong	146	721	383	338	161	88	73	2	486	386	215	171
278829	Wahkhim(Sohsarat)	64	259	124	135	43	19	24	0	258	214	105	109
278830	Wahkrem	35	177	86	91	31	12	19	0	157	141	72	69
278831	Laitkynsew	111	474	244	230	72	38	34	0	461	392	203	189
278832	Nongwar	117	562	266	296	83	41	42	0	561	472	223	249
278834	Mustoh	104	451	236	215	83	41	42	0	447	360	194	166
278835	Nongnong	12	79	39	40	14	5	9	0	79	64	33	31
278836	Mot	5	25	14	11	7	7	0	0	23	18	7	11

278837	Nongrum	16	81	37	44	7	4	3	0	81	63	28	35
278842	Jasir	29	148	64	84	25	12	13	0	147	114	49	65
278843	Ramsongkatenor	29	148	78	70	27	19	8	0	148	108	52	56
278844	Siej	9	23	14	9	5	2	3	0	19	17	12	5
278846	Nongduh	82	424	208	216	60	27	33	0	423	351	174	177
278847	Ri-ngur	30	134	62	72	28	12	16	0	133	93	43	50
278848	Lad Sohbar	27	146	83	63	27	19	8	0	146	93	47	46
278849	Sohbar	193	1072	532	540	182	88	94	0	1060	585	284	301
278850	Old Kamorah	1	5	1	4	3	0	3	0	5	1	1	0
278851	Tharia	29	145	96	49	26	15	11	3	107	84	61	23
278852	Umdud	32	150	78	72	35	20	15	0	138	95	49	46
278853	Wahjain	3	3	3	0	0	0	0	0	3	3	3	0
278854	Shnongkawar	37	180	88	92	41	27	14	0	179	92	36	56
278855	Mawthangsohkhyllung	119	660	323	337	119	59	60	0	653	413	187	226
278856	Byrong	53	299	156	143	66	38	28	0	298	198	98	100
278857	Diengsiar Mawlong	144	808	367	441	146	63	83	0	800	632	291	341
278858	Khahumrin	174	824	433	391	210	117	93	0	606	111	66	45
278859	Saikarap	60	262	148	114	57	30	27	0	247	193	113	80
278860	Jatap	34	183	90	93	34	18	16	8	173	148	71	77
278861	Jalba	2	2	2	0	0	0	0	0	2	1	1	0
278862	Lum-U-Smon	23	101	61	40	28	14	14	0	92	65	40	25
278863	Umdohmawpud	46	266	127	139	56	26	30	5	259	171	90	81
278864	Sohlap	73	415	225	190	78	42	36	7	377	261	152	109
278866	Kalorkhar	15	55	33	22	16	9	7	0	55	32	21	11
278867	Lumpukri	9	52	28	24	5	2	3	0	8	24	15	9
278868	Saitsohphan	10	39	17	22	8	2	6	1	38	28	14	14
278869	Khahkangi	51	284	145	139	67	33	34	109	21	79	49	30
278870	Ichamati	124	627	338	289	111	63	48	2	172	350	213	137
278871	Lailad	23	111	63	48	29	19	10	0	89	47	27	20
278872	New Kamorah	113	480	260	220	82	45	37	0	304	279	160	119
278873	Bholaganj (Majai)	232	1225	620	605	238	123	115	0	168	643	357	286
278874	Diengkain	16	101	51	50	22	11	11	0	64	29	18	11
278875	Khahmalai	49	258	144	114	44	28	16	0	2	49	42	7
278876	Lummuri	42	219	101	118	57	25	32	0	157	77	32	45

278883	Lubia	40	208	104	104	53	26	27	174	0	82	48	34
278886	Umtaru	160	801	419	382	145	70	75	5	603	274	178	96
278888	Kalibari	101	674	357	317	139	80	59	396	0	355	208	147
278889	Dhorom	127	681	350	331	122	66	56	0	189	418	230	188
278890	Diengrai	83	448	242	206	118	64	54	6	370	162	106	56
278892	Rangkamati	17	92	48	44	25	13	12	6	80	40	28	12
278893	Mawbang	99	483	247	236	106	52	54	262	111	196	113	83
278894	Kurikhal	26	158	89	69	30	17	13	0	13	65	40	25
278895	Chaklabasti	41	262	134	128	52	21	31	0	0	136	78	58
278896	Nayabasti	137	680	365	315	103	59	44	0	358	303	183	120
278897	Dhorombasti	130	679	353	326	113	57	56	0	58	227	117	110
278899	Umsawmaskon	82	427	226	201	118	66	52	0	333	145	79	66
278900	Tyllap	57	230	122	108	52	28	24	26	159	77	45	32
278901	Cherrapunjee (CT)	2252	11722	5615	6107	1871	912	959	49	11262	9121	4352	4769
	Sub total	**8020**	**40395**	**20345**	**20050**	**7301**	**3727**	**3574**	**1091**	**33086**	**26085**	**13249**	**12836**
Sub Distt.	**Pynursla**												
278995	Wahdop	15	86	38	48	17	8	9	0	86	60	28	32
278997	Dewsaw	48	223	108	115	56	22	34	0	222	138	72	66
278999	Weikian	51	218	107	111	50	23	27	0	218	131	64	67
279000	Rana	25	141	75	66	31	17	14	0	140	86	47	39
279001	Nongjri Tluh	209	1101	524	577	212	112	100	0	1098	743	349	394
279002	Nongjri Bah	105	596	287	309	102	54	48	0	592	438	207	231
279034	Tishang	34	180	119	61	26	8	18	1	86	112	95	17
279035	Nongjri War	119	680	338	342	153	84	69	1	675	425	216	209
279036	Mawpathaw	9	42	22	20	12	5	7	0	28	14	8	6
	Sub total	**615**	**3267**	**1618**	**1649**	**659**	**333**	**326**	**2**	**3145**	**2147**	**1086**	**1061**

	GRAND TOTAL	**9032**	**45789**	**23020**	**22769**	**8459**	**4310**	**4149**	**1093**	**38357**	**29169**	**14755**	**14414**
	Percentage		**100.00**	**50.27**	**49.73**	**18.47**	**9.41**	**9.06**	**2.39**	**83.77**	**63.70**	**32.22**	**31.48**

VILLAGE WISE EMPLOYMENT PATTERN IN THE STUDY AREA (CENSUS 2011)											
ARJUST LIMESTONE MINE, EAST KHASIHILLS DISTT., MEGHALAYA											
Employment pattern											
Total	**Main workers**					**Marginal workers**					**Non**
workers	**Total**	**Cultivators**	**Agri. Labours**	**HH ind.**	**Others**	**Total**	**Cultivators**	**Agr. Labours**	**HH ind.**	**Others**	**workers**
53	53	52	0	0	1	0	0	0	0	0	33
22	22	22	0	0	0	0	0	0	0	0	15
60	60	59	0	0	1	0	0	0	0	0	75
167	167	164	1	0	2	0	0	0	0	0	140
392	392	376	0	0	16	0	0	0	0	0	422
338	292	122	124	32	14	46	10	32	1	3	410
1032	**986**	**795**	**125**	**32**	**34**	**46**	**10**	**32**	**1**	**3**	**1095**
93	93	0	60	2	31	0	0	0	0	0	176
181	181	4	125	1	51	0	0	0	0	0	240
132	132	20	106	1	5	0	0	0	0	0	167
125	121	17	93	0	11	4	0	4	0	0	142
12	12	0	0	0	12	0	0	0	0	0	29
198	183	0	0	1	182	15	0	0	0	15	545
379	351	2	2	0	347	28	0	0	0	28	773
24	24	23	0	0	1	0	0	0	0	0	36

23	23	23	0	0	0	0	0	0	0	0	20
49	48	28	10	0	10	1	1	0	0	0	87
37	36	14	7	1	14	1	0	0	0	1	60
26	26	0	21	0	5	0	0	0	0	0	36
19	19	5	8	0	6	0	0	0	0	0	28
10	10	6	0	0	4	0	0	0	0	0	15
76	74	17	23	0	34	2	1	1	0	0	107
245	241	7	188	1	45	4	0	1	0	3	497
69	45	0	1	0	44	24	0	0	0	24	167
143	128	0	0	0	128	15	1	0	0	14	359
147	131	1	0	2	128	16	0	0	2	14	328
157	2	0	0	0	2	155	151	0	2	2	108
95	5	0	4	0	1	90	83	6	1	0	76
77	25	20	0	0	5	52	0	52	0	0	111
76	65	3	0	0	62	11	2	0	0	9	206
33	33	0	0	0	33	0	0	0	0	0	71
23	23	0	21	0	2	0	0	0	0	0	35
124	55	51	0	0	4	69	0	66	0	3	192
213	194	62	120	0	12	19	2	17	0	0	309
181	92	4	47	0	41	89	1	73	0	15	258
61	28	1	21	0	6	33	0	27	0	6	77
24	24	5	14	0	5	0	0	0	0	0	48
232	228	1	0	0	227	4	0	0	0	4	398
222	221	46	142	0	33	1	0	1	0	0	419
246	216	10	159	0	47	30	0	7	1	22	300
228	221	0	187	1	33	7	0	7	0	0	493
82	82	61	1	1	19	0	0	0	0	0	177
62	60	48	1	0	11	2	1	0	0	1	115
198	158	7	32	7	112	40	0	12	0	28	276
184	140	75	13	0	52	44	1	5	0	38	378
170	152	1	1	0	150	18	0	1	0	17	281
20	20	0	0	0	20	0	0	0	0	0	59
7	7	6	0	0	1	0	0	0	0	0	18
36	20	5	0	1	14	16	13	0	0	3	45

42	37	4	0	0	33	5	1	0	0	4	106
51	45	12	0	0	33	6	3	0	1	2	97
10	10	7	0	0	3	0	0	0	0	0	13
154	152	33	106	1	12	2	0	1	0	1	270
52	52	0	48	0	4	0	0	0	0	0	82
62	55	0	0	0	55	7	0	0	0	7	84
406	400	2	0	1	397	6	0	0	0	6	666
1	1	0	0	0	1	0	0	0	0	0	4
67	59	1	5	0	53	8	0	2	0	6	78
51	38	0	8	0	30	13	0	11	0	2	99
3	3	0	0	0	3	0	0	0	0	0	0
60	60	0	0	0	60	0	0	0	0	0	120
256	16	0	0	0	16	240	2	0	1	237	404
148	147	0	140	0	7	1	0	1	0	0	151
279	242	24	143	1	74	37	1	34	0	2	529
248	245	0	3	0	242	3	1	0	0	2	576
152	148	15	50	2	81	4	1	2	0	1	110
68	67	0	0	0	67	1	0	0	0	1	115
2	2	1	1	0	0	0	0	0	0	0	0
32	32	0	0	0	32	0	0	0	0	0	69
83	80	1	0	0	79	3	1	0	0	2	183
156	155	0	0	0	155	1	0	0	0	1	259
17	17	12	0	0	5	0	0	0	0	0	38
29	27	0	15	0	12	2	0	0	0	2	23
24	23	0	10	0	13	1	0	0	0	1	15
82	24	17	0	2	5	58	0	1	2	55	202
210	210	2	2	1	205	0	0	0	0	0	417
30	27	0	5	0	22	3	0	3	0	0	81
177	169	2	11	0	156	8	0	2	0	6	303
370	364	5	8	15	336	6	1	1	0	4	855
27	13	10	0	2	1	14	0	2	0	12	74
133	132	2	89	0	41	1	0	0	0	1	125
72	3	2	0	0	1	69	0	0	0	69	147

56	32	2	8	0	22	24	0	5	0	19	152
242	231	1	48	1	181	11	0	2	1	8	559
177	71	30	30	1	10	106	1	42	0	63	497
217	160	4	28	4	124	57	1	14	1	41	464
138	23	7	1	0	15	115	0	11	3	101	310
29	12	1	3	0	8	17	1	8	1	7	63
159	20	1	5	0	14	139	0	27	7	105	324
44	41	1	7	0	33	3	0	2	1	0	114
81	50	15	0	0	35	31	1	0	0	30	181
210	148	23	2	0	123	62	4	1	2	55	470
188	122	14	5	3	100	66	0	5	1	60	491
132	132	0	25	0	107	0	0	0	0	0	295
79	26	0	4	0	22	53	0	5	1	47	151
3765	3531	10	30	13	3478	234	2	1	1	230	7957
13810	**11603**	**834**	**2247**	**66**	**8456**	**2207**	**278**	**463**	**29**	**1437**	**26585**
23	23	0	0	0	23	0	0	0	0	0	63
70	63	0	0	0	63	7	0	0	0	7	153
91	90	0	0	0	90	1	0	0	0	1	127
49	49	0	0	0	49	0	0	0	0	0	92
495	457	1	0	0	456	38	0	0	0	38	606
231	225	3	2	1	219	6	0	0	0	6	365
117	117	6	4	0	107	0	0	0	0	0	63
308	299	2	0	0	297	9	0	0	0	9	372
17	17	0	0	0	17	0	0	0	0	0	25
1401	**1340**	**12**	**6**	**1**	**1321**	**61**	**0**	**0**	**0**	**61**	**1866**
16243	**13929**	**1641**	**2378**	**99**	**9811**	**2314**	**288**	**495**	**30**	**1501**	**29546**

35.47	**30.42**	**11.78**	**17.07**	**0.71**	**70.44**	**5.05**	**12.45**	**21.39**	**1.30**	**64.87**	**64.53**

