DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT/ ENVIRONMENTAL MANAGEMENT PLAN

FOR

THANGHUNAI LIMESTONE QUARRY

PROJECT AREA: 3 Ha.

PEAK PRODUCTION CAPACITY: 0.148 MTPA

AT THANGHUNAI, NONGTALANG ELAKAKA, AMLAREM C&RD BLOCK, WEST JAINTIA HILLS DISTRICT, MEGHALAYA

PROJECT PROPONENT :

Plenty K Pyngrope

PREPARED BY :

Novomine India Private Limited

NABET Category 'A' Certified Organisation [Sector 1 (a) (i)] Vide Certificate No. NABET/EIA/2326/IA 0124

www.novomineindia.com

August 2024

File No: ML/SEAC/SEIAA/PP/WJH/18/2024

Government of India

Ministry of Environment, Forest and Climate Change

(Issued by the State Environment Impact Assessment Authority(SEIAA), MEGHALAYA)

****

Dated **03/07/2024**

To,

PLENTY PYNGROPE
THANGHUNAI LIMESTONE MINE
Bankur, Dawki, West Jaiñtia Hills, Meghalaya, 793109
pyngropemine@gmail.com

Subject: Grant of Terms of Reference under the provision of the EIA Notification 2006-regarding.

Sir/Madam,

This is in reference to your application for Grant of Terms of Reference under the provision of the EIA Notification 2006-regarding in respect of project Thanghunai Limestone Quarry for an area of 3.00 hectares submitted to Ministry vide proposal number SIA/ML/MIN/462544/2024 dated 28/02/2024.

2. The particulars of the proposal are as below :

(i) TOR Identification No.	TO24B0108ML5950899N
(ii) File No.	ML/SEAC/SEIAA/PP/WJH/18/2024
(iii) Clearance Type	TOR
(iv) Category	B1
(v) Project/Activity Included Schedule No.	1(a) Mining of minerals
(vii) Name of Project	Thanghunai Limestone Quarry
(viii) Name of Company/Organization	PLENTY PYNGROPE
(ix) Location of Project (District, State)	WEST JAINTIA HILLS, MEGHALAYA
(x) Issuing Authority	SEIAA
(xii) Applicability of General Conditions	no
(xiii) Applicability of Specific Conditions	yes

3. In view of the particulars given in the Para 1 above, the project proposal interalia including Form-1(Part A and B) were submitted to the Ministry for an appraisal by the State Environment Impact AssessmentAuthority(SEIAA) Appraisal Committee (SEIAA) in the Ministry under the provision of EIA notification 2006 and its subsequent amendments.

4. The above-mentioned proposal has been considered by State Environment Impact AssessmentAuthority(SEIAA) Appraisal Committee of SEIAA in the meeting held on 10/06/2024. The minutes of the meeting and all the Application

and documents submitted [(viz. Form-1 Part A, Part B, Part C EIA, EMP)] are available on PARIVESH portal which can be accessed by scanning the QR Code above.

5. The brief about configuration of plant/equipment, products and byproducts and salient features of the project along with environment settings, as submitted by the Project proponent in Form-1 (Part A, B and C)/EIA & EMP Reports/presented during SEIAA are annexed to this EC as Annexure (1).

6. The SEIAA, in its meeting held on 10/06/2024, based on information & clarifications provided by the project proponent and after detailed deliberations recommended the proposal for grant of Terms of Reference under the provision of EIA Notification, 2006 and as amended thereof subject to stipulation of specific and general conditions as detailed in Annexure (2).

7. The SEIAA has examined the proposal in accordance with the Environment Impact Assessment (EIA) Notification, 2006 & further amendments thereto and after accepting the recommendations of the State Environment Impact AssessmentAuthority(SEIAA) Appraisal Committee hereby decided to grant Terms of Reference for instant proposal of M/s. PLENTY PYNGROPE under the provisions of EIA Notification, 2006 and as amended thereof.

8. The Ministry reserves the right to stipulate additional conditions, if found necessary.

9. The Terms of Reference to the aforementioned project is under provisions of EIA Notification, 2006. It does not tantamount to approvals/consent/permissions etc. required to be obtained under any other Act/Rule/regulation. The Project Proponent is under obligation to obtain approvals /clearances under any other Acts/ Regulations or Statutes, as applicable, to the project.

10. This issues with the approval of the Competent Authority.

Copy To

1. The Principal Chief Conservator of Forests and HoFF Meghalaya, Shillong, for information.
2. The Secretary to the Govt. Meghalaya, Forests & Environment Department, Shillong, for information.
3. The Deputy Director General of Forests (C), Regional office,N.E.Z, Ministry of Environment, Forests & Climate Change (MoEF&CC), Law-u-sib, Lumbatngen, Sawlad, Near M.T.C. workshop, Shillong- 793 021, for information and necessary action.
4. The Secretary to the Govt. of Meghalaya, Mining & Geology Dept., Shillong for information.
5. The Deputy Commissioner, West Jaiñtia Hills, Jowai for information and necessary action.
6. The Divisional Forest Officer, Jaiñtia Hills (T) Division, Jowai for information and necessary action.
7. The Member Secretary, State Expert Appraisal Committee, Meghalaya for information.
8. The Divisional Mining Officer, Directorate of Mineral Resources, Meghalaya, Jowai for information.
9. The Member Secretary, Meghalaya Pollution Control Board, 'Arden', Lumpyngngad, Shillong – 793 014 for information and necessary action.