Dispersion Modelling with ISCST3 model for Sohmluh Limestone Mine and Arjust Limestone Mine operation

```
CO STARTING
   TITLEONE SOHMLUH AND ARJUST LIMESTONE
MINES
   TITLETWO PM10 EMISSIONS FROM MINING
   MODELOPT DFAULT CONC RURAL
   AVERTIME 24 PERIOD
   POLLUTID PM10
   RUNORNOT RUN
 CO FINISHED
 SO STARTING
 **  S1  Sohmluh LS mine pit
 **  A1  Arjust LS mine pit
 **  A2  Arjust LS mine pit
 **  A3  Arjust LS mine pit

 SO LOCATION S1  AREA  10526.278  10603.8078
 SO LOCATION A1  AREA  11065.5135  10389.7247
 SO LOCATION A2  AREA  11066.7317  10367.3134
 SO LOCATION A3  AREA  11070.8185  10345.8103

 SO SRCPARAM S1  3.87965555555556E-06  0  175.5
183.2  71  35
 SO SRCPARAM A1  5.45413292376431E-06  0  47.09
62.66  15  35
 SO SRCPARAM A2  5.45413292376431E-06  0  9.65
21.28  15  35
 SO SRCPARAM A3  5.45413292376431E-06  0  30.31
40.93  15  35

 SO SRCGROUP ALL
 SO FINISHED
 RE STARTING
   GRIDPOLR POL1 STA
   GRIDPOLR POL1 ORIG  10876.08  10441.78
   GRIDPOLR POL1 DIST   500  1000  1500  2000
2500  3000  3500  4000  5000
   GRIDPOLR POL1 GDIR  16  0  22.5
   GRIDPOLR POL1 END
 **  100 M
   DISCCART  11002.7238  10568.4228
   DISCCART  11133.8572  10547.3354
   DISCCART  11240.9627  10441.7801
   DISCCART  11209.9851  10303.4725
   DISCCART  11107.4068  10210.4544
   DISCCART  10961.1182  10356.743
   DISCCART  10958.4332  10407.6688
   DISCCART  10967.8315  10441.7801
   DISCCART  10979.6512  10484.6803
   DISCCART  10768.2439  10397.1125
   DISCCART  10459.6074  10441.7801
   DISCCART  10414.1414  10633.1218
   DISCCART  10582.1337  10735.7276
   DISCCART  10725.1833  10806.0797
   DISCCART  10872.5517  10433.8268
 **  200 M
   DISCCART  10876.0811  10921.2191
   DISCCART  10982.0697  10697.6592
   DISCCART  11097.1816  10662.8806
   DISCCART  11277.9857  10608.2544
   DISCCART  11344.9924  10441.7801
   DISCCART  11305.5706  10263.8798
   DISCCART  10996.4819  10151.107
   DISCCART  10876.0811  10206.5115
   DISCCART  10821.4196  10309.8156
   DISCCART  10702.1284  10267.8273
   DISCCART  10459.2887  10269.139
   DISCCART  10686.8355  10898.6593
 ** 300 M
   DISCCART  11020.5275  10790.5045
   DISCCART  11177.4075  10743.1065
   DISCCART  11052.591  10015.6475
   DISCCART  10876.0811  10096.0774
   DISCCART  10770.0124  10185.7075
   DISCCART  10538.5317  10104.2307
 ** AAQ
   DISCCART  11720.4047  9959.0153
   DISCCART  11710.5462  11988.3131
   DISCCART  10281.0463  9988.5682
   DISCCART  11714.2789  11219.9562
   DISCCART  10074.0154  8471.5202
   DISCCART  9374.0532  9013.3229
   DISCCART  13938.5945  10185.5874
   DISCCART  9117.7291  10037.8229
 RE FINISHED
 ME STARTING
   INPUTFIL MA\SA\ARJUST.MET
   ANEMHGHT 5.0
   SURFDATA 99999 2019 DEC
   UAIRDATA 99999 2020 FEB
   WDROTATE 180
 ME FINISHED
 OU STARTING
 OU RECTABLE 24 FIRST
 OU MAXTABLE 24 50
 OU PLOTFILE 24 ALL FIRST MA\SA\SAPM10.PLT

 OU FINISHED

 **********************************
 *** SETUP Finishes Successfully ***
 ********************************** *
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Dispersion Modelling with ISCST3 model for Sohmluh Limestone Mine and Arjust Limestone Mine operation

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                    **Intermediate Terrain Processing is Selected

 **Model Is Setup For Calculation of Average CONCentration Values.

   --  SCAVENGING/DEPOSITION LOGIC --
 **Model Uses NO DRY DEPLETION.  DDPLETE = F
 **Model Uses NO WET DEPLETION.  WDPLETE = F
 **NO WET SCAVENGING Data Provided.
 **Model Does NOT Use GRIDDED TERRAIN Data for Depletion Calculations

 **Model Uses RURAL Dispersion.

 **Model Uses Regulatory DEFAULT Options:
           1. Final Plume Rise.
           2. Stack-tip Downwash.
           3. Buoyancy-induced Dispersion.
           4. Use Calms Processing Routine.
           5. Not Use Missing Data Processing Routine.
           6. Default Wind Profile Exponents.
           7. Default Vertical Potential Temperature Gradients.
           8. "Upper Bound" Values for Supersquat Buildings.
           9. No Exponential Decay for RURAL Mode

 **Model Assumes Receptors on FLAT Terrain.

 **Model Assumes No FLAGPOLE Receptor Heights.

 **Model Calculates  1 Short Term Average(s) of:  24-HR and Calculates PERIOD Averages

 **This Run Includes:    4 Source(s);      1 Source Group(s); and    185 Receptor(s)

 **The Model Assumes A Pollutant Type of:  PM10

 **Model Set To Continue RUNning After the Setup Testing.

 **Output Options Selected:
         Model Outputs Tables of PERIOD Averages by Receptor
         Model Outputs Tables of Highest Short Term Values by Receptor (RECTABLE Keyword)
         Model Outputs Tables of Overall Maximum Short Term Values (MAXTABLE Keyword)
         Model Outputs External File(s) of High Values for Plotting (PLOTFILE Keyword)

 **NOTE: The Following Flags May Appear Following CONC Values: c for Calm Hours
                                                               m for Missing Hours
                                                               b for Both Calm and Missing Hours

 **Misc. Inputs:  Anem. Hgt. (m) =   5.00 ;    Decay Coef. = .0000  ;    Rot. Angle = 180.0
                  Emission Units = GRAMS/SEC  ;  Emission Rate Unit Factor = .10000E+07
                  Output Units   = MICROGRAMS/M**3

 **Input Runstream File: MA\SA\SAPM10.INP  ;  **Output Print File: MA\SA\SAPM10.OUT

**MODELOPTs: CONC                        RURAL  FLAT          DFAULT

                                *** AREA SOURCE DATA ***
```

Source	No part	Emission rate (g/s/m2)				Coord. (SW corner) (m)		Base elev.	Rel. Height	Dim of area (m)		Orient, of area	Init. SZ
ID	Cats.	PM10	PM2.5	SO2	NO2	X	Y	(m)	(m)	X	Y	(deg)	(m)
S1	0	.388E-05	.2231E-05	.3025E-06	.6049E-06	10526.3	10603.8	0	0	175.5	183.2	71	35
A1	0	.545E-05	.1361E-05	.2765E-06	.5531E-06	11065.5	10389.7	0	0	47.09	62.66	15	35
A2	0	.545E-05	.1361E-05	.2765E-06	.5531E-06	11066.7	10367.3	0	0	9.65	21.28	15	35
A3	0	.545E-05	.1361E-05	.2765E-06	.5531E-06	11070.8	10345.8	0	0	30.31	40.93	15	35

```
          *** GRIDDED RECEPTOR NETWORK SUMMARY ***
        *** NETWORK ID: POL1     ;  NETWORK TYPE: GRIDPOLR ***

                    *** ORIGIN FOR POLAR NETWORK ***
          X-ORIG =  10876.08 ;   Y-ORIG =   10441.78  (METERS)

                    *** DISTANCE RANGES OF NETWORK ***
                                (METERS)
```

```
500.0, 1000.0, 1500.0, 2000.0, 2500.0, 3000.0, 3500.0, 4000.0, 5000.0,

                *** DIRECTION RADIALS OF NETWORK ***
                            (DEGREES)

360.0, 22.5, 45.0, 67.5, 90.0, 112.5, 135.0, 157.5, 180.0, 202.5, 225.0,
            247.5, 270.0, 292.5, 315.0, 337.5

                *** DISCRETE CARTESIAN RECEPTORS ***
                (X-COORD, Y-COORD, ZELEV, ZFLAG)
                            (METERS)
 (  11002.7,   10568.4,  .0,  .0);    (  11133.9,   10547.3,  .0,  .0);
 (  11241.0,   10441.8,  .0,  .0);    (  11210.0,   10303.5,  .0,  .0);
 (  11107.4,   10210.5,  .0,  .0);    (  10961.1,   10356.7,  .0,  .0);
 (  10958.4,   10407.7,  .0,  .0);    (  10967.8,   10441.8,  .0,  .0);
 (  10979.7,   10484.7,  .0,  .0);    (  10768.2,   10397.1,  .0,  .0);
 (  10459.6,   10441.8,  .0,  .0);    (  10414.1,   10633.1,  .0,  .0);
 (  10582.1,   10735.7,  .0,  .0);    (  10725.2,   10806.1,  .0,  .0);
 (  10872.6,   10433.8,  .0,  .0);    (  10876.1,   10921.2,  .0,  .0);
 (  10982.1,   10697.7,  .0,  .0);    (  11097.2,   10662.9,  .0,  .0);
 (  11278.0,   10608.3,  .0,  .0);    (  11345.0,   10441.8,  .0,  .0);
 (  11305.6,   10263.9,  .0,  .0);    (  10996.5,   10151.1,  .0,  .0);
 (  10876.1,   10206.5,  .0,  .0);    (  10821.4,   10309.8,  .0,  .0);
 (  10702.1,   10267.8,  .0,  .0);    (  10459.3,   10269.1,  .0,  .0);
 (  10686.8,   10898.7,  .0,  .0);    (  11020.5,   10790.5,  .0,  .0);
 (  11177.4,   10743.1,  .0,  .0);    (  11052.6,   10015.6,  .0,  .0);
 (  10876.1,   10096.1,  .0,  .0);    (  10770.0,   10185.7,  .0,  .0);
 (  10538.5,   10104.2,  .0,  .0);    (  11720.4,    9959.0,  .0,  .0);
 (  11710.5,   11988.3,  .0,  .0);    (  10281.0,    9988.6,  .0,  .0);
 (  11714.3,   11220.0,  .0,  .0);    (  10074.0,    8471.5,  .0,  .0);
 (   9374.1,    9013.3,  .0,  .0);    (  13938.6,   10185.6,  .0,  .0);
 (   9117.7,   10037.8,  .0,  .0);

                    *** METEOROLOGICAL DAYS SELECTED FOR PROCESSING ***
                                      (1=YES; 0=NO)
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1
NOTE:  METEOROLOGICAL DATA ACTUALLY PROCESSED WILL ALSO DEPEND ON WHAT IS INCLUDED IN THE DATA FILE.

            *** UPPER BOUND OF FIRST THROUGH FIFTH WIND SPEED CATEGORIES ***
                                  (METERS/SEC)
                     1.54,   3.09,   5.14,   8.23,  10.80,

                          *** WIND PROFILE EXPONENTS ***

 STABILITY                             WIND SPEED CATEGORY
 CATEGORY       1            2             3             4             5             6
A          .70000E-01   .70000E-01    .70000E-01    .70000E-01    .70000E-01    .70000E-01
B          .70000E-01   .70000E-01    .70000E-01    .70000E-01    .70000E-01    .70000E-01
C          .10000E+00   .10000E+00    .10000E+00    .10000E+00    .10000E+00    .10000E+00
D          .15000E+00   .15000E+00    .15000E+00    .15000E+00    .15000E+00    .15000E+00
E          .35000E+00   .35000E+00    .35000E+00    .35000E+00    .35000E+00    .35000E+00
F          .55000E+00   .55000E+00    .55000E+00    .55000E+00    .55000E+00    .55000E+00


                *** VERTICAL POTENTIAL TEMPERATURE GRADIENTS ***
                          (DEGREES KELVIN PER METER)

STABILITY                              WIND SPEED CATEGORY
CATEGORY        1            2             3             4             5             6
A          .00000E+00   .00000E+00    .00000E+00    .00000E+00    .00000E+00    .00000E+00
B          .00000E+00   .00000E+00    .00000E+00    .00000E+00    .00000E+00    .00000E+00
```

C	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
D	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
E	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01
F	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01

*** THE FIRST 24 HOURS OF METEOROLOGICAL DATA ***

FILE: MA\PIRTMAI\PIRTMAI.MET FORMAT: (4I2,2F9.4,F6.1,I2,2F7.1,f9.4,f10.1,f8.4,i4,f7.2)
SURFACE STATION NO.: 99999 UPPER AIR STATION NO.: 99999
NAME: DEC NAME: FEB
YEAR: 2019 YEAR: 2020

YEAR	MONTH	DAY	HOUR	FLOW VECTOR	SPEED (M/S)	TEMP (K)	STAB CLASS	MIXING HEIGHT (M) RURAL	MIXING HEIGHT (M) URBAN	USTAR (M/S)	M-O LENGTH (M)	Z-0 (M)	IPCODE	PRATE (mm/HR)
19	12	1	1	45.0	.00	292.0	6	128.0	128.0	.0000	.0	.0000	0	.00
19	12	1	2	293.0	.00	291.0	6	103.0	103.0	.0000	.0	.0000	0	.00
19	12	1	3	.0	.00	291.0	6	98.0	98.0	.0000	.0	.0000	0	.00
19	12	1	4	45.0	.00	290.0	6	88.0	88.0	.0000	.0	.0000	0	.00
19	12	1	5	90.0	.00	289.0	6	85.0	85.0	.0000	.0	.0000	0	.00
19	12	1	6	.0	.00	289.0	1	95.0	95.0	.0000	.0	.0000	0	.00
19	12	1	7	203.0	.00	288.0	1	113.0	113.0	.0000	.0	.0000	0	.00
19	12	1	8	293.0	.00	287.0	1	215.0	215.0	.0000	.0	.0000	0	.00
19	12	1	9	23.0	.00	291.0	1	460.0	460.0	.0000	.0	.0000	0	.00
19	12	1	10	203.0	.00	293.0	1	778.0	778.0	.0000	.0	.0000	0	.00
19	12	1	11	158.0	.00	295.0	1	1095.0	1095.0	.0000	.0	.0000	0	.00
19	12	1	12	.0	.00	297.0	1	1430.0	1430.0	.0000	.0	.0000	0	.00
19	12	1	13	158.0	.00	299.0	1	1693.0	1693.0	.0000	.0	.0000	0	.00
19	12	1	14	180.0	.00	301.0	1	1803.0	1803.0	.0000	.0	.0000	0	.00
19	12	1	15	33.0	.00	299.0	1	1803.0	1803.0	.0000	.0	.0000	0	.00
19	12	1	16	203.0	.00	297.0	1	1683.0	1683.0	.0000	.0	.0000	0	.00
19	12	1	17	203.0	.00	296.0	1	1253.0	1253.0	.0000	.0	.0000	0	.00
19	12	1	18	338.0	.56	295.0	1	955.0	955.0	.0000	.0	.0000	0	.00
19	12	1	19	293.0	.00	294.0	1	748.0	748.0	.0000	.0	.0000	0	.00
19	12	1	20	293.0	.00	293.0	6	608.0	608.0	.0000	.0	.0000	0	.00
19	12	1	21	.0	.56	292.0	6	515.0	515.0	.0000	.0	.0000	0	.00
19	12	1	22	338.0	.00	292.0	6	418.0	418.0	.0000	.0	.0000	0	.00
19	12	1	23	45.0	.00	291.0	6	300.0	300.0	.0000	.0	.0000	0	.00
19	12	1	24	.0	.56	290.0	6	165.0	165.0	.0000	.0	.0000	0	.00

*** NOTES: STABILITY CLASS 1=A, 2=B, 3=C, 4=D, 5=E AND 6=F.
FLOW VECTOR IS DIRECTION TOWARD WHICH WIND IS BLOWING.

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP:ALL***
INCLUDING SOURCE(S): A1, A2, A3
*** NETWORK ID: POL1 ; NETWORK TYPE: GRIDPOLR ***
**** CONC OF PM10 IN MICROGRAMS/M**3****