Annexure 1

Standard Terms of Reference for (Mining of minerals)

1.

S. No	Terms of Reference
1.1	An EIA-EMP Report shall be prepared for peak capacity (…..MTPA)operation in an ML/project

S. No	Terms of Reference
	area of.....ha based on the generic structure specified in Appendix III of the EIA Notification, 2006.
1.2	An EIA-EMP Report would be prepared for peak capacity operation to cover the impacts and environment management plan for the project specific activities on the environment of the region, and the environmental quality encompassing air, water, land, biotic community, etc. through collection of data and information, generation of data on impacts including prediction modeling for..... MTPA of coal production based on approved project/Mining Plan for.....MTPA. Baseline data collection can be for any season (three months) except monsoon.
1.3	Propoer KML file with pin drop and coordinate of mine at 500-1000 m interval be provided
1.4	A Study area map of the core zone (project area) and 10 km area of the buffer zone (1: 50,000 scale) clearly delineating the major topographical features such as the land use, surface drainage pattern including rivers/streams/nullahs/canals, locations of human habitations, major constructions including railways, roads, pipelines, major industries, mines, coal washery and other polluting sources. In case of ecologically sensitive areas such as Biosphere Reserves/National Parks/WL Sanctuaries/ Elephant Reserves, forests (Reserved/Protected), migratory corridors of fauna, and areas where endangered fauna and plants of medicinal and economic importance found in the 15 km study area should be given. The above details to be furnished in tabular form also
1.5	Map showing the core zone delineating the agricultural land (irrigated and un-irrigated, uncultivable land as defined in the revenue records, forest areas (as per records), along with other physical features such as water bodies, etc should be furnished.
1.6	A contour map showing the area drainage of the core zone and 25 km of the study area (where the water courses of the core zone ultimately join the major rivers/streams outside the lease/project area) should also be clearly indicated in the separate map.
1.7	Catchment area with its drainage map of 25 km area within and outside the mine shall be provided with names, details of rivers/ riverlet system and its respective order. The map should clearly indicate drainage pattern of the catchment area with basin of major rivers. Diversion of drains/ river need eloboration in form of lengthe, quantity and quality of water to be diverted
1.8	(Details of mineral reserves, geological status of the study area and the seams to be worked, ultimate working depth and progressive stage-wise working scheme until the end of mine life should be provided on the basis of the approved rated capacity and calendar plans of production from the approved Mining Plan. Geological maps and sections should be included. The Progressive mine development and Conceptual Final Mine Closure Plan should also be shown in figures. Details of mine plan and mine closure plan approval of Competent Authority should be furnished for green field and expansion projects.
1.9	Details of mining methods, technology, equipment to be used, etc., rationale for selection of specified technology and equipment proposed to be used vis-à-vis the potential impacts should be provided.
1.10	Impact of mining on hydrology, modification of natural drainage, diversion and channeling of the existing rivers/water courses flowing though the ML and adjoining the lease/project and the impact on the existing users and impacts of mining operations thereon.
1.11	A detailed Site plan of the mine showing the proposed break-up of the land for mining operations

S. No	Terms of Reference
	such as the quarry area, OB dumps, green belt, safety zone, buildings, infrastructure, CHP, ETP, Stockyard, township/colony (within and adjacent to the ML), undisturbed area -if any, and landscape features such as existing roads, drains/natural water bodies to be left undisturbed along with any natural drainage adjoining the lease /project areas, and modification of thereof in terms of construction of embankments/bunds, proposed diversion/re-channelling of the water courses, etc., approach roads, major haul roads, etc should be indicated.
1.12	Original land use (agricultural land/forestland/grazing land/wasteland/water bodies) of the area should be provided as per the tables given below. Impacts of project, if any on the land use, in particular, agricultural land/forestland/grazing land/water bodies falling within the lease/project and acquired for mining operations should be analyzed. Extent of area under surface rights and under mining rights should be specified. Area under Surface Rights S.N ML/Project Land use Area under Surface Rights(ha) Area Under Mining Rights(ha) Area under Both (ha) 1 Agricultural land 2 Forest Land 3 Grazing Land 4 Settlements 5 Others (specify) S.N. Details Area (ha) 1 Buildings 2 Infrastructure 3 Roads 4 Others (specify) Total
1.13	Study on the existing flora and fauna in the study area (10km) should be carried out by an institution of relevant discipline. The list of flora and fauna duly authenticated separately for the core and study area and a statement clearly specifying whether the study area forms a part of the migratory corridor of any endangered fauna should be given. If the study area has endangered flora and fauna, or if the area is occasionally visited or used as a habitat by Schedule-I species, or if the project falls within 15 km of an ecologically sensitive area, or used as a migratory corridor then a Comprehensive Conservation Plan along with the appropriate budgetary provision should be prepared and submitted with EIA-EMP Report; and comments/observation from the CWLW of the State Govt. should also be obtained and furnished.
1.14	One-season (other than monsoon) primary baseline data on environmental quality - air (PM10, PM2.5, SOx, NOx and heavy metals such as Hg, Pb, Cr, As, etc), noise, water (surface and groundwater), soil - along with one-season met data coinciding with the same season for AAQ collection period should be provided. The detail of NABL/ MoEF&CC certification of the respective laborartory and NABET accreditation of the consultant to be provided.
1.15	Map (1: 50, 000 scale) of the study area (core and buffer zone) showing the location of various sampling stations superimposed with location of habitats, other industries/mines, polluting sources, should be provided. The number and location of the sampling stations in both core and buffer zones should be selected on the basis of size of lease/project area, the proposed impacts in the downwind

S. No	Terms of Reference
	(air)/downstream (surface water)/groundwater regime (based on flow). One station should be in the upwind/upstream/non-impact/non-polluting area as a control station. The monitoring should be as per CPCB guidelines and parameters for water testing for both ground water and surface water as per ISI standards and CPCB classification wherever applicable. Observed values should be provided along with the specified standards.
1.16	For proper baseline air quality assessment, Wind rose pattern in the area should be reviewed and accordingly location of AAMSQ shall be planned by the collection of air quality data by adequate monitoring stations in the downwind areas. Monitoring location for collecting baseline data should cover overall the 10 km buffer zone i.e. dispersed in 10 km buffer area. In case of expansion, the displayed data of CAAQMS and its comparison with the monitoring data to be provided
1.17	A detailed traffic study along with presence of habitation in 100 mts distance from both side of road, the impact on the air quality with its proper measures and plan of action with timeline for widening of road. The project will increase the no. of vehicle along the road which will indirectly contribute to carbon emission so what will be the compensatory action plan should be clearly spell out in EIA/ EMP report.
1.18	The socio-economic study to conducted with actual survey report and a comparative assessment to be provided from the census data should be provided in EIA/ EMP report also occupational status & economic status of the study area and what economically project will contribute should be clearly mention. The study should also include the status of infrastructural facilities and amenities present in the study area and a comparative assessment with census data to be provided and to link it with the initialization and quantification of need based survey for CSR activities to be followed.
1.19	The Ecology and biodiversity study should also indicate the likely impact of change in forest area for surface infrastructural development or mining activity in relation to the climate change of that area and what will be the compensatory measure to be adopted by PP to minimize the impact of forest diversion.
1.20	Baseline data on the health of the population in the impact zone and measures for occupational health and safety of the personnel and manpower for the mine should be submitted.
1.21	Impact of proposed project/activity on hydrological regime of the area shall be assessed and report be submitted. Hydrological studies as per GEC 2015 guidelines to be prepared and submitted
1.22	Impact of mining and water abstraction from the mine on the hydrogeology and groundwater regime within the core zone and 10 km buffer zone including long-term monitoring measures should be provided. Details of rainwater harvesting and measures for recharge of groundwater should be reflected in case there is a declining trend of groundwater availability and/or if the area falls within dark/grey zone.
1.23	Study on land subsidence including modeling for prediction, mitigation/prevention of subsidence, continuous monitoring measures, and safety issues should be carried out.
1.24	Detailed water balance should be provided. The break up of water requirement as per different activities in the mining operations, including use of water for sand stowing should be given separately. Source of water for use in mine, sanction of the Competent Authority in the State Govt. and impacts vis-à-vis the competing users should be provided.

S. No	Terms of Reference
1.25	PP shall submit design details of all Air Pollution control equipment (APCEs) to be implemented as part of Environment Management Plan vis-à-vis reduction in concentration of emission for each APCEs
1.26	PP shall propose to use LNG/CNG based mining machineries and trucks for mining operation and transportation of minerals. The measures adopted to conserve energy or use of renewable sources shall be explored
1.27	PP to evaluate the green house emission gases from the mine operation/ washery plant and corresponding carbon absorption plan.
1.28	Site specific Impact assessment with its mitigation measures, Risk Assessment and Disaster Preparedness and Management Plan should be provided.
1.29	Impact of choice of mining method, technology, selected use of machinery and impact on air quality, mineral transportation, coal handling & storage/stockyard, etc, Impact of blasting, noise and vibrations should be provided.
1.30	Impacts of mineral transportation within the mining area and outside the lease/project along with flow-chart indicating the specific areas generating fugitive emissions should be provided. Impacts of transportation, handling, transfer of mineral and waste on air quality, generation of effluents from workshop etc, management plan for maintenance of HEMM and other machinery/equipment should be given. Details of various facilities such as rest areas and canteen for workers and effluents/pollution load emanating from these activities should also be provided.
1.31	Details of various facilities to be provided to the workers in terms of parking, rest areas and canteen, and effluents/pollution load resulting from these activities should also be given.
1.32	The number and efficiency of mobile/static water jet, Fog cannon sprinkling system along the main mineral transportation road inside the mine, approach roads to the mine/stockyard/siding, and also the frequency of their use in impacting air quality should be provided.
1.33	Impacts of CHP, if any on air and water quality should be given. A flow chart showing water balance along with the details of zero discharge should be provided.
1.34	Conceptual Final Mine Closure Plan and post mining land use and restoration of land/habitat to the pre- mining status should be provided. A Plan for the ecological restoration of the mined out area and post mining land use should be prepared with detailed cost provisions. Impact and management of wastes and issues of re-handling (wherever applicable) and backfilling and progressive mine closure and reclamation should be furnished.
1.35	Adequate greenbelt nearby areas, coal stock yard and transportaion area of coal shall be provided with details of species selected and survival rate Greenbelt development should be undertaken particularly around the transport route and CHP.
1.36	Cost of EMP (capital and recurring) should be included in the project cost and for progressive and final mine closure plan.
1.37	Details of R&R. Detailed project specific R&R Plan with data on the existing socio- economic status of the population (including tribals, SC/ST, BPL families) found in the study area and broad