DIRECTION (DEGREES)	DISTANCE (METERS) 500.00	1000.00	1500.00	2000.00	2500.00
360.0	.37520c(20013024)	.09731c(20013024)	.04260c(20013024)	.03042c(20013024)	.03372c(20013024)
22.5	.82218c(20013024)	.11137c(20013024)	.05671c(20013024)	.05022c(20013024)	.04413c(20013024)
45.0	.11352c(20012224)	.01949c(20012224)	.00850c(20013024)	.01212c(20013024)	.02359c(20013024)
67.5	.68747c(20012224)	.05400c(20012824)	.02756c(20012824)	.01660c(20012824)	.01104c(20012824)
90.0	.52861c(20012224)	.51700c(20012224)	.52887c(20012224)	.51736c(20012224)	.49344c(20012224)
112.5	2.72366 (20010724)	2.32524 (20010724)	1.97439 (20010724)	1.66292 (20010724)	1.41022 (20010724)
135.0	2.02797c(20010624)	.44201c(20022624)	.42094c(20022624)	.41171c(20022624)	.39762c(20022624)
157.5	1.10345c(20012224)	.15009c(20010624)	.19028c(20010624)	.27991c(20010624)	.38270c(20010624)
180.0	4.33874c(20010624)	.24052c(20010624)	.18922c(20010624)	.18291c(20010824)	.21001c(20010824)
202.5	3.18950c(20012224)	.53649c(20010624)	.20238c(19121424)	.09815c(19120824)	.08781c(20021724)
225.0	1.69738c(20010624)	1.50227c(19121424)	1.21371c(19121424)	.21403c(19121424)	.16144c(19122424)
247.5	3.69032c(19122424)	.34502c(19122424)	.11401c(20021524)	.09680c(20013024)	.13135c(20013024)
270.0	2.06459c(20012524)	.34610c(19123024)	.38050c(19123024)	.38735c(19123024)	.38127c(19123024)
292.5	1.07790c(19122924)	.64481c(19122924)	.54566c(19122924)	.45787c(19122924)	.38663c(19122924)
315.0	.37175c(20020324)	.05539c(20013024)	.03945c(20013024)	.03067c(20013024)	.02514c(20013024)
337.5	1.11712c(20013024)	.06015c(20020424)	.01489c(20020424)	.00714c(20020424)	.00442c(20020424)

DIRECTION (DEGREES)	DISTANCE (METERS) 3000.00	3500.00	4000.00	5000.00
360.0	.04445c(20013024)	.05747c(20013024)	.06968c(20013024)	.08718c(20013024)
22.5	.03909c(20013024)	.03499c(20013024)	.03168c(20013024)	.02655c(20013024)
45.0	.03868c(20013024)	.05381c(20013024)	.06682c(20013024)	.08440c(20013024)
67.5	.00790c(20012824)	.00592c(20012824)	.00462c(20012824)	.00360 (20010724)
90.0	.46434c(20012224)	.43418c(20012224)	.40432c(20012224)	.34956c(20012224)
112.5	1.21190 (20010724)	1.05641 (20010724)	.93154 (20010724)	.74531 (20010724)
135.0	.37775c(20022624)	.35523c(20022624)	.33169c(20022624)	.28711c(20022624)
157.5	.47272c(20010624)	.53924c(20010624)	.58151c(20010624)	.61123c(20010624)
180.0	.25104c(20010824)	.29488c(20010824)	.33334c(20010824)	.39473c(20012224)
202.5	.09264c(20021724)	.10131c(20010624)	.12294c(20010624)	.15732c(20010624)
225.0	.21199c(19122424)	.26540c(19122424)	.31332c(19122424)	.37988c(19122424)
247.5	.15777c(20013024)	.17657c(20013024)	.18870c(20013024)	.19832c(20013024)
270.0	.36735c(19123024)	.34912c(19123024)	.32893c(19123024)	.28778c(19123024)
292.5	.33084c(19122924)	.28710c(19122924)	.25258c(19122924)	.20134c(19122924)
315.0	.02138c(20013024)	.01863c(20013024)	.01655c(20013024)	.01359c(20013024)
337.5	.00303c(20020424)	.00219c(20020424)	.00167c(20020424)	.00107c(20020424)

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

X-COORD (M)	Y-COORD (M)	** CONC OF PM10 IN MICROGRAMS/M**3 CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	** CONC	(YYMMDDHH)
11002.72	10568.42	1.33491c	(20012224)	11133.86	10547.33	1.42447c	(20012224)
11240.96	10441.78	.72149c	(20012224)	11209.99	10303.47	2.89677	(20010724)
11107.41	10210.45	2.72127c	(20012224)	10961.12	10356.74	1.85591	(20010724)
10958.43	10407.67	2.58542	(20010724)	10967.83	10441.78	2.18545	(20010724)
10979.65	10484.68	1.60260c	(20012224)	10768.24	10397.11	5.27181c	(20010624)
10459.61	10441.78	4.57454c	(19122424)	10414.14	10633.12	1.07790c	(19122924)
10582.13	10735.73	1.34196c	(20013024)	10725.18	10806.08	1.22739c	(20013024)
10872.55	10433.83	2.45816	(20010724)	10876.08	10921.22	.48328c	(20013024)
10982.07	10697.66	.36293c	(20012224)	11097.18	10662.88	.59727c	(20013024)
11277.99	10608.25	1.04343c	(20012224)	11344.99	10441.78	.54451c	(20012224)
11305.57	10263.88	2.75814	(20010724)	10996.48	10151.11	1.64303c	(20010624)
10876.08	10206.51	2.91217c	(20010624)	10821.42	10309.82	4.12874c	(20010624)
10702.13	10267.83	6.91496c	(20010624)	10459.29	10269.14	3.44244c	(20010624)
10686.84	10898.66	1.13283c	(20013024)	11020.53	10790.50	.29149c	(20012224)
11177.41	10743.11	.17930	(20010724)	11052.59	10015.65	.58556c	(20012824)
10876.08	10096.08	4.26883c	(20010624)	10770.01	10185.71	4.53539c	(20010624)
10538.53	10104.23	1.87253c	(20010624)	11720.41	9959.01	.36531	(20010724)
11710.55	11988.31	.03901c	(20013024)	10281.05	9988.57	2.23146c	(19121424)
11714.28	11219.96	.01372c	(20012224)	10074.01	8471.52	.08771c	(19120824)
9374.05	9013.32	.22440c	(19122424)	13938.59	10185.59	.04232c	(20012824)
9117.73	10037.82	.49371c	(20013024)				

Dispersion Modelling with ISCST3 model for Sohmluh Limestone Mine and Arjust Limestone Mine operation

*** THE MAXIMUM 50 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***

RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR,YR)		OF TYPE	RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR,YR)		OF TYPE
1.	6.91496c	(20010624)	AT (	10702.13,	10267.83)	DC	26.	3.07840c	(20012824)	AT (	10770.01,	10185.71)	DC
2.	5.68574c	(20012824)	AT (	10702.13,	10267.83)	DC	27.	3.07267c	(19121324)	AT (	10459.29,	10269.14)	DC
3.	5.46482c	(20010824)	AT (	10702.13,	10267.83)	DC	28.	3.05456c	(20011124)	AT (	10459.61,	10441.78)	DC
4.	5.27181c	(20010624)	AT (	10768.24,	10397.11)	DC	29.	2.91217c	(20010624)	AT (	10876.08,	10206.51)	DC
5.	4.94826c	(20012124)	AT (	10702.13,	10267.83)	DC	30.	2.89677	(20010724)	AT (	11209.99,	10303.47)	DC
6.	4.57454c	(19122424)	AT (	10459.61,	10441.78)	DC	31.	2.86633c	(20010824)	AT (	10684.74,	9979.84)	GP
7.	4.53539c	(20010624)	AT (	10770.01,	10185.71)	DC	32.	2.86445c	(19121724)	AT (	10459.29,	10269.14)	DC
8.	4.43421c	(20012224)	AT (	10702.13,	10267.83)	DC	33.	2.80491c	(20013024)	AT (	10459.61,	10441.78)	DC
9.	4.33874c	(20010624)	AT (	10876.08,	9941.78)	GP	34.	2.80491c	(20013124)	AT (	10459.61,	10441.78)	DC
10.	4.26883c	(20010624)	AT (	10876.08,	10096.08)	DC	35.	2.75814	(20010724)	AT (	11305.57,	10263.88)	DC
11.	4.12874c	(20010624)	AT (	10821.42,	10309.82)	DC	36.	2.72366	(20010724)	AT (	11338.02,	10250.44)	GP
12.	4.00029c	(20010324)	AT (	10768.24,	10397.11)	DC	37.	2.72127c	(20012224)	AT (	11107.41,	10210.45)	DC
13.	3.99758c	(20012824)	AT (	10768.24,	10397.11)	DC	38.	2.71886c	(20010324)	AT (	10821.42,	10309.82)	DC
14.	3.97023	(20010724)	AT (	10702.13,	10267.83)	DC	39.	2.71508c	(19121424)	AT (	10414.14,	10250.44)	GP
15.	3.69032c	(19122424)	AT (	10414.14,	10250.44)	GP	40.	2.70586	(20010724)	AT (	10768.24,	10397.11)	DC
16.	3.44400c	(20012524)	AT (	10459.61,	10441.78)	DC	41.	2.68550c	(20010624)	AT (	10414.14,	10250.44)	GP
17.	3.44244c	(20010624)	AT (	10459.29,	10269.14)	DC	42.	2.60198c	(20010824)	AT (	10768.24,	10397.11)	DC
18.	3.32857c	(20012124)	AT (	10768.24,	10397.11)	DC	43.	2.60042c	(20010624)	AT (	10684.74,	9979.84)	GP
19.	3.31566c	(20010324)	AT (	10702.13,	10267.83)	DC	44.	2.58542	(20010724)	AT (	10958.43,	10407.67)	DC
20.	3.26659c	(19121424)	AT (	10459.29,	10269.14)	DC	45.	2.56115c	(20012824)	AT (	10821.42,	10309.82)	DC
21.	3.26397c	(20012024)	AT (	10702.13,	10267.83)	DC	46.	2.56089c	(20010324)	AT (	10770.01,	10185.71)	DC
22.	3.18950c	(20012224)	AT (	10684.74,	9979.84)	GP	47.	2.54404c	(20012524)	AT (	10702.13,	10267.83)	DC
23.	3.14365c	(19122424)	AT (	10459.29,	10269.14)	DC	48.	2.53475c	(19122324)	AT (	10459.61,	10441.78)	DC
24.	3.10796c	(19122324)	AT (	10459.29,	10269.14)	DC	49.	2.52349c	(19122324)	AT (	10414.14,	10250.44)	GP
25.	3.07952	(20012924)	AT (	10702.13,	10267.83)	DC	50.	2.48040c	(20012124)	AT (	10770.01,	10185.71)	DC

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP:ALL***
INCLUDING SOURCE(S): A1, A2, A3
*** NETWORK ID: POL1 ; NETWORK TYPE: GRIDPOLR ***
**** CONC OF PM2.5 IN MICROGRAMS/M**3****

DIRECTION (DEGREES)	DISTANCE (METERS) 500.00	1000.00	1500.00	2000.00	2500.00
360.0	.21574c(20013024)	.05595c(20013024)	.02450c(20013024)	.01749c(20013024)	.01939c(20013024)
22.5	.47275c(20013024)	.06403c(20013024)	.03261c(20013024)	.02888c(20013024)	.02538c(20013024)
45.0	.06527c(20012224)	.01121c(20012224)	.00489c(20013024)	.00697c(20013024)	.01356c(20013024)
67.5	.39530c(20012224)	.03105c(20012824)	.01585c(20012824)	.00954c(20012824)	.00635c(20012824)
90.0	.30395c(20012224)	.29728c(20012224)	.30410c(20012224)	.29748c(20012224)	.28373c(20012224)
112.5	1.56610 (20010724)	1.33701 (20010724)	1.13527 (20010724)	.95618 (20010724)	.81088 (20010724)
135.0	1.16608c(20010624)	.25416c(20022624)	.24204c(20022624)	.23673c(20022624)	.22863c(20022624)
157.5	.63448c(20012224)	.08630c(20010624)	.10941c(20010624)	.16095c(20010624)	.22005c(20010624)
180.0	2.49477c(20010624)	.13830c(20010624)	.10880c(20010624)	.10517c(20010824)	.12075c(20010824)
202.5	1.83396c(20012224)	.30848c(20010624)	.11637c(19121424)	.05643c(19120824)	.05049c(20021724)
225.0	.97600c(20010624)	.86380c(19121424)	.69788c(19121424)	.12307c(19121424)	.09283c(19122424)
247.5	2.12194c(19122424)	.19839c(19122424)	.06555c(20021524)	.05566c(20013024)	.07553c(20013024)
270.0	1.18714c(20012524)	.19901c(19123024)	.21879c(19123024)	.22273c(19123024)	.21923c(19123024)
292.5	.61979c(19122924)	.37077c(19122924)	.31375c(19122924)	.26328c(19122924)	.22231c(19122924)
315.0	.21376c(20020324)	.03185c(20013024)	.02268c(20013024)	.01763c(20013024)	.01446c(20013024)
337.5	.64234c(20013024)	.03459c(20020424)	.00856c(20020424)	.00410c(20020424)	.00254c(20020424)

DIRECTION (DEGREES)	DISTANCE (METERS) 3000.00	3500.00	4000.00	5000.00
360.0	.02556c(20013024)	.03304c(20013024)	.04007c(20013024)	.05013c(20013024)
22.5	.02247c(20013024)	.02012c(20013024)	.01821c(20013024)	.01527c(20013024)
45.0	.02224c(20013024)	.03094c(20013024)	.03842c(20013024)	.04853c(20013024)
67.5	.00454c(20012824)	.00340c(20012824)	.00265c(20012824)	.00207 (20010724)
90.0	.26700c(20012224)	.24965c(20012224)	.23248c(20012224)	.20100c(20012224)
112.5	.69684 (20010724)	.60744 (20010724)	.53564 (20010724)	.42855 (20010724)
135.0	.21721c(20022624)	.20426c(20022624)	.19072c(20022624)	.16509c(20022624)
157.5	.27181c(20010624)	.31006c(20010624)	.33437c(20010624)	.35146c(20010624)
180.0	.14435c(20010824)	.16955c(20010824)	.19167c(20010824)	.22697c(20012224)
202.5	.05327c(20021724)	.05826c(20010624)	.07069c(20010624)	.09046c(20010624)
225.0	.12190c(19122424)	.15261c(19122424)	.18016c(19122424)	.21843c(19122424)
247.5	.09072c(20013024)	.10153c(20013024)	.10850c(20013024)	.11403c(20013024)
270.0	.21123c(19123024)	.20074c(19123024)	.18914c(19123024)	.16547c(19123024)
292.5	.19023c(19122924)	.16508c(19122924)	.14523c(19122924)	.11577c(19122924)
315.0	.01229c(20013024)	.01071c(20013024)	.00952c(20013024)	.00782c(20013024)
337.5	.00174c(20020424)	.00126c(20020424)	.00096c(20020424)	.00061c(20020424)

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

X-COORD (M)	Y-COORD (M)	** CONC OF PM10 IN MICROGRAMS/M**3 CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	** CONC	(YYMMDDHH)
11002.72	10568.42	.76757c	(20012224)	11133.86	10547.33	.81907c	(20012224)
11240.96	10441.78	.41486c	(20012224)	11209.99	10303.47	1.66564	(20010724)
11107.41	10210.45	1.56473c	(20012224)	10961.12	10356.74	1.06715	(20010724)
10958.43	10407.67	1.48662	(20010724)	10967.83	10441.78	1.25663	(20010724)
10979.65	10484.68	.92150c	(20012224)	10768.24	10397.11	3.03129c	(20010624)
10459.61	10441.78	2.63036c	(19122424)	10414.14	10633.12	.61979c	(19122924)
10582.13	10735.73	.77163c	(20013024)	10725.18	10806.08	.70575c	(20013024)
10872.55	10433.83	1.41344	(20010724)	10876.08	10921.22	.27789c	(20013024)
10982.07	10697.66	.20868c	(20012224)	11097.18	10662.88	.34343c	(20013024)
11277.99	10608.25	.59997c	(20012224)	11344.99	10441.78	.31309c	(20012224)
11305.57	10263.88	1.58593	(20010724)	10996.48	10151.11	.94474c	(20010624)
10876.08	10206.51	1.67450c	(20010624)	10821.42	10309.82	2.37402c	(20010624)
10702.13	10267.83	3.97610c	(20010624)	10459.29	10269.14	1.97941c	(20010624)
10686.84	10898.66	.65138c	(20013024)	11020.53	10790.50	.16761c	(20012224)
11177.41	10743.11	.10309	(20010724)	11052.59	10015.65	.33670c	(20012824)
10876.08	10096.08	2.45458c	(20010624)	10770.01	10185.71	2.60785c	(20010624)
10538.53	10104.23	1.07670c	(20010624)	11720.41	9959.01	.21006	(20010724)
11710.55	11988.31	.02243c	(20013024)	10281.05	9988.57	1.28309c	(19121424)
11714.28	11219.96	.00789c	(20012224)	10074.01	8471.52	.05044c	(19120824)
9374.05	9013.32	.12903c	(19122424)	13938.59	10185.59	.02433c	(20012824)
9117.73	10037.82	.28388c	(20013024)				

Dispersion Modelling with ISCST3 model for Sohmluh Limestone Mine and Arjust Limestone Mine operation

*** THE MAXIMUM 50 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***

RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR,YR)		OF TYPE	RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR,YR)		OF TYPE
1.	3.97610c	(20010624)	AT (	10702.13,	10267.83)	DC	26.	1.77008c	(20012824)	AT (	10770.01,	10185.71)	DC
2.	3.26930c	(20012824)	AT (	10702.13,	10267.83)	DC	27.	1.76679c	(19121324)	AT (	10459.29,	10269.14)	DC
3.	3.14227c	(20010824)	AT (	10702.13,	10267.83)	DC	28.	1.75637c	(20011124)	AT (	10459.61,	10441.78)	DC
4.	3.03129c	(20010624)	AT (	10768.24,	10397.11)	DC	29.	1.67450c	(20010624)	AT (	10876.08,	10206.51)	DC
5.	2.84525c	(20012124)	AT (	10702.13,	10267.83)	DC	30.	1.66564	(20010724)	AT (	11209.99,	10303.47)	DC
6.	2.63036c	(19122424)	AT (	10459.61,	10441.78)	DC	31.	1.64814c	(20010824)	AT (	10684.74,	9979.84)	GP
7.	2.60785c	(20010624)	AT (	10770.01,	10185.71)	DC	32.	1.64706c	(19121724)	AT (	10459.29,	10269.14)	DC
8.	2.54967c	(20012224)	AT (	10702.13,	10267.83)	DC	33.	1.61282c	(20013024)	AT (	10459.61,	10441.78)	DC
9.	2.49477c	(20010624)	AT (	10876.08,	9941.78)	GP	34.	1.61282c	(20013124)	AT (	10459.61,	10441.78)	DC
10.	2.45458c	(20010624)	AT (	10876.08,	10096.08)	DC	35.	1.58593	(20010724)	AT (	11305.57,	10263.88)	DC
11.	2.37402c	(20010624)	AT (	10821.42,	10309.82)	DC	36.	1.56610	(20010724)	AT (	11338.02,	10250.44)	GP
12.	2.30017c	(20010324)	AT (	10768.24,	10397.11)	DC	37.	1.56473c	(20012224)	AT (	11107.41,	10210.45)	DC
13.	2.29861c	(20012824)	AT (	10768.24,	10397.11)	DC	38.	1.56335c	(20010324)	AT (	10821.42,	10309.82)	DC
14.	2.28288	(20010724)	AT (	10702.13,	10267.83)	DC	39.	1.56117c	(19121424)	AT (	10414.14,	10250.44)	GP
15.	2.12194c	(19122424)	AT (	10414.14,	10250.44)	GP	40.	1.55587	(20010724)	AT (	10768.24,	10397.11)	DC
16.	1.98030c	(20012524)	AT (	10459.61,	10441.78)	DC	41.	1.54416c	(20010624)	AT (	10414.14,	10250.44)	GP
17.	1.97941c	(20010624)	AT (	10459.29,	10269.14)	DC	42.	1.49614c	(20010824)	AT (	10768.24,	10397.11)	DC
18.	1.91393c	(20012124)	AT (	10768.24,	10397.11)	DC	43.	1.49524c	(20010624)	AT (	10684.74,	9979.84)	GP
19.	1.90650c	(20010324)	AT (	10702.13,	10267.83)	DC	44.	1.48662	(20010724)	AT (	10958.43,	10407.67)	DC
20.	1.87829c	(19121424)	AT (	10459.29,	10269.14)	DC	45.	1.47266c	(20012824)	AT (	10821.42,	10309.82)	DC
21.	1.87678c	(20012024)	AT (	10702.13,	10267.83)	DC	46.	1.47251c	(20010324)	AT (	10770.01,	10185.71)	DC
22.	1.83396c	(20012224)	AT (	10684.74,	9979.84)	GP	47.	1.46282c	(20012524)	AT (	10702.13,	10267.83)	DC
23.	1.80760c	(19122424)	AT (	10459.29,	10269.14)	DC	48.	1.45748c	(19122324)	AT (	10459.61,	10441.78)	DC
24.	1.78708c	(19122324)	AT (	10459.29,	10269.14)	DC	49.	1.45101c	(19122324)	AT (	10414.14,	10250.44)	GP
25.	1.77073	(20012924)	AT (	10702.13,	10267.83)	DC	50.	1.42623c	(20012124)	AT (	10770.01,	10185.71)	DC

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP:ALL***
INCLUDING SOURCE(S): A1, A2, A3
*** NETWORK ID: POL1 ; NETWORK TYPE: GRIDPOLR ***
**** CONC OF SO_2 IN MICROGRAMS/M**3****

DIRECTION (DEGREES)	DISTANCE (METERS) 500.00	1000.00	1500.00	2000.00	2500.00
360.0	.02907c(20013024)	.00754c(20013024)	.00329c(20013024)	.00233c(20013024)	.00254c(20013024)
22.5	.05797c(20013024)	.00833c(20013024)	.00415c(20013024)	.00368c(20013024)	.00324c(20013024)
45.0	.00803c(20012224)	.00144c(20012224)	.00055c(20012224)	.00081c(20013024)	.00164c(20013024)
67.5	.05158c(20012224)	.00419c(20012824)	.00213c(20012824)	.00128c(20012824)	.00085c(20012824)
90.0	.03305c(20012224)	.03444c(20012224)	.03608c(20012224)	.03590c(20012224)	.03468c(20012224)
112.5	.19862 (20010724)	.16913 (20010724)	.14307 (20010724)	.12046 (20010724)	.10228 (20010724)
135.0	.10316c(20010624)	.03424c(20022624)	.03245c(20022624)	.03134c(20022624)	.02994c(20022624)
157.5	.05612c(20012224)	.01022c(20010624)	.01406c(20010624)	.02084c(20010624)	.02801c(20010624)
180.0	.31974c(20010624)	.01787c(20010624)	.01399c(20010624)	.01350c(20010824)	.01557c(20010824)
202.5	.24834c(20012224)	.03545c(20010624)	.01272c(20010624)	.00697c(19120824)	.00632c(20021724)
225.0	.13233c(20010624)	.11708c(19121424)	.09459c(19121424)	.01665c(19121424)	.01139c(19122424)
247.5	.28766c(19122424)	.02686c(19122424)	.00839c(20021524)	.00687c(20021524)	.00803c(20013024)
270.0	.16052c(20012524)	.02283c(19123024)	.02607c(19123024)	.02712c(19123024)	.02708c(19123024)
292.5	.08169c(19122924)	.04821c(19122924)	.04073c(19122924)	.03413c(19122924)	.02878c(19122924)
315.0	.02898c(20020324)	.00414c(20013024)	.00294c(20013024)	.00228c(20013024)	.00186c(20013024)
337.5	.08677c(20013024)	.00469c(20020424)	.00116c(20020424)	.00055c(20020424)	.00034c(20020424)

DIRECTION (DEGREES)	DISTANCE (METERS) 3000.00	3500.00	4000.00	5000.00
360.0	.00330c(20013024)	.00423c(20013024)	.00511c(20013024)	.00638c(20013024)
22.5	.00287c(20013024)	.00257c(20013024)	.00233c(20013024)	.00195c(20013024)
45.0	.00271c(20013024)	.00379c(20013024)	.00473c(20013024)	.00603c(20013024)
67.5	.00060c(20012824)	.00045c(20012824)	.00035c(20012824)	.00026 (20010724)
90.0	.03294c(20012224)	.03101c(20012224)	.02903c(20012224)	.02526c(20012224)
112.5	.08802 (20010724)	.07683 (20010724)	.06782 (20010724)	.05435 (20010724)
135.0	.02823c(20022624)	.02642c(20022624)	.02459c(20022624)	.02120c(20022624)
157.5	.03408c(20010624)	.03854c(20010624)	.04139c(20010624)	.04343c(20010624)
180.0	.01858c(20010824)	.02174c(20010824)	.02451c(20010824)	.02894c(20012224)
202.5	.00656c(20021724)	.00700c(20021724)	.00825c(20010624)	.01065c(20010624)
225.0	.01490c(19122424)	.01872c(19122424)	.02222c(19122424)	.02721c(19122424)
247.5	.01002c(20013024)	.01152c(20013024)	.01257c(20013024)	.01358c(20013024)
270.0	.02634c(19123024)	.02519c(19123024)	.02385c(19123024)	.02098c(19123024)
292.5	.02460c(19122924)	.02133c(19122924)	.01875c(19122924)	.01492c(19122924)
315.0	.00158c(20013024)	.00138c(20013024)	.00122c(20013024)	.00100c(20013024)
337.5	.00023c(20020424)	.00017c(20020424)	.00013c(20020424)	.00008c(20020424)

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

X-COORD (M)	Y-COORD (M)	** CONC OF PM10 IN MICROGRAMS/M**3 CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	** CONC	(YYMMDDHH)
11002.72	10568.42	.10309c	(20012224)	11133.86	10547.33	.10495c	(20012224)
11240.96	10441.78	.04378c	(20012224)	11209.99	10303.47	.21011	(20010724)
11107.41	10210.45	.13992c	(20012224)	10961.12	10356.74	.13803	(20010724)
10958.43	10407.67	.19960	(20010724)	10967.83	10441.78	.16996	(20010724)
10979.65	10484.68	.12492c	(20012224)	10768.24	10397.11	.41101c	(20010624)
10459.61	10441.78	.35664c	(19122424)	10414.14	10633.12	.08169c	(19122924)
10582.13	10735.73	.10435c	(20013024)	10725.18	10806.08	.09518c	(20013024)
10872.55	10433.83	.19127	(20010724)	10876.08	10921.22	.03747c	(20013024)
10982.07	10697.66	.02728c	(20012224)	11097.18	10662.88	.03039c	(20013024)
11277.99	10608.25	.07885c	(20012224)	11344.99	10441.78	.03374c	(20012224)
11305.57	10263.88	.20105	(20010724)	10996.48	10151.11	.08797c	(20010624)
10876.08	10206.51	.21606c	(20010624)	10821.42	10309.82	.32189c	(20010624)
10702.13	10267.83	.53911c	(20010624)	10459.29	10269.14	.26838c	(20010624)
10686.84	10898.66	.08799c	(20013024)	11020.53	10790.50	.02127c	(20012224)
11177.41	10743.11	.01147	(20010724)	11052.59	10015.65	.03785c	(20022624)
10876.08	10096.08	.32090c	(20010624)	10770.01	10185.71	.35351c	(20010624)
10538.53	10104.23	.14599c	(20010624)	11720.41	9959.01	.02847	(20010724)
11710.55	11988.31	.00273c	(20013024)	10281.05	9988.57	.17394c	(19121424)
11714.28	11219.96	.00100c	(20012224)	10074.01	8471.52	.00634c	(19120824)
9374.05	9013.32	.01706c	(19122424)	13938.59	10185.59	.00307c	(20012824)
9117.73	10037.82	.03849c	(20013024)				

Dispersion Modelling with ISCST3 model for Sohmluh Limestone Mine and Arjust Limestone Mine operation

*** THE MAXIMUM 50 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***

RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR,YR)		OF TYPE	RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR,YR)		OF TYPE
1.	.53911c	(20010624)	AT (	10702.13,	10267.83)	DC	26.	.23930	(20012924)	AT (	10702.13,	10267.83)	DC
2.	.44288c	(20012824)	AT (	10702.13,	10267.83)	DC	27.	.23778c	(20011124)	AT (	10459.61,	10441.78)	DC
3.	.42605c	(20010824)	AT (	10702.13,	10267.83)	DC	28.	.23767c	(20012824)	AT (	10770.01,	10185.71)	DC
4.	.41101c	(20010624)	AT (	10768.24,	10397.11)	DC	29.	.22332c	(19121724)	AT (	10459.29,	10269.14)	DC
5.	.38380c	(20012124)	AT (	10702.13,	10267.83)	DC	30.	.22331c	(20010824)	AT (	10684.74,	9979.84)	GP
6.	.35664c	(19122424)	AT (	10459.61,	10441.78)	DC	31.	.21868c	(20013024)	AT (	10459.61,	10441.78)	DC
7.	.35351c	(20010624)	AT (	10770.01,	10185.71)	DC	32.	.21868c	(20013124)	AT (	10459.61,	10441.78)	DC
8.	.34569c	(20012224)	AT (	10702.13,	10267.83)	DC	33.	.21606c	(20010624)	AT (	10876.08,	10206.51)	DC
9.	.32189c	(20010624)	AT (	10821.42,	10309.82)	DC	34.	.21144c	(19121424)	AT (	10414.14,	10250.44)	GP
10.	.32090c	(20010624)	AT (	10876.08,	10096.08)	DC	35.	.21042	(20010724)	AT (	10768.24,	10397.11)	DC
11.	.31974c	(20010624)	AT (	10876.08,	9941.78)	GP	36.	.21011	(20010724)	AT (	11209.99,	10303.47)	DC
12.	.31165c	(20012824)	AT (	10768.24,	10397.11)	DC	37.	.20937c	(20010624)	AT (	10414.14,	10250.44)	GP
13.	.31117c	(20010324)	AT (	10768.24,	10397.11)	DC	38.	.20932c	(20010324)	AT (	10821.42,	10309.82)	DC
14.	.30827	(20010724)	AT (	10702.13,	10267.83)	DC	39.	.20286c	(20010824)	AT (	10768.24,	10397.11)	DC
15.	.28766c	(19122424)	AT (	10414.14,	10250.44)	GP	40.	.20105	(20010724)	AT (	11305.57,	10263.88)	DC
16.	.26838c	(20010624)	AT (	10459.29,	10269.14)	DC	41.	.19960	(20010724)	AT (	10958.43,	10407.67)	DC
17.	.26788c	(20012524)	AT (	10459.61,	10441.78)	DC	42.	.19876c	(20012824)	AT (	10821.42,	10309.82)	DC
18.	.25714c	(20010324)	AT (	10702.13,	10267.83)	DC	43.	.19862	(20010724)	AT (	11338.02,	10250.44)	GP
19.	.25663c	(20012124)	AT (	10768.24,	10397.11)	DC	44.	.19831c	(20010324)	AT (	10770.01,	10185.71)	DC
20.	.25437c	(19121424)	AT (	10459.29,	10269.14)	DC	45.	.19762c	(19122324)	AT (	10459.61,	10441.78)	DC
21.	.25384c	(20012024)	AT (	10702.13,	10267.83)	DC	46.	.19670c	(19122324)	AT (	10414.14,	10250.44)	GP
22.	.24834c	(20012224)	AT (	10684.74,	9979.84)	GP	47.	.19321c	(20012524)	AT (	10702.13,	10267.83)	DC
23.	.24504c	(19122424)	AT (	10459.29,	10269.14)	DC	48.	.19199c	(20010624)	AT (	10684.74,	9979.84)	GP
24.	.24226c	(19122324)	AT (	10459.29,	10269.14)	DC	49.	.19198c	(20012124)	AT (	10770.01,	10185.71)	DC
25.	.23955c	(19121324)	AT (	10459.29,	10269.14)	DC	50.	.19127	(20010724)	AT (	10872.55,	10433.83)	DC