S. No	Terms of Reference
	plan for resettlement of the displaced population, site for the resettlement colony, alternate livelihood concerns/employment for the displaced people, civic and housing amenities being offered, etc and costs along with the schedule of the implementation of the R&R Plan should be given.
1.38	CSR Plan along with details of villages and specific budgetary provisions (capital and recurring) for specific activities over the life of the project should be given.
1.39	Corporate Environment Responsibility:
1.40	a) The Company must have a well laid down Environment Policy approved by the Board of Directors.
1.41	b) The Environment Policy must prescribe for standard operating process/procedures to bring into focus any infringements/deviation/violation of the environmental or forest norms/conditions.
1.42	c) The hierarchical system or Administrative Order of the company to deal with environmental issues and for ensuring compliance with the environmental clearance conditions must be furnished.
1.43	d) To have proper checks and balances, the company should have a well laid down 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.
1.44	e) Environment Managament Cell and its responsibilities to be clearly spleel out in EIA/ EMP report
1.45	f) In built mechanism of self-monitoring of compliance of environmental regulations should be indicated.
1.46	Submission of sample test analysis of Characteristics of coal: This should include details on grade of coal and other characteristics such as ash content, S and heavy metals including levels of Hg, As, Pb, Cr etc.
1.47	Status of any litigations/ court cases filed/pending on the project should be provided.
1.48	Copy of clearances/approvals such as Forestry clearances, Mining Plan Approval, mine closer plan approval. NOC from Flood and Irrigation Dept. (if req.), etc. wherever applicable.
1.49	In case of expansion of the proposal, the status of the work done as per mining plan and approved mine closure plan shall be detailed in EIA/ EMP report
1.50	Details on Public Hearing should cover the information relating to notices issued in the newspaper, proceedings/minutes of Public Hearing, the points raised by the general public and commitments made by the proponent and the time bound action proposed with budgets in suitable time frame. These details should be presented in a tabular form. If the Public Hearing is in the regional language, an authenticated English Translation of the same should be provided.
1.51	PP shall carry out survey through drone highlighting the ground reality for atleast 10 minutes

S. No	Terms of Reference
1.52	Detailed Chronology of the project starting from the first lease deed alloted/Block allotment/ Land acquired to its No. of renewals, CTO /CTE with details of no. renewals, previous EC(s) granted details and its compliance details, NOC details from various Govt bodies like Forest NOC(s), CGWA permissions, Power permissions, etc as per the requisites respectively to be furnished in tabular form.
1.53	The first page of the EIA/ EMP report must mention the peak capacity production, area, detail of PP, Consultant (NABET acrreditation) and Laboratory (NABL / MoEF & CC certification)
1.54	The compliances of ToR must be properly cited with respective chapter section and page no in tabular form and also mention sequence of the respective ToR complied within the EIA-EMP report in all the chapter,s section.

Additional Terms of Reference

1. Site photographs together with photographs and other related details of site visits by resource persons of NABET accredited consultant of project proponent, with their names and profession/designation, together with date(s) of visit, date(s) of data collection including names of instrument/machine actually used in the field, during preparation of EIA report, is to be clearly highlighted in the EIA/EMP report.
2. Boundary pillars with the height not less than 2.5 feet above the ground level and 1.5 feet below ground and minimum 8 inches on all face of pillar should be erected.
3. GPS coordinates of each pillar should be carved/painted clearly on the pillars with red colour.

Annexure 2

Details of Products & By-products

Name of the product /By-product	Product / By-product	Quantity	Unit	Mode of Transport / Transmission	Remarks (eg. CAS number)
Limestone	Limestone	148908	Tons per Annum (TPA)	Road	LoM is 12 years. Peak production capacity of 148908 TPA will be achieved in the eight year of mining operations.

Table 1-A: Reference for the Terms of Reference issued by the State Environment Impact Assessment Authority (SEIAA) of Meghalaya vide File No. ML/SEAC/SEIAA/PP/WJH/18/2024

S. No.	Description of Terms of Reference (ToR)	Terms of Reference (ToR) Compliances
1	**Standard Terms of Reference for (Mining of Minerals)**	
1.1	An EIA-EMP Report shall be prepared for peak capacity (..... MTPA) in an ML/project area of.....ha based on the generic structure specified in Appendix III of the EIA Notification, 2006.	This EIA-EMP Report has been prepared based on the generic structure as specified in Appendix III of the EIA Notification of 2006. **Chapter No.:** 1-12
1.2	An EIA-EMP Report would be prepared for peak capacity operation to cover the impacts and environment management plan for the project specific activities on the environment of the region, and the environmental quality encompassing air, water, land, biotic community, etc. through collection of data and information, generation of data on impacts including prediction modeling for MTPA of coal production based on approved project/Mining Plan for.....MTPA. Baseline data collection can be for any season (three months) except monsoon.	This EIA/EMP Report has been prepared for 0.148 MTPA peak production capacity with mine lease area of 3.00 Ha (as per the production schedule in the approved Modified Mining Plan with Progressive Mine Closure Plan of Thanghunai Limestone Quarry). The baseline data encompassing air, water, noise, soil, ecology & biodiversity, etc. has been generated for the winter months of December 2023 to February 2024. **Chapter and Section:** All sections of Chapters 3, 4, and 10 **Page No.:** 3-1 to 3-47, 4-1 to 4-34, and 10-1 to 10-18
1.3	Propoer KML file with pin drop and coordinate of mine at 500-1000 m interval be provided	.kml file of the project was uploaded during the process of Application for Grant of ToR in PARIVESH 2.0 website. The ML boundary with coordinates superimposed on the project area's topographical map has been provided in this EIA-EMP Report. **Chapter and Figure No.:** Fig 1.2 (Co-ordinate Plan) of Chapter 1