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP:ALL***
INCLUDING SOURCE(S): A1, A2, A3
*** NETWORK ID: POL1 ; NETWORK TYPE: GRIDPOLR ***
**** CONC OF NO_2 IN MICROGRAMS/M**3****

DIRECTION (DEGREES)	DISTANCE (METERS) 500.00	1000.00	1500.00	2000.00	2500.00
360.0	.05814c(20013024)	.01508c(20013024)	.00658c(20013024)	.00466c(20013024)	.00508c(20013024)
22.5	.11594c(20013024)	.01667c(20013024)	.00829c(20013024)	.00736c(20013024)	.00648c(20013024)
45.0	.01606c(20012224)	.00287c(20012224)	.00111c(20012224)	.00162c(20013024)	.00327c(20013024)
67.5	.10316c(20012224)	.00838c(20012824)	.00426c(20012824)	.00255c(20012824)	.00169c(20012824)
90.0	.06609c(20012224)	.06888c(20012224)	.07217c(20012224)	.07181c(20012224)	.06936c(20012224)
112.5	.39724 (20010724)	.33826 (20010724)	.28613 (20010724)	.24093 (20010724)	.20455 (20010724)
135.0	.20631c(20010624)	.06848c(20022624)	.06490c(20022624)	.06268c(20022624)	.05988c(20022624)
157.5	.11224c(20012224)	.02044c(20010624)	.02812c(20010624)	.04168c(20010624)	.05602c(20010624)
180.0	.63948c(20010624)	.03574c(20010624)	.02799c(20010624)	.02700c(20010824)	.03114c(20010824)
202.5	.49668c(20012224)	.07089c(20010624)	.02544c(20010624)	.01394c(19120824)	.01263c(20021724)
225.0	.26466c(20010624)	.23415c(19121424)	.18917c(19121424)	.03330c(19121424)	.02278c(19122424)
247.5	.57532c(19122424)	.05373c(19122424)	.01678c(20021524)	.01374c(20021524)	.01606c(20013024)
270.0	.32105c(20012524)	.04566c(19123024)	.05213c(19123024)	.05424c(19123024)	.05415c(19123024)
292.5	.16337c(19122924)	.09641c(19122924)	.08147c(19122924)	.06826c(19122924)	.05756c(19122924)
315.0	.05797c(20020324)	.00828c(20013024)	.00587c(20013024)	.00455c(20013024)	.00373c(20013024)
337.5	.17353c(20013024)	.00937c(20020424)	.00232c(20020424)	.00111c(20020424)	.00068c(20020424)

DIRECTION (DEGREES)	DISTANCE (METERS) 3000.00	3500.00	4000.00	5000.00
360.0	.00660c(20013024)	.00847c(20013024)	.01023c(20013024)	.01277c(20013024)
22.5	.00574c(20013024)	.00514c(20013024)	.00466c(20013024)	.00391c(20013024)
45.0	.00542c(20013024)	.00758c(20013024)	.00947c(20013024)	.01207c(20013024)
67.5	.00121c(20012824)	.00090c(20012824)	.00070c(20012824)	.00053 (20010724)
90.0	.06589c(20012224)	.06203c(20012224)	.05805c(20012224)	.05052c(20012224)
112.5	.17604 (20010724)	.15365 (20010724)	.13563 (20010724)	.10870 (20010724)
135.0	.05647c(20022624)	.05284c(20022624)	.04918c(20022624)	.04241c(20022624)
157.5	.06817c(20010624)	.07708c(20010624)	.08278c(20010624)	.08685c(20010624)
180.0	.03716c(20010824)	.04349c(20010824)	.04902c(20010824)	.05788c(20012224)
202.5	.01311c(20021724)	.01400c(20021724)	.01649c(20010624)	.02129c(20010624)
225.0	.02981c(19122424)	.03744c(19122424)	.04445c(19122424)	.05443c(19122424)
247.5	.02003c(20013024)	.02305c(20013024)	.02514c(20013024)	.02715c(20013024)
270.0	.05267c(19123024)	.05039c(19123024)	.04769c(19123024)	.04196c(19123024)
292.5	.04920c(19122924)	.04265c(19122924)	.03749c(19122924)	.02985c(19122924)
315.0	.00316c(20013024)	.00276c(20013024)	.00245c(20013024)	.00201c(20013024)
337.5	.00047c(20020424)	.00034c(20020424)	.00026c(20020424)	.00016c(20020424)

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

X-COORD (M)	Y-COORD (M)	** CONC OF PM10 IN MICROGRAMS/M**3 CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	** CONC	(YYMMDDHH)
11002.72	10568.42	.20618c	(20012224)	11133.86	10547.33	.20991c	(20012224)
11240.96	10441.78	.08757c	(20012224)	11209.99	10303.47	.42022	(20010724)
11107.41	10210.45	.27984c	(20012224)	10961.12	10356.74	.27606	(20010724)
10958.43	10407.67	.39921	(20010724)	10967.83	10441.78	.33992	(20010724)
10979.65	10484.68	.24985c	(20012224)	10768.24	10397.11	.82201c	(20010624)
10459.61	10441.78	.71329c	(19122424)	10414.14	10633.12	.16337c	(19122924)
10582.13	10735.73	.20870c	(20013024)	10725.18	10806.08	.19036c	(20013024)
10872.55	10433.83	.38254	(20010724)	10876.08	10921.22	.07495c	(20013024)
10982.07	10697.66	.05457c	(20012224)	11097.18	10662.88	.06077c	(20013024)
11277.99	10608.25	.15770c	(20012224)	11344.99	10441.78	.06748c	(20012224)
11305.57	10263.88	.40211	(20010724)	10996.48	10151.11	.17594c	(20010624)
10876.08	10206.51	.43211c	(20010624)	10821.42	10309.82	.64377c	(20010624)
10702.13	10267.83	1.07822c	(20010624)	10459.29	10269.14	.53677c	(20010624)
10686.84	10898.66	.17597c	(20013024)	11020.53	10790.50	.04253c	(20012224)
11177.41	10743.11	.02294	(20010724)	11052.59	10015.65	.07571c	(20022624)
10876.08	10096.08	.64180c	(20010624)	10770.01	10185.71	.70702c	(20010624)
10538.53	10104.23	.29197c	(20010624)	11720.41	9959.01	.05695	(20010724)
11710.55	11988.31	.00547c	(20013024)	10281.05	9988.57	.34788c	(19121424)
11714.28	11219.96	.00200c	(20012224)	10074.01	8471.52	.01268c	(19120824)
9374.05	9013.32	.03412c	(19122424)	13938.59	10185.59	.00615c	(20012824)
9117.73	10037.82	.07698c	(20013024)				

Dispersion Modelling with ISCST3 model for Sohmluh Limestone Mine and Arjust Limestone Mine operation

*** THE MAXIMUM 50 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***

RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR,YR)		OF TYPE	RANK	CONC	(YYMMDDHH)	AT	RECEPTOR (XR,YR)		OF TYPE
1.	1.07822c	(20010624)	AT (	10702.13,	10267.83)	DC	26.	.47859	(20012924)	AT (	10702.13,	10267.83)	DC
2.	.88575c	(20012824)	AT (	10702.13,	10267.83)	DC	27.	.47556c	(20011124)	AT (	10459.61,	10441.78)	DC
3.	.85211c	(20010824)	AT (	10702.13,	10267.83)	DC	28.	.47534c	(20012824)	AT (	10770.01,	10185.71)	DC
4.	.82201c	(20010624)	AT (	10768.24,	10397.11)	DC	29.	.44664c	(19121724)	AT (	10459.29,	10269.14)	DC
5.	.76761c	(20012124)	AT (	10702.13,	10267.83)	DC	30.	.44661c	(20010824)	AT (	10684.74,	9979.84)	GP
6.	.71329c	(19122424)	AT (	10459.61,	10441.78)	DC	31.	.43736c	(20013024)	AT (	10459.61,	10441.78)	DC
7.	.70702c	(20010624)	AT (	10770.01,	10185.71)	DC	32.	.43736c	(20013124)	AT (	10459.61,	10441.78)	DC
8.	.69139c	(20012224)	AT (	10702.13,	10267.83)	DC	33.	.43211c	(20010624)	AT (	10876.08,	10206.51)	DC
9.	.64377c	(20010624)	AT (	10821.42,	10309.82)	DC	34.	.42288c	(19121424)	AT (	10414.14,	10250.44)	GP
10.	.64180c	(20010624)	AT (	10876.08,	10096.08)	DC	35.	.42085	(20010724)	AT (	10768.24,	10397.11)	DC
11.	.63948c	(20010624)	AT (	10876.08,	9941.78)	GP	36.	.42022	(20010724)	AT (	11209.99,	10303.47)	DC
12.	.62330c	(20012824)	AT (	10768.24,	10397.11)	DC	37.	.41874c	(20010624)	AT (	10414.14,	10250.44)	GP
13.	.62234c	(20010324)	AT (	10768.24,	10397.11)	DC	38.	.41865c	(20010324)	AT (	10821.42,	10309.82)	DC
14.	.61653	(20010724)	AT (	10702.13,	10267.83)	DC	39.	.40572c	(20010824)	AT (	10768.24,	10397.11)	DC
15.	.57532c	(19122424)	AT (	10414.14,	10250.44)	GP	40.	.40211	(20010724)	AT (	11305.57,	10263.88)	DC
16.	.53677c	(20010624)	AT (	10459.29,	10269.14)	DC	41.	.39921	(20010724)	AT (	10958.43,	10407.67)	DC
17.	.53576c	(20012524)	AT (	10459.61,	10441.78)	DC	42.	.39753c	(20012824)	AT (	10821.42,	10309.82)	DC
18.	.51427c	(20010324)	AT (	10702.13,	10267.83)	DC	43.	.39724	(20010724)	AT (	11338.02,	10250.44)	GP
19.	.51327c	(20012124)	AT (	10768.24,	10397.11)	DC	44.	.39663c	(20010324)	AT (	10770.01,	10185.71)	DC
20.	.50873c	(19121424)	AT (	10459.29,	10269.14)	DC	45.	.39523c	(19122324)	AT (	10459.61,	10441.78)	DC
21.	.50768c	(20012024)	AT (	10702.13,	10267.83)	DC	46.	.39340c	(19122324)	AT (	10414.14,	10250.44)	GP
22.	.49668c	(20012224)	AT (	10684.74,	9979.84)	GP	47.	.38643c	(20012524)	AT (	10702.13,	10267.83)	DC
23.	.49007c	(19122424)	AT (	10459.29,	10269.14)	DC	48.	.38399c	(20010624)	AT (	10684.74,	9979.84)	GP
24.	.48453c	(19122324)	AT (	10459.29,	10269.14)	DC	49.	.38396c	(20012124)	AT (	10770.01,	10185.71)	DC
25.	.47911c	(19121324)	AT (	10459.29,	10269.14)	DC	50.	.38254	(20010724)	AT (	10872.55,	10433.83)	DC

```
*** Message Summary : ISCST3 Model Execution ***
  --------- Summary of Total Messages --------
 A Total of           0 Fatal Error Message(s)
 A Total of           0 Warning Message(s)
 A Total of        1742 Informational Message(s)
 A Total of        1742 Calm Hours Identified
    ******** FATAL ERROR MESSAGES ********
                ***  NONE  ***
    ********   WARNING MESSAGES   ********
                ***  NONE  ***
    **********************************
    *** ISCST3 Finishes Successfully ***
    **********************************
```

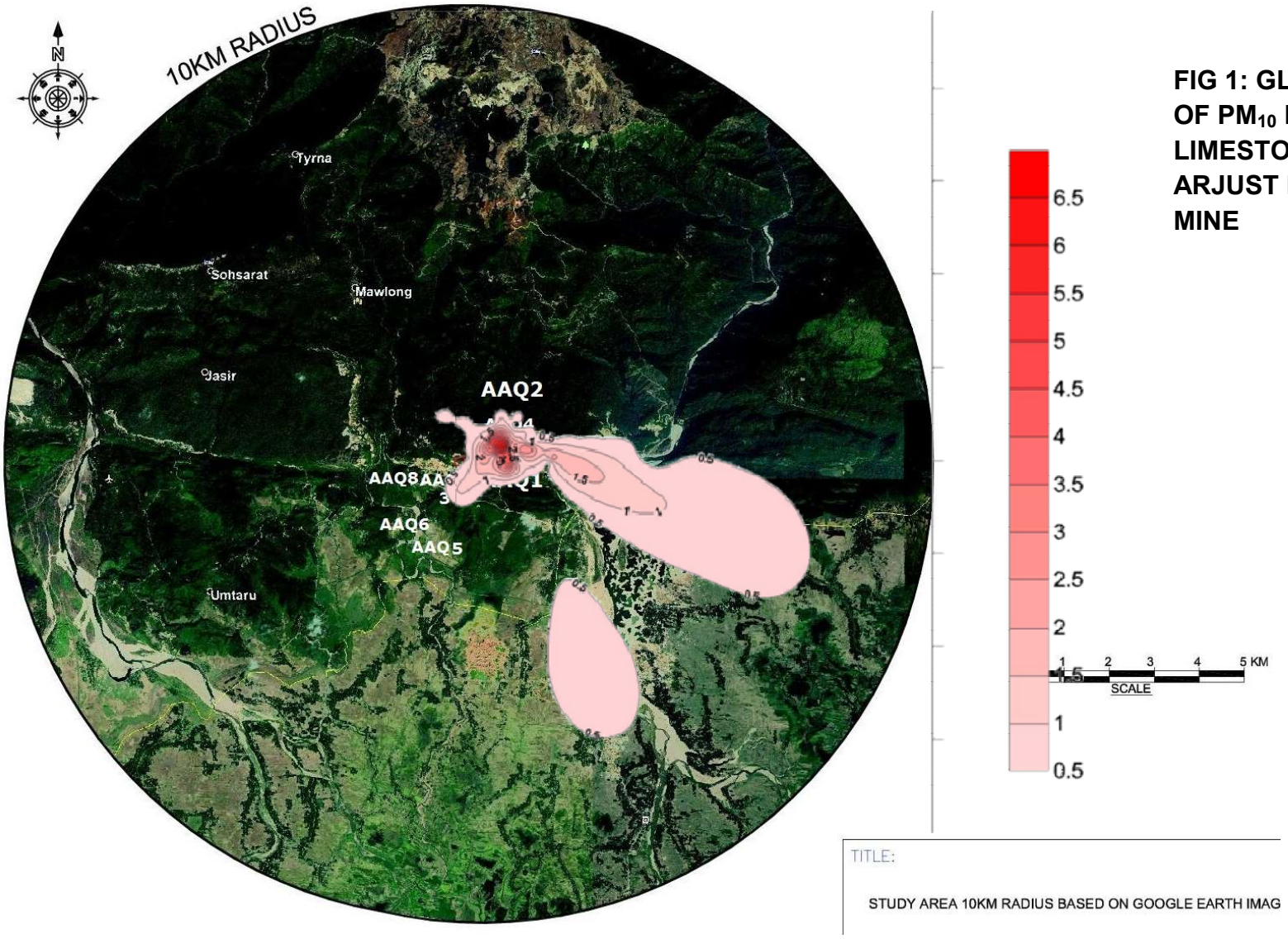

FIG 1: GLC CONTOURS OF PM_{10} FROM SOHMLUH LIMESTONE MINE AND ARJUST LIMESTONE MINE

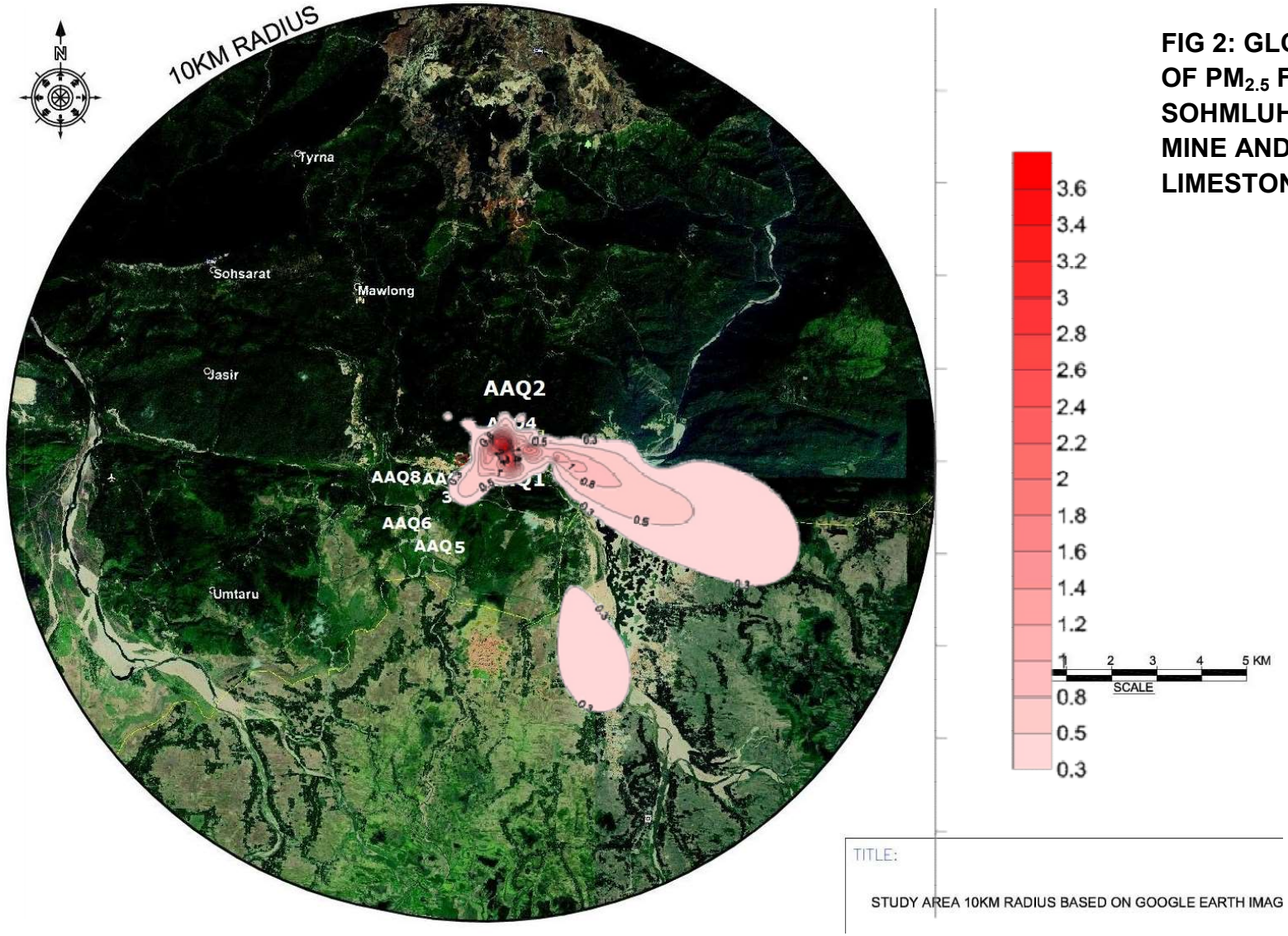

FIG 2: GLC CONTOURS OF $PM_{2.5}$ FROM SOHMLUH LIMESTONE MINE AND ARJUST LIMESTONE MINE

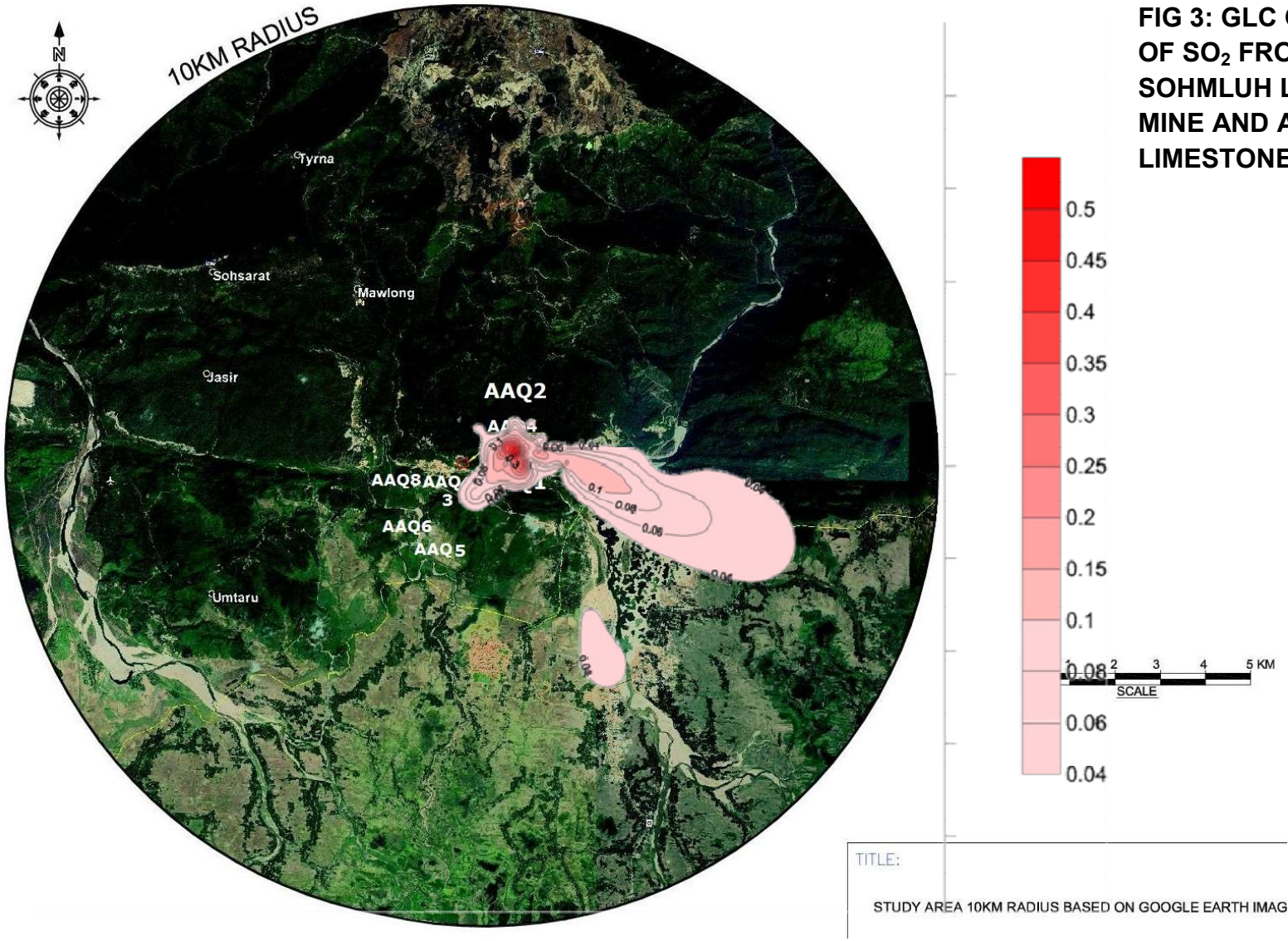

FIG 3: GLC CONTOURS OF SO_2 FROM SOHMLUH LIMESTONE MINE AND ARJUST LIMESTONE MINE

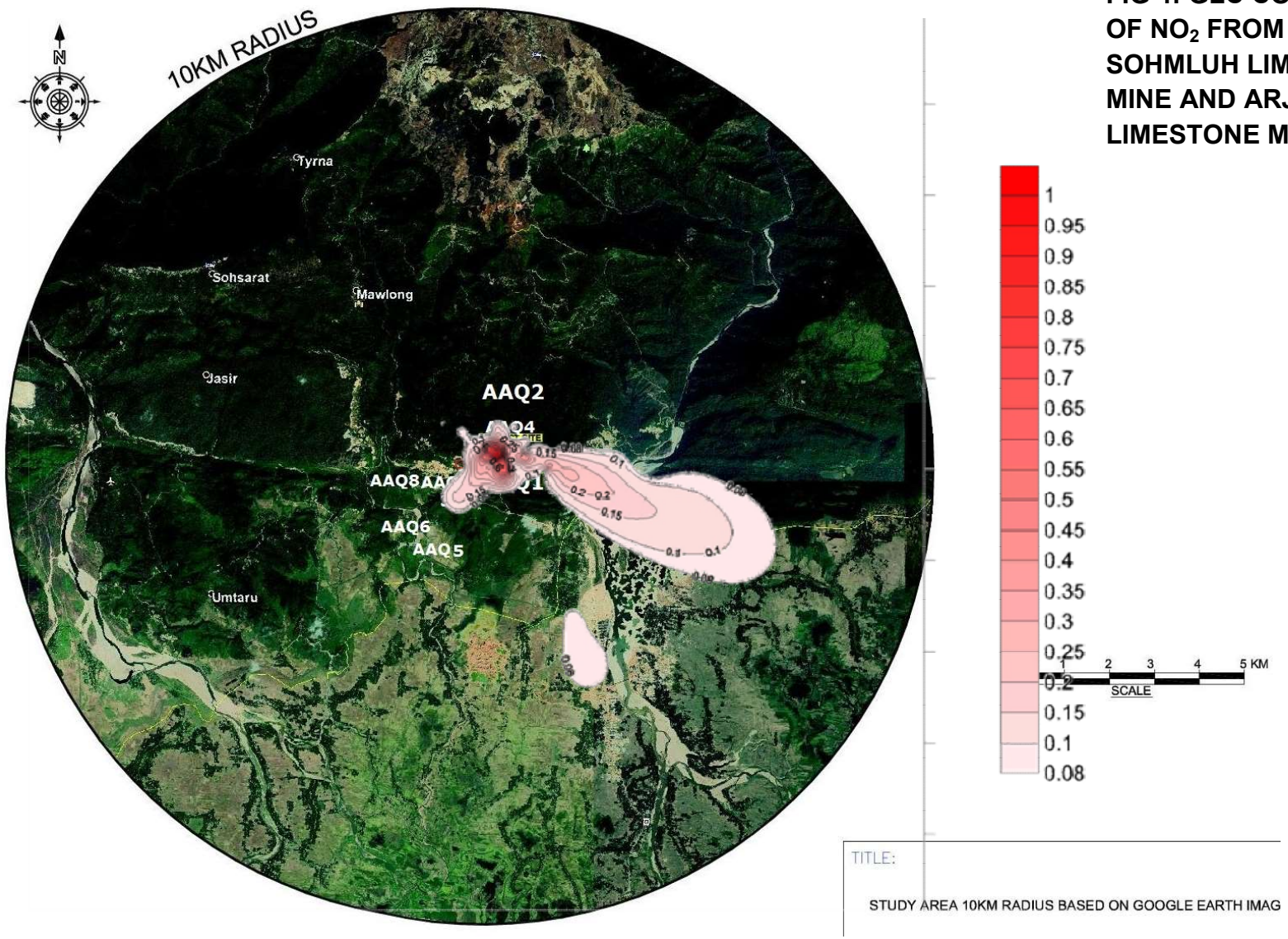

FIG 4: GLC CONTOURS OF NO_2 FROM SOHMLUH LIMESTONE MINE AND ARJUST LIMESTONE MINE

Flora (Trees, Shrubs, Herbs Ornamental spices) of Buffer Zone

Trees:

Acacia auriculiformis, Actinodaphne obovata, Ailanthus grandis, Alangium chinensis, Albizia lucida, Albizia lebbeck, Alstonia scholaris, Anthocephalus chinense, Aralia armata, Ardisia nerifolia, Artocarpus heterophyllus, Azadirachta indica, Bauhinia acuminate, Bauhinia purpurea, Bischofia javanica, Bombax ceiba, Bridelia tomentosa, Butea monosperma, Callicarpa arborea, Carallia branchiata, Caryota urens, Castanopsis indica, Castanopsis tribuloides, Cinnamomum bezolghota, Cinnamomum obtusifolium, Cyathea sp. Cynometra polyandra, Dalbergia sp., Dalbergia sisso, Duabanga grandiflora, Delonix regia, Drypetes assamica, Dysoxylum binectariferum, Elaeocarpus aristatus, Elaeocarpus sp., Englegardtia spicata, Exbucklandia populnea, Ficus benghalensis, Ficus elmeri, Ficus geniculata, Ficus hirta, Ficus hispida, Ficus religiosa, Ficus rumphii, Garuga gamblei, Ficus sp., Garcinia acuminata, Gmelina arborea, Grewia disperma, Grewia sp., Hevea brasiliensis, Hydnocarpus kurzii, Lagerstroemia parviflora, Leucaena leucocephala, Licuala peltata, Litsaea sebifera, Litsea citrita, Litsea laeta, Litsea salicifolia, Litsea sp., Macaranga denticulate, Macropanax disperma, Magnolia hodgsonii, Mallotus tetracoccus, Mangifera indica, Meliosma sp., Oroxylum indicum, Ostodes paniculata, Pandanus sp., Persea sp., Pithecellobium sp., Pongamia pinnata, Premna milleflora, Prunus acuminata, Psidium guajava, Pterospermum acerifolium, Pterospermum lancifolium, Quercus lancifolia, Quercus spicata, Rhus javanica, Sapium baccatum, Sarcosperma griffithii, Saurauia roxburghii, Saurauia sp., Schima wallichii, Shima sp., Spondias pinnata, Sterculia villosa, Streospermum chelenoides, Strobilanthus anisophyllus, Symplocos racemosa, Syzygium cumini, Syzygium sp., Terminalia bellerica, Terminalia chebula, Terminalia myriocarpa, Tetrameles nudiflora, Toona ciliata, Toona febrifuga, Travesia palmata, Trema orientalis, Villebrunea frutescens, Vitex negundo, Vitex pedunculata, Vitex sp., Wallichii densiflora, Wendlandia paniculata & Xerospermum sp.