		Page No.: 1-12
1.4	A Study area map of the core zone (project area) and 10 km area of the buffer zone (1: 50,000 scale) clearly delineating the major topographical features such as the land use, surface drainage pattern including rivers/streams/nullahs/canals, locations of human habitations, major constructions including railways, roads, pipelines, major industries, mines, washery and other polluting sources. In case of ecologically sensitive areas such as Biosphere Reserves/National Parks/WL Sanctuaries/ Elephant Reserves, forests (Reserved/Protected), migratory corridors of fauna, and areas where endangered fauna and plants of medicinal and economic importance found in the 15 km study area should be given. The above details to be furnished in tabular form also	A Study area map of the core zone (project area) and 10 km area of the buffer zone has been provided in this EIA-EMP Report. **Chapter and Figure No.:** Fig 2.2 (Study Area Map of Thanghunai Limestone Quarry) of Chapter 2 **Page No.:** 2-5
1.5	Map showing the core zone delineating the agricultural land (irrigated and un-irrigated, uncultivable land as defined in the revenue records, forest areas (as per records), along with other physical features such as water bodies, etc should be furnished.	Map showing various surface features of the project's core zone is provided in the approved Modified Mining Plan with Progressive Mine Closure Plan of Thanghunai Limestone Quarry as **Plate 3 (Surface Plan)**. A separate land use land cover map of the core area has also been provided in this EIA-EMP Report. **Chapter and Figure No.:** Fig 3.12 (Land Use Pattern of the Core Area) of Chapter 3 **Page No.:** 3-37
1.6	A contour map showing the area drainage of the core zone and 25 km of the study area (where the water courses of the core zone ultimately join the major rivers/streams outside the lease/project area) should also be clearly indicated in the separate map.	A separate contour map showing the area drainage of the core zone and 25 km of the study area has been provided in this EIA-EMP Report as **Annexure 13**.
1.7	Catchment area with its drainage map of 25 km area within and outside the mine shall be provided with names, details of rivers/ riverlet system and its respective order. The map should clearly indicate drainage pattern of the catchment area with basin of major rivers. Diversion of drains/ river need eloboration in form of lengthe, quantity and quality of water to be diverted	Catchment area with its drainage map of 25 km area has been provided in this EIA-EMP Report as **Annexure 14**.
1.8	(Details of mineral reserves, geological status of the study area and the seams to be worked, ultimate working depth and progressive stage-wise	Details of the mineral reserves, geo-mining parameters, progressive

	working scheme until the end of mine life should be provided on the basis of the approved rated capacity and calendar plans of production from the approved Mining Plan. Geological maps and sections should be included. The Progressive mine development and Conceptual Final Mine Closure Plan should also be shown in figures. Details of mine plan and mine closure plan approval of Competent Authority should be furnished for green field and expansion projects.	mechanism of limestone extraction, production schedule for the mineral and generation of OB, details of OB management, etc. have been provided in this EIA-EMP Report. The Geological Plan and sections and Conceptual Plan have been attached as **Annexures 15** and **16** respectively. **Chapter No.:** 1 and 2
1.9	Details of mining methods, technology, equipment to be used, etc., rationale for selection of specified technology and equipment proposed to be used vis-à-vis the potential impacts should be provided.	Details of mining methods, technology, equipment to be used and rationale for selection of specified approach of mining and equipment etc., have been provided in this EIA-EMP Report. **Chapter No.:** 2
1.10	Impact of mining on hydrology, modification of natural drainage, diversion and channeling of the existing rivers/water courses flowing though the ML and adjoining the lease/project and the impact on the existing users and impacts of mining operations thereon.	Impacts have been provided in **Chapter 4** of this EIA-EMP Report. There is no major stream or river flowing through the ML and adjoining the lease/project area that will require diversion.
1.11	A detailed Site plan of the mine showing the proposed break-up of the land for mining operations such as the quarry area, OB dumps, green belt, safety zone, buildings, infrastructure, CHP, ETP, Stockyard, township/colony (within and adjacent to the ML), undisturbed area -if any, and landscape features such as existing roads, drains/natural water bodies to be left undisturbed along with any natural drainage adjoining the lease /project areas, and modification of thereof in terms of construction of embankments/bunds, proposed diversion/re-channelling of the water courses, etc., approach roads, major haul roads, etc should be indicated.	A detailed Site Plan for the project, i.e., the Conceptual Plan and Section is provided in the approved Modified Mining Plan with Progressive Mine Closure Plan of Thanghunai Limestone Quarry. The same has also been provided in this EIA-EMP Report. **Chapter and Figure No.:** Fig 2.5 (Conceptual Plan and Section of Thanghunai Limestone Quarry) of **Chapter 2** **Page No.:** 2-20

<table>
<tr>
<td>1.12</td>
<td>Original land use (agricultural land/forestland/grazing land/wasteland/water bodies) of the area should be provided as per the tables given below. Impacts of project, if any on the land use, in particular, agricultural land/forestland/grazing land/water bodies falling within the lease/project and acquired for mining operations should be analyzed. Extent of area under surface rights and under mining rights should be specified.
<table>
<tr><th>S.N</th><th>ML/Project Land use</th><th>Area under Surface Rights(ha)</th><th>Area Under Mining Rights(ha)</th><th>Area under Both (ha)</th></tr>
<tr><td>1</td><td></td><td></td><td></td><td></td></tr>
<tr><td>2</td><td></td><td></td><td></td><td></td></tr>
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<tr><th>S.N.</th><th>Details</th><th>Area (ha)</th></tr>
<tr><td>1</td><td>Buildings</td><td></td></tr>
<tr><td>2</td><td>Infrastructure</td><td></td></tr>
<tr><td>3</td><td>Roads</td><td></td></tr>
<tr><td>4</td><td>Others (specify)</td><td></td></tr>
<tr><td colspan="2">Total</td><td></td></tr>
</table>
</td>
<td>The Mine Lease area of 3.0 Ha is a non-forest land and entirely belongs to the proponent as per the Deed of Lease, along with the subsurface rights for carrying out mining activities. The original land use breakup of the area has been indicated in Table 2.10.