Shrubs:

Ageratum conyzoides, Allamanda cathartica, Allophylus sp., Alpinia sp. Amblyanthus grandulosus, Ardisia crispa, Ardisia nerifolia, Ardisia paniculata, Aroides sp., Baliospermum montana, Baliospermum sp., Boehmaria sp., Breynia patens, Breynia vitis-idaea, Buddleja asiatica, Calotropis gigantia, Calotropis procera, Cassia alata, Cassia tora, Cassia occidentalis, Citrus sp., Clerodendron colebrookianum, Clerodendron viscosum, Clerodendrum sp., Clorophytum khasianum, Coffea sp., Coix lacryma-jobi, Datura metal, Dendrocalamus hamiltonii, Dendrocnide sinuate, Dracaena angustifolia, Elaegnus conferta, Eupatorium odoratum, Helixanthera ligustrina, Hibiscus macrophyllus, Holmskioldia sanguine, Homonoia riparia, Hymenodictyon sp., Ilex sp., Jasminium sp., Jatropha curcas, Lantana camara, Leea aspera, Leea indica, Manihot esculenta, Melastoma malabathricum, Morinda angustifolia, Mussaenda roxburghii, Nyctanthus arbortristis, Ocimum gratissimum, Ophiorrhiza sp., Phoenix sylvestris, Rauwolfia serpentine, Rubus alceifolius, Rubus ellipticus, Rubus lucens, Saccharum spontaneum, Saccharum arundinaceum, Salamona sp., Saurauia sp., Scoperia dulcis, Sida rhombifolia, Solanum torvum, Strobilanthes anisophyllus, Xerospermum glabratum

Herbs:

Alternanthera sessilis, Amaranthus spinosus, Amaranthus viridis, Ambrosia artemesifolia, Amischotolype mollissima, Amorphophalus bulbifera, Amorphophalus sp., Arundina graminifolia, Begonia hatacoa, Begonia sp, Bidens biternata, Bidens pilosa, Blachnum sp., Boehmeria glomerulifera, Boehmeria sp., Calamus flagellum, Calamus leptospadix, Carax cruciata, Castos speciosus, Chenopodium sp., Coleus sp., Commelina benghalensis, Commelina sp., Crassocephalum crepidioides, Cyathula prostrate, Dichrocephala integrifolia, Dracena trifasciata, Drymeria diandra, Diplezium esculentum, Elatostema monandrum, Eleusine indica, Erigeron Canadensis, Eupatorium adenophorum, Eupatorium odoratum, Euphorbia hirta, Euphorbia sp., Fagopyrum dibotrys, Fimbristylis dichotoma, Floscopa scandens, Fagopteris auriculata, Ferns sp., Forrestia sp., Globba multiflora, Globba clarkeii, Hedychium sp., Jasminum sp., Laportea crenulata, Leea indica, Leea sp., Licuala peltata, Luduwigia octovalis, Lycopodium sp., Maesa indica, Maesa sp., Melastoma malabathricum, Mannihot esculenta, Mimosa himalayana, Morinda angustifolia, Musa sp., Osbeckia sp., Osbekia

crenata, Oscimum sanctum, Oxalis corniculata, Oxyspora sp., Ophiorrhiza sp., Phrynium capitata, Phrynium pubenervae, Pinanga gracilis, Polygonum chinense, Pteris sp., Randia sp. Rhynchotecum ellipticum, Rubus rugosus, Rungia sp., Scoparia dulcis, Selaginella monospora, Selaginella sp., Solanum torvum, Spilanthus paniculata, Tabernaemontana divericata, Thysanolaena maxima, Trevesia palmate, Triumfetta pilosa, Urena lobata, Wallichia densiflora, Sida acuta, Sida cordata, Spilanthes paniculata, Tridax procumbens, Vernonia cineraria & Viola betonicifolia

Climbers:

Acacia oxyphylla, Acacia pinnata, Acacia prunascens, Acampe sp., Aeschynanthus sp., Agapetes sp., Ampelocissus barbata, Asplenium nidus, Bauhinia scandens, Bauhinia vahlii, Byttneria aspera, Calamus leptospadix, Cayratia pedata, Cissampelos pareira, Combretum dasystachyum, Cryptolepis sinensis, Diascorea alata, Diascorea bulbifera, Dendrobium sp., Derris sp., Diascorea sp., Entada rheedei, Ficus sp., Gnetum scandens, Hedyotis scandens, Hodgsonia macrocarpa, Hoya sp., Ipomea nervosa, Jasminium flexile, Leea compactiflora, Luisea sp., Lygodium flexuosum, Lygodium fluxuosa, Melocalamus compectiflorus, Melothria heterophylla, Merremia umbellate,Microsorum sp.,Mikania micrantha, Milletia cinerea, Mucuna sp., Nepenthes khasiana, Paederia scandens, Parabaena sagittata, Pegia nitida, Piper thomsonii, Poikilospermum suaveolens, Porana paniculata, Pothos sp., Raphidophora decursiva, Raphidophora lancifolia, Rubus alceifolius, Scefflera venulosa, Smilex lancifolia, Tetrastigma angustifolia, Tetrastigma leucostophylum, Tetrastigma serrulatum, Thunbergia grandiflora & Zizyphus oenoplia

Grasses:

Apluda mutica,Bambusa tulda, Cymbopogon martini, Cynodon dactylon, Cyperus compressus, Cyperus cyperinus, Cyperus rotundus, Dendrocalamus hemiltonii, Dendrocalamus strictus, Digitaria bicornis, Heteropogon contortus & Neohouzeaua helferii

Epiphytes:

Aeschynanthus parasitica, Agapetes setigera, Aglaomorpha coronus, Asplenium nidus, Bulbophyllum careyanum, Dendrobium densiflorum, Eria lasiopetala, Hoya parasitica, Liparis viridiflora, Microsorum punctatum, Pholidota articulate, Pathos cathcartii, Pyrrosia adnascens, Pyrrosia flocculosa, Rhaphidophora calophyllum, Rhaphidophora lancifolium, Rhynchostylis retusa, Cuscuta reflexa &Vanda roxburghaii

Hydrophytes:

Nelumbo nucifera & Nymphaea stellata

Fauna (Mammals, Aves, Reptiles Amphibians, Fishes, Insects & Mollusca) of Study Area

Mammals:

Canis aureus, Cannomys badius, Callosciurus erythraeus, Crocidura attenuate, Suncus murinus, Felis chaus, Funambulus pennant, Funambulus palmarum, Herpestes edwardsi, Lepus nigricollis, Lutra Lutra, Muntiacus muntjak, Mus booduga, Mus musculus, Niviventer fulvescens, Ratufa bicolor, Rattus nitidus, Rattus rattus, Rhinolophus affinis, Rhinolophus hipposideros, Vulpes bengalensis, Presbytis entellus & Presbytis pileatus

Aves:

Acridotheres tristis, Bambusicola fytchii, Ketupa flavipes, Cinnyris asiaticus, Columba livia, Coracias bengalensis, Corvus splendens,Eudyna mysscolopaceus, Milvus migrans, Francolinus pondicerianus, Hirundo rustica, Dendronanthus indicus, Passer domesticus, Psittacula krameri, Pycnonotus cafer, Scolopax rusticola, Alcedo atthis & Streptopelia chinensis

Reptiles & Amphibians:

Amolops afghanus, Bufo parietalis, Bufo stomaticus, Bufoides meghalayana, Bungarus caeruleus, Calotes versicolor, Sinomicrurus macclellandi, Natrix natrix, Rhacophorus maximus, Hylarana

garoensis, Odorrana livida, Varanus bengalensis, Chameleon sp., Calotes maria, Mobuya carinata, Microhyla ornate, Naja naja, Ptyas mucosus, Ptyctolaemus gularis
Fishes: *Danio rerio, Catla catla,Danio aequipinnatus, Danio dangila, Labeo dero, Labeo rohita, Labeo fimbriatus, Mystus aor, Mystus vittatus & Puntius shalynius*
Insecta: *Acrida turrita, Acontia marmoralis, Orthetrum luzonicum, Agriocnemis pygmaea, Apis cerana, Ariadne merione, Ceriagrion coromandelianum, Euploca core, Eurema brigitta, Graphium sarpedon, Halpe kumara, Heterojinus semilaetaneus, Holochlora indica, Ischnura aurora, Matapa druna, Musca domestica, Papilio arcturus, Periplaneta Americana, Pseudagrion rubriceps, Apodemia mejicanus & Vespa orientalis*
Mollusca: *Bellamya bendalensis, Cypraea limacine & Turbo marmoratus*

Annexure –12
Employment Pattern

Town/village	Employment pattern											
name	Total	Main workers					Marginal workers					Non
	workers	Total	Cultivators	Agri. Labours	HH ind.	Others	Total	Cultivators	Agr. Labours	HH ind.	Others	workers
East Khasi Hills												
Khatarshnong Laitkroh												
Mawtongreng	53	53	52	0	0	1	0	0	0	0	0	33
Thangkyrta	22	22	22	0	0	0	0	0	0	0	0	15
Jarain	60	60	59	0	0	1	0	0	0	0	0	75
Nongbah	167	167	164	1	0	2	0	0	0	0	0	140
Jalynteng	392	392	376	0	0	16	0	0	0	0	0	422
Wahtyngngai-Ummluh	338	292	122	124	32	14	46	10	32	1	3	410
Sub total	**1032**	**986**	**795**	**125**	**32**	**34**	**46**	**10**	**32**	**1**	**3**	**1095**
Shella Bholaganj												
Mawkliaw	93	93	0	60	2	31	0	0	0	0	0	176
Kemrang	181	181	4	125	1	51	0	0	0	0	0	240
Nongpriang	132	132	20	106	1	5	0	0	0	0	0	167
Sohkhmie	125	121	17	93	0	11	4	0	4	0	0	142
Mawmluh MSEB	12	12	0	0	0	12	0	0	0	0	0	29
Mawmluh MCCL	198	183	0	0	1	182	15	0	0	0	15	545
Mawmluh	379	351	2	2	0	347	28	0	0	0	28	773
Pyndemdkhar	24	24	23	0	0	1	0	0	0	0	0	36
Mynteng	23	23	23	0	0	0	0	0	0	0	0	20
Nongriat	49	48	28	10	0	10	1	1	0	0	0	87
Lumsohphie	37	36	14	7	1	14	1	0	0	0	1	60

Nongthymmai (Tyrna)	26	26	0	21	0	5	0	0	0	0	0	36
Nongkroh	19	19	5	8	0	6	0	0	0	0	0	28
Lumrynjang	10	10	6	0	0	4	0	0	0	0	0	15
Mawshamok	76	74	17	23	0	34	2	1	1	0	0	107
Tyrna	245	241	7	188	1	45	4	0	1	0	3	497
Wah-U-Tim	69	45	0	1	0	44	24	0	0	0	24	167
Nongthynmmai	143	128	0	0	0	128	15	1	0	0	14	359
Mawsmai	147	131	1	0	2	128	16	0	0	2	14	328
Mawlatang	157	2	0	0	0	2	155	151	0	2	2	108
Tyrngei	95	5	0	4	0	1	90	83	6	1	0	76
Nongla	77	25	20	0	0	5	52	0	52	0	0	111
Mawblang	76	65	3	0	0	62	11	2	0	0	9	206
Lad Ryngud	33	33	0	0	0	33	0	0	0	0	0	71
Khliehumlang	23	23	0	21	0	2	0	0	0	0	0	35
Mawsiangei	124	55	51	0	0	4	69	0	66	0	3	192
Suktia Inc. Diengsiar	213	194	62	120	0	12	19	2	17	0	0	309
Laittyra	181	92	4	47	0	41	89	1	73	0	15	258
Thangkharang	61	28	1	21	0	6	33	0	27	0	6	77
Lyngngar	24	24	5	14	0	5	0	0	0	0	0	48
Ryngud	232	228	1	0	0	227	4	0	0	0	4	398
Laitiam	222	221	46	142	0	33	1	0	1	0	0	419
Umwai	246	216	10	159	0	47	30	0	7	1	22	300
Mawlong	228	221	0	187	1	33	7	0	7	0	0	493
Wahkhim(Sohsarat)	82	82	61	1	1	19	0	0	0	0	0	177
Wahkrem	62	60	48	1	0	11	2	1	0	0	1	115
Laitkynsew	198	158	7	32	7	112	40	0	12	0	28	276
Nongwar	184	140	75	13	0	52	44	1	5	0	38	378
Mustoh	170	152	1	1	0	150	18	0	1	0	17	281
Nongnong	20	20	0	0	0	20	0	0	0	0	0	59
Mot	7	7	6	0	0	1	0	0	0	0	0	18
Nongrum	36	20	5	0	1	14	16	13	0	0	3	45
Jasir	42	37	4	0	0	33	5	1	0	0	4	106
Ramsongkatenor	51	45	12	0	0	33	6	3	0	1	2	97
Siej	10	10	7	0	0	3	0	0	0	0	0	13
Nongduh	154	152	33	106	1	12	2	0	1	0	1	270

Ri-ngur	52	52	0	48	0	4	0	0	0	0	0	82
Lad Sohbar	62	55	0	0	0	55	7	0	0	0	7	84
Sohbar	406	400	2	0	1	397	6	0	0	0	6	666
Old Kamorah	1	1	0	0	0	1	0	0	0	0	0	4
Tharia	67	59	1	5	0	53	8	0	2	0	6	78
Umdud	51	38	0	8	0	30	13	0	11	0	2	99
Wahjain	3	3	0	0	0	3	0	0	0	0	0	0
Shnongkawar	60	60	0	0	0	60	0	0	0	0	0	120
Mawthangsohkhyllung	256	16	0	0	0	16	240	2	0	1	237	404
Byrong	148	147	0	140	0	7	1	0	1	0	0	151
Diengsiar Mawlong	279	242	24	143	1	74	37	1	34	0	2	529
Khahumrin	248	245	0	3	0	242	3	1	0	0	2	576
Saikarap	152	148	15	50	2	81	4	1	2	0	1	110
Jatap	68	67	0	0	0	67	1	0	0	0	1	115
Jalba	2	2	1	1	0	0	0	0	0	0	0	0
Lum-U-Smon	32	32	0	0	0	32	0	0	0	0	0	69
Umdohmawpud	83	80	1	0	0	79	3	1	0	0	2	183
Sohlap	156	155	0	0	0	155	1	0	0	0	1	259
Kalorkhar	17	17	12	0	0	5	0	0	0	0	0	38
Lumpukri	29	27	0	15	0	12	2	0	0	0	2	23
Saitsohphan	24	23	0	10	0	13	1	0	0	0	1	15
Khahkangi	82	24	17	0	2	5	58	0	1	2	55	202
Ichamati	210	210	2	2	1	205	0	0	0	0	0	417
Lailad	30	27	0	5	0	22	3	0	3	0	0	81
New Kamorah	177	169	2	11	0	156	8	0	2	0	6	303
Bholaganj (Majai)	370	364	5	8	15	336	6	1	1	0	4	855
Diengkain	27	13	10	0	2	1	14	0	2	0	12	74
Khahmalai	133	132	2	89	0	41	1	0	0	0	1	125
Lummuri	72	3	2	0	0	1	69	0	0	0	69	147
Lubia	56	32	2	8	0	22	24	0	5	0	19	152
Umtaru	242	231	1	48	1	181	11	0	2	1	8	559
Kalibari	177	71	30	30	1	10	106	1	42	0	63	497
Dhorom	217	160	4	28	4	124	57	1	14	1	41	464
Diengrai	138	23	7	1	0	15	115	0	11	3	101	310
Rangkamati	29	12	1	3	0	8	17	1	8	1	7	63