Chapter No.: 2

Annexure: 2 & 6</td>
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<tr>
<td>1.13</td>
<td>Study on the existing flora and fauna in the study area (10km) should be carried out by an institution of relevant discipline. The list of flora and fauna duly authenticated separately for the core and study area and a statement clearly specifying whether the study area forms a part of the migratory corridor of any endangered fauna should be given. If the study area has endangered flora and fauna, or if the area is occasionally visited or used as a habitat by Schedule-I species, or if the project falls within 15 km of an ecologically sensitive area, or used as a migratory corridor then a Comprehensive Conservation Plan along with the appropriate budgetary provision should be prepared and submitted with EIA-EMP Report; and comments/observation from the CWLW of the State Govt. should also be</td>
<td>Baseline data on the existing flora and fauna and ecological and biological environment has been carried out for Thanghunai Limestone Quarry during the winter season from December 2023 to February 2024. It is incorporated in Chapter 3 of this EIA-EMP Report.

Chapter and Section: Section 3.3.12 of Chapter 3.

Page No.: 3-37 to 3-44.</td>
</tr>
</table>

	obtained and furnished.	
1.14	One-season (other than monsoon) primary baseline data on environmental quality - air (PM10, PM2.5, SOx, NOx and heavy metals such as Hg, Pb, Cr, As, etc), noise, water (surface and groundwater), soil - along with one-season met data coinciding with the same season for AAQ collection period should be provided. The detail of NABL/ MoEF&CC certification of the respective laboratory and NABET accreditation of the consultant to be provided.	One-season (other than monsoon) primary baseline data on environmental quality - air (PM10, $PM_{2.5}$, SOx, NOx and heavy metals such as Hg, Pb, Cr, As, etc), noise, water (surface and groundwater), soil - has been collected and analysed from December 2023 to February 2024 and provided in **Chapter 3** of this EIA-EMP Report. The details of NABL certification of the laboratory and NABET certification of the consultant has been provided in **Chapter 12** of this EIA-EMP Report. **Chapter and Section:** Section 12.2 on Page No. 12-4 and 12.3 on Page No. 12-5 of **Chapter 12**.
1.15	Map (1: 50, 000 scale) of the study area (core and buffer zone) showing the location of various sampling stations superimposed with location of habitats, other industries/mines, polluting sources, should be provided. The number and location of the sampling stations in both core and buffer zones should be selected on the basis of size of lease/project area, the proposed impacts in the downwind (air)/downstream (surface water)/groundwater regime (based on flow). One station should be in the upwind/upstream/non-impact/non-polluting area as a control station. The monitoring should be as per CPCB guidelines and parameters for water testing for both ground water and surface water as per ISI standards and CPCB classification wherever applicable. Observed values should be provided along with the specified standards.	Maps showing locations of the sampling/monitoring stations, the scope of the Baseline Data Collection study, and observed values along with specified standards are provided in **Chapter 3** of this EIA-EMP Report. The sampling stations have been selected on the basis of guidelines laid out by CPCB, and other regulatory bodies, as applicable.
1.16	For proper baseline air quality assessment, Wind rose pattern in the area should be reviewed and accordingly location of AAMSQ shall be planned by the collection of air quality data by adequate monitoring stations in the downwind areas. Monitoring location for collecting baseline data should cover overall the 10 km buffer zone i.e. dispersed in 10 km buffer area. In case of expansion, the displayed data of CAAQMS and its comparison with the monitoring data to be provided	Wind rose pattern of the study area has been reviewed and sampling locations for AAQ monitoring were accordingly planned. Locations of the AAQ monitoring stations for collecting baseline data cover the overall core area and 10 km buffer area. Wind rose diagrams for the study period from December 2023 to February 2024 is

		provided in Chapter 3 of this EIA-EMP Report. **Chapter No.:** 3 **Figure and Page No.:** 3.2 on Page No. 3-14
1.17	A detailed traffic study along with presence of habitation in 100 mts distance from both side of road, the impact on the air quality with its proper measures and plan of action with timeline for widening of road. The project will increase the no. of vehicle along the road which will indirectly contribute to carbon emission so what will be the compensatory action plan should be clearly spell out in EIA/ EMP report.	A detailed traffic study was conducted with presence of habitation in 100 m distance from both side of road. Details has been provided in **Chapter 3** of this EIA-EMP Report. **Section and Page No.:** 3.3.3 on Page No. 3-17 to 3-19
1.18	The socio-economic study to conducted with actual survey report and a comparative assessment to be provided from the census data should be provided in EIA/ EMP report also occupational status & economic status of the study area and what economically project will contribute should be clearly mention. The study should also include the status of infrastructural facilities and amenities present in the study area and a comparative assessment with census data to be provided and to link it with the initialization and quantification of need based survey for CSR activities to be followed.	Details of the preliminary socio-economic study have been provided in **Chapter 3** of this EIA-EMP Report. Census 2011 data regarding the study area's demography, occupational status, infrastructural facilities, etc. is also attached as **Annexure 17**. The project proponent will conduct a detailed socio-economic study and link it with the initialization and quantification of a need-based survey for CSR and CER activities after conducting the Public Consultation. The survey report for the same will be furnished along with the final EIA-EMP report for this project. **Page No.:** 3-45 to 3-47
1.19	The Ecology and biodiversity study should also indicate the likely impact of change in forest area for surface infrastructural development or mining activity in relation to the climate change of that area and what will be the compensatory measure to be adopted by PP to minimize the impact of forest diversion.	No forest diversion has been proposed for this project. A Non-Forest Land Certificate for the entire project/ ML area has been attached to this EIA-EMP Report as **Annexure 6**.
1.20	Baseline data on the health of the population in the impact zone and measures for occupational health and safety of the personnel and	To gather information for the baseline socio-economic assessment, the study

	manpower in the mine should be submitted.	employed extensive research of existing data (secondary data) and fresh data collection (primary data) – wherever possible. Details have been provided in **Chapter 3** of this EIA-EMP Report. **Section and Page No.:** Section 3.3.13 on Page No. 3-45 to 3-47 Mitigation measures and monitoring system regarding Occupational Health and Safety are provided in **Chapters 6, 7 and 10** of this Report.
1.21	Impact of proposed project/activity on hydrological regime of the area shall be assessed and report be submitted. Hydrological studies as per GEC 2015 guidelines to be prepared and submitted	Secondary data on the groundwater regime for the project district of West Jaintia Hills has been provided in **Chapter 4** of this draft EIA-EMP Report. A detailed primary hydrological study to assess the anticipated impacts of the proposed project/activity will be carried out after the end of the monsoon season and subsequently, the report will be submitted along with the final EIA-EMP Report. **Chapter and Section:** Section 4.5.1.3 of Chapter 4. **Page No.:** 4-20 to 4-24
1.22	Impact of mining and water abstraction from the mine on the hydrogeology and groundwater regime within the core zone and 10 km buffer zone including long-term monitoring measures should be provided. Details of rainwater harvesting and measures for recharge of groundwater should be reflected in case there is a declining trend of groundwater availability and/or if the area falls within dark/grey zone.	Impact of mining and water abstraction from the mine on the hydrogeology and groundwater regime within the core zone and 10 km buffer zone including a detailed monitoring programme have been provided in this EIA-EMP Report. **Chapter No.:** 4, 6, and 10 As per the Dynamic Groundwater Resources of India 2022 data, the status of groundwater availability in the study

		area falls under SAFE category. Details of rainwater harvesting and measures for artificial recharge of groundwater are provided in the Rainwater Harvesting Proposal and Artificial Recharge to Groundwater Plan, that is attached as **Annexure 12** to this EIA-EMP Report.
1.23	Study on land subsidence including modelling for prediction, mitigation/prevention of subsidence, continuous monitoring measures, and safety issues should be carried out.	**Not Applicable to this project.**
1.24	Detailed water balance should be provided. The break up of water requirement as per different activities in the mining operations, including use of water for sand stowing should be given separately. Source of water for use in mine, sanction of the Competent Authority in the State Govt. and impacts vis-à-vis the competing users should be provided.	Break-up of the water requirement for various mine operations along with a detailed water balance diagram have been provided in **Chapter 2** of this EIA-EMP Report. **Table No. and Figure No.:** Table 2.9 and Figure 2.4 **Page No.:** 2-16, 2-17, and 2-19
1.25	PP shall submit design details of all Air Pollution control equipment (APCEs) to be implemented as part of Environment Management Plan vis-à-vis reduction in concentration of emission for each APCEs	Details of the Air Pollution Control Equipment (APCEs) to be implemented as part of the project's Environment Management Plan are provided in **Chapters 4** and **10** of this EIA-EMP Report.
1.26	PP shall propose to use LNG/CNG based mining machineries and trucks for mining operation and transportation of minerals. The measures adopted to conserve energy or use of renewable sources shall be explored	The probability of exploring the use of LNG/CNG based mining machineries and trucks for mining operations and mineral transportation is provided in **Chapter 4** of this EIA-EMP Report. Measures to be adopted to use renewable energy has been provided in **Chapter 2** – Table 2.9 on Page 2-17. Implementation of above technology will be undertaken based on a successful outcome by end of FY 2024-

		25. Therefore, use of LNG/CNG based mining machinery may be adopted at a later stage, after techno-commercial feasibility is established in opencast mines extensively, and the necessary infrastructure (CNG/LNG refuelling stations) is established in the state of Meghalaya. **Section and Page No.:** Sub-section 4.3.1.3 of Section 4.3.1 on Page No. 4-10.
1.27	PP to evaluate the greenhouse emission gases from the mine operation/ washery plant and corresponding carbon absorption plan.	There is no provision of a washery plant within the mine lease area and the primary greenhouse gas, i.e., CO_2 will be absorbed by the extensive amount of green cover that shall be subsequently developed in the mine. It is believed that electric power production enterprises and transport are the main sources of GHG emissions (SO_2, N_2O, CH_4, SF_6, hydrofluorocarbons, perfluorocarbons, etc.) In order to keep these within permissible limits, HEMMs and other vehicles will be regularly maintained and monitored. A detailed study to evaluate greenhouse gas emissions shall be undertaken after the mine is operational and details thereof, shall be furnished in the Compliance Reports.
1.28	Site specific Impact assessment with its mitigation measures, Risk Assessment and Disaster Preparedness and Management Plan should be provided.	This EIA-EMP Report has been prepared keeping in mind all specifications of the project site. Site specific impact assessment with their respective mitigation measures is provided in **Chapter 4** of this EIA-EMP Report.