Mawbang	159	20	1	5	0	14	139	0	27	7	105	324
Kurikhal	44	41	1	7	0	33	3	0	2	1	0	114
Chaklabasti	81	50	15	0	0	35	31	1	0	0	30	181
Nayabasti	210	148	23	2	0	123	62	4	1	2	55	470
Dhorombasti	188	122	14	5	3	100	66	0	5	1	60	491
Umsawmaskon	132	132	0	25	0	107	0	0	0	0	0	295
Tyllap	79	26	0	4	0	22	53	0	5	1	47	151
Cherrapunjee (CT)	3765	3531	10	30	13	3478	234	2	1	1	230	7957
Sub total	**13810**	**11603**	**834**	**2247**	**66**	**8456**	**2207**	**278**	**463**	**29**	**1437**	**26585**
Pynursla												
Wahdop	23	23	0	0	0	23	0	0	0	0	0	63
Dewsaw	70	63	0	0	0	63	7	0	0	0	7	153
Weikian	91	90	0	0	0	90	1	0	0	0	1	127
Rana	49	49	0	0	0	49	0	0	0	0	0	92
Nongjri Tluh	495	457	1	0	0	456	38	0	0	0	38	606
Nongjri Bah	231	225	3	2	1	219	6	0	0	0	6	365
Tishang	117	117	6	4	0	107	0	0	0	0	0	63
Nongjri War	308	299	2	0	0	297	9	0	0	0	9	372
Mawpathaw	17	17	0	0	0	17	0	0	0	0	0	25
Sub total	**1401**	**1340**	**12**	**6**	**1**	**1321**	**61**	**0**	**0**	**0**	**61**	**1866**
GRAND TOTAL	**16243**	**13929**	**1641**	**2378**	**99**	**9811**	**2314**	**288**	**495**	**30**	**1501**	**29546**
Percentage	**35.47**	**30.42**	**11.78**	**17.07**	**0.71**	**70.44**	**5.05**	**12.45**	**21.39**	**1.30**	**64.87**	**64.53**

Annexure –16
Details of Amenities

SUMMARY OF AMENITIES AVAILABLE (CENSUS 2011) IN VILLAGES WITHIN THE STUDY AREA OF ARJUST LIMESTONE MINE, EAST KHASIHILLS DISTT., MEGHALAYA							
AMENITIES	**NOS.**		**AMENITIES**	**NOS.**		**AMENITIES**	**NOS.**
EDUCATION FACILITIES			**DRINKING WATER FACILITY**			**APPROACH TO VILLAGE**	
PPS (Pre-Primary School)	**131**		**TWT (Tap Water-Treated)**	**43**		**NH (National Highway)**	**0**
PS (Primary school)	**109**		**TWUT (Tap Water Untreated)**	**51**		**SH (State Highway)**	**10**
MS (Middle school)	**36**		**CW (Covered Well)**	**5**		**MDR (Major District Road)**	**13**
SS (Secondary school)	**10**		**UW (Uncovered Well)**	**14**		**ODR (Other District Road)**	**11**
SSS (Sr. Sec. School)	**1**		**HP (Hand Pump)**	**10**		**BTPR (Black Topped (pucca) Road)**	**34**
DCAS (Deg. College Arts & Science only)	**0**		**TW/ BW (Tube Wells/Borehole)**	**4**		**GCR (Gravel (kuchha) Roads)**	**82**
EC (Engg. College)	**0**		**S (Spring)**	**46**		**WBM (Water Bounded Macadam)**	**7**
MC (Medicine College)	**0**		**R/C (River/Canal)**	**29**		**AWR (All Weather Road)**	**8**
MI (Management Institute)	**0**		**T/P (Tank/Pond/Lake)**	**15**		**NWR/C (Navigable waterways:river/canal)**	**0**
P (Polytechnic)	**0**		**WO (Others)**	**6**		**FP (Foot Path)**	**103**
VTS/ITI (Vocational Trg School/ITI)	**0**						
NFTC (Non Formal Training Centre)	**0**		**COMMUNICATION SYSTEM**			**BANKS AND COMMERCIAL SOCIETIES**	
SFD (School For Disabled)	**0**		**PO (Post Office)**	**0**		**ATM (ATM)**	**0**
EO (Others)	**0**		**SPO (Sub Post Office)**	**7**		**CB (Commercial bank)**	**3**
			P&T (Post & Telegraph office)	**0**		**COB (Co-operative bank)**	**2**
MEDICAL FACILITIES			**PIN (Village PIN code)**	**116**		**ACS (Agricultural Crredit Societies)**	**0**
CHC (Community Health Centres)	**1**		**T (Telephone (landline))**	**24**		**SHG (Self-Help Group (SHG))**	**37**

PHC (Primary Health Centre)	**3**		**PCO (Public Call Office/ Mobile PCO)**	**10**		**PDS (Public Distribution System (PDS))**	**57**
PHSC (Primary Health Sub-Centre)	**7**		**MPC (Mobile phone coverage)**	**59**		**M/RM (Mandis/Regular Market)**	**4**
MCWC (Maternity And Child Welfare Centre)	**4**		**IC/CSC (Internet Cafes/Common Service Centre)**	**1**		**WH (Weekly Haat)**	**8**
TBC (TB Clinic)	**0**		**PCF (Private Courier Facility)**	**0**		**AMS (Agricultural Marketing Society)**	**0**
HA (Hospital Allopathic)	**0**					**NCICDS (Nutritional Centres-ICDS)**	**60**
HAM (Hospiltal Alternative Medicine)	**0**		**TRANSPORT SYSTEM**			**NCAC (Nutritional Centres: Anganwadi)**	**60**
D (Dispensary)	**0**		**PBS (Public Bus Service)**	**21**		**NCO (Nutritional Centres-Others)**	**1**
VH (Veterinary Hospital)	**0**		**PvtBS (Private Bus Service)**	**27**		**ASHA (ASHA)**	**89**
MHC (Mobile Health Clinic)	**0**		**RS (Railway station)**	**0**		**CC-TV (Community centre with/without TV)**	**27**
FWC (Family Welfare Centre)	**4**		**MA (Auto/Modified Autos)**	**2**			
NGMF-OP (Non Govt. Med.Facilities: Out Patient)	**1**		**Taxi (Taxi)**	**30**		**SPORTS AND ENTERTAINMENT**	
NGMF-IOP (Non Govt.Med.Facilities: In&Out patient)	**1**		**Van (Vans)**	**34**		**SF (Sports Field)**	**32**
NGMF-C (Non Govt. Med.Facilities: Charitable)	**0**		**T (Tractors)**	**19**		**SC/RC (Sports Club/Recreation Centre)**	**33**
NGMF-MBBS (Non Govt. Med.Facilities: Medical prctitioner with MBBS degree)	**2**		**CPR-Man (Cycle-pulled Rickshaws (manual driven))**	**32**		**C/VH (Cinema/Video Hall)**	**0**
			CPR-Mec (Cycle-pulled Rickshaws (machine driven))	**0**		**PL (Public Library)**	**0**
NGMF-OD (Non Govt. Med.Facilities: Medical prctitioner with other degree)	**0**		**CDA (Carts Drivens by Animals)**	**0**		**PRR (Public Reading Room)**	**0**
			S/R/FS (Sea/River/Ferry Service)	**0**		**DNS (Daily Newspaper Supply)**	**9**
NGMF-ND (Non Govt. Med.Facilities: Medical practitioner with no degree)	**0**					**APS (Assembly Polling Station)**	**27**
			POWER SUPPLY			**BDRO (Birth and Death**	**4**

						Registration Office)	
NGMF-TPFH (Non Govt. Med.Facilities: Traditional practitioner and faith healer)	**23**		**PSDU (Power Supply For Domestic Use)**	**100**			
			PSIAU (Power Supply ForAgriculture Use)	**0**			
NGMF-MS (Non Govt. Med.Facilities: Medicine shop)	**11**		**PSCU (Power Supply For Commercial Use)**	**0**			
NGMF-O (Non Govt. Med.Facilities: Others)	**2**		**PSALL (Power Supply For All Users)**	**1**			
						ANNEXURE :	
SUMMARY OF AMENITIES AVAILABLE (CENSUS 2011) IN TOWNS WITHIN THE STUDY AREA OF ARJUST LIMESTONE MINE, EAST KHASIHILLS DISTT., MEGHALAYA							
AMENITIES	**NOS.**		**AMENITIES**	**NOS.**		**AMENITIES**	**NOS.**
EDUCATION			**Private-MS Office (Nos.)**	**2**		**WATER SUPPLY AND SANITATION**	
Govt. Primary School (Nos.)	**1**		**Govt.-Desk Top Publishing (Nos.))**	**0**		**Latrines-Pit (Nos.)**	**159**
Private Primary School (Nos.)	**6**		**Private-Desk Top Publishing (Nos.)**	**0**		**Latrines-Flush/Pour Flush (Nos.)**	**1301**
Govt. Middle School (Nos.)	**1**		**Govt.-Vocational(Others) (Nos.))**	**0**		**Latrines-Service (Nos.)**	**6**
Private Middle School (Nos.)	**6**		**Private-Vocational(Others) (Nos.)**	**0**		**Latrines-Others (Nos.)**	**44**
Govt. Secondary School (Nos.)	**1**		**Govt.-Non Formal Education (Nos.))**	**0**		**Protected Water Supply Source-1**	**0**
Private Secondary School (Nos.)	**6**		**Private-Non Formal Education (Nos.)**	**0**		**Capacity Source-1 (KL)**	**40**
Govt. Senior Secondary School (Nos.)	**1**		**Govt.-Special School for Disabled (Nos.))**	**1**		**Protected Water Supply Source-2**	**0**
Private Senior Secondary School (Nos.)	**4**		**Private-Special School for Disabled (Nos.)**	**0**		**Capacity Source-2 (KL)**	**30**
Govt. Degree College-Art Only (Nos.)	**1**		**Govt.-Others(Specify) (Nos.))**	**0**		**Protected Water Supply Source-3**	**0**
Private Degree College-Art Only (Nos.)	**0**		**Private-Others(Specify) (Nos.)**	**0**		**Capacity Source-3 (KL)**	**0**

Govt. Degree College-Science Only (Nos.)	**0**		**MEDICAL**			**Protected Water Supply Source-4**	**0**
Private Degree College-Science Only (Nos.)	**0**		**Hospital Allopathic (Nos.)**	**0**		**Capacity Source-4 (KL)**	**0**
Govt. Degree College-Commerce Only (Nos.))	**0**		**Hospital Alternative Medicine (Nos.)**	**0**		**Protected Water Supply Source-5**	**0**
Private Degree College-Commerce Only (Nos.)	**0**		**Dispensary/Health Centre (Nos.)**	**0**		**Capacity Source-5 (KL)**	**0**
Govt. Degree College-Art and Science Only (Nos.))	**0**		**Family Welfare Centre (Nos.)**	**0**		**TRANSPORT**	
Private Degree College-Art and Science Only (Nos.)	**0**		**Maternity and Child Welfare Centre (Nos.)**	**0**		**Bus Route Road Distance (in kms.)**	**52**
Govt. Degree College-Art and Commerce Only (Nos.))	**0**		**Maternity Home (Nos.)**	**0**		**Pucca Road Length (in kms.)**	**38.0**
Private Degree College-Art and Commerce Only (Nos.)	**0**		**Maternity Home Nearest facility Distance (in kms.)**	**50**		**Kutcha Road Length (in kms.)**	**0**
Govt. Degree College-Art,Science and Commerce (Nos.))	**0**		**T.B. Hospital/ Clinic (Nos.)**	**0**		**ENTERTAINMENT AND COMMODITY**	
Private Degree College-Art,Science and Commerce (Nos.)	**0**		**Nursing Home (Nos.)**	**0**		**Govt.-Stadium (Nos.))**	**0**
Govt. Degree College-Law (Nos.))	**0**		**Veterinary Hospital (Nos.)**	**0**		**Private-Stadium (Nos.)**	**2**
Private Degree College-Law (Nos.)	**0**		**Mobile Health Clinic (Nos.)**	**0**		**Govt.-Cinema Theatre (Nos.))**	**0**
Govt. Degree College-University (Nos.))	**0**		**Others (Nos.)**	**0**		**Private-Cinema Theatre (Nos.)**	**0**
Private Degree College-University (Nos.)	**0**		**Non-Government Out-Patient (Nos.)**	**5**		**Govt.-Auditorium/Community Hall (Nos.))**	**1**
Govt. Degree College-Others (Nos.))	**0**		**Non-Government In and Out Patient (Nos.)**	**0**		**Private-Auditorium/Community Hall (Nos.)**	**4**
Private Degree College-Others (Nos.)	**0**		**Non-Government Charitable-Hospital/Nursing Home (Nos.)**	**1**		**Govt.-Public Library (Nos.))**	**0**
Govt.-Medical College (Nos.))	**0**		**Non-Government Medicine Shop (Nos.)**	**5**		**Private-Public Library (Nos.)**	**0**

Private-Vocational(Others) (Nos.)	**0**		**ELECTRICITY**			**Govt.-Public Reading Room (Nos.))**	**0**
Govt.-Engineering College (Nos.))	**0**		**Electricity-Domestic Connection (Nos.)**	**1791**		**Private-Public Reading Room (Nos.)**	**0**
Private-Engineering College (Nos.)	**0**		**Electricity-Industrial Connection (Nos.)**	**8**		**Manufactured Commodity (First)**	**0**
Govt.-Management Institute (Nos.))	**0**		**Electricity-Commercial Connection (Nos.)**	**135**		**Manufactured Commodity (Second)**	**0**
Private-Management Institute (Nos.)	**0**		**Electricity-Road Lighting Connection (Nos.)**	**12**		**Manufactured Commodity (Third)**	**0**
Govt.-Polytechnic (Nos.))	**0**		**Electricity-Others Connection (Nos.)**	**0**		**HELP HOMES**	
Private-Polytechnic (Nos.)	**0**		**FINANCIAL**			**Govt.-Orphanage Home (Nos.))**	**0**
Govt.-Shorthand (Nos.))	**0**		**Nationalised Bank (Nos.)**	**2**		**Private-Orphanage Home (Nos.)**	**1**
Private-Shorthand (Nos.)	**0**		**Private Commercial Bank (Nos.)**	**0**		**Govt.-Working Women's Hostel (Nos.))**	**0**
Govt.-Typewriting (Nos.))	**0**		**Co-operative Bank (Nos.)**	**1**		**Private-Working Women's Hostel (Nos.)**	**2**
Private-Typewriting (Nos.)	**0**		**Agricultural Credit Society (Nos.)**	**0**		**Govt.-Old Age Home (Nos.))**	**0**
Govt.-Shorthand and Typewriting (Nos.))	**0**		**Non-Agricultural Credit Society (Nos.)**	**1**		**Private-Old Age Home (Nos.)**	**0**
Private-Shorthand and Typewriting (Nos.)	**0**		**FIRE FIGHTING**				
Govt.-MS Office (Nos.))	**0**		**Fire Fighting Service (Status A(1)/NA(2))**	**0**			