		Page No.: 4-1 to 4-34
1.29	Impact of choice of mining method, technology, selected use of machinery and impact on air quality, mineral transportation, coal handling & storage/stockyard, etc, Impact of blasting, noise and vibrations should be provided.	Incorporated into this EIA-EMP Report in **Chapter Nos.: 2 and 4**
1.30	Impacts of mineral transportation within the mining area and outside the lease/project along with flow-chart indicating the specific areas generating fugitive emissions should be provided. Impacts of transportation, handling, transfer of mineral and waste on air quality, generation of effluents from workshop etc, management plan for maintenance of HEMM and other machinery/equipment should be given. Details of various facilities such as rest areas and canteen for workers and effluents/pollution load emanating from these activities should also be provided.	Anticipated impacts of mineral transportation, handling, transfer of mineral and waste on air quality and their mitigation measures, along with details of HEMM management and maintenance have been provided in this EIA-EMP Report. **Chapter No.:** 4 and 10
1.31	Details of various facilities to be provided to the workers in terms of parking, rest areas and canteen, and effluents/pollution load resulting from these activities should also be given.	As the ML area is only 3.0 Ha in size, temporary infrastructure such as rest shelters, first-aid room, mine office, toilets, etc. have been constructed. These shall be subsequently dismantled after the end of LoM.
1.32	The number and efficiency of mobile/static water jet, Fog cannon sprinkling system along the main mineral transportation road inside the mine, approach roads to the mine/stockyard/siding, and also the frequency of their use in impacting air quality should be provided.	Incorporated into this EIA-EMP Report in **Chapter No. 4**
1.33	Impacts of CHP, if any on air and water quality should be given. A flow chart showing water balance along with the details of zero discharge should be provided.	**This is a proposal for a limestone mining project. No CHP is proposed.** A detailed water balance has been provided in **Chapter 2** of this EIA-EMP Report. **Figure and Page No.:** Fig 2.4 on Page No. 2-19
1.34	Conceptual Final Mine Closure Plan and post mining land use and restoration of land/habitat to the pre- mining status should be provided. A Plan for the ecological restoration of the mined out area and post mining land use should be prepared with detailed cost provisions. Impact and management of wastes and issues of re-handling (wherever applicable) and backfilling and progressive mine closure and reclamation should be	Incorporated into this EIA-EMP Report in **Chapter Nos. 2, 4,** and **10**.

	furnished.	
1.35	Adequate greenbelt nearby areas, coal stock yard and transportaion area of coal shall be provided with details of species selected and survival rate Greenbelt development should be undertaken particularly around the transport route and CHP.	A Greenbelt Development Plan has been detailed in Section 4.7.2.1 in **Chapter 4** of this EIA-EMP Report. **However, this is a proposal for limestone mining. Hence, greenbelt development in the coal stock yard, transportation of coal route and around the CHP is not applicable to this project.**
1.36	Cost of EMP (capital and recurring) should be included in the project cost and for progressive and final mine closure plan.	Included in **Chapter 10** of this EIA-EMP Report. **Table and Page No.:** Table 10.3 on Page No. 10-17
1.37	Details of R&R. Detailed project specific R&R Plan with data on the existing socio- economic status of the population (including tribals, SC/ST, BPL families) found in the study area and broad plan for resettlement of the displaced population, site for the resettlement colony, alternate livelihood concerns/employment for the displaced people, civic and housing amenities being offered, etc and costs along with the schedule of the implementation of the R&R Plan should be given.	**Not Applicable to this project.**
1.38	CSR Plan along with details of villages and specific budgetary provisions (capital and recurring) for specific activities over the life of the project should be given.	A CSR Plan has been provided in Section 10.3 of **Chapter 10** on Page No. 10-18.
1.39	Corporate Environment Responsibility:	This project is privately owned by the project proponent and he shall ensure that all environmental stipulations, standard operating procedures, etc. are followed as detailed in this EIA-EMP Report and other existing environmental regulations. For self-monitoring of compliance to environmental regulations, a well laid mechanism is in place which is detailed in **Chapters 6** and **10** of this EIA-EMP
1.40	a) The Company must have a well laid down Environment Policy approved by the Board of Directors.	
1.41	b) The Environment Policy must prescribe for standard operating process/procedures to bring into focus any infringements/deviation/violation of the environmental or forest norms/conditions.	
1.42	c) The hierarchical system or Administrative Order of the company to deal with environmental issues and for ensuring compliance with the environmental clearance conditions must be furnished.	

1.43	d) To have proper checks and balances, the company should have a well laid down 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.	Report. A declaration by the project proponent is attached as **Annexure 18**.
1.44	e) Environment Management Cell and its responsibilities to be clearly spleel out in EIA/ EMP report	
1.45	f) In built mechanism of self-monitoring of compliance of environmental regulations should be indicated.	
1.46	Submission of sample test analysis of Characteristics of coal: This should include details on grade of coal and other characteristics such as ash content, S and heavy metals including levels of Hg, As, Pb, Cr etc.	**This is a proposal for limestone mining. Hence, this ToR condition is not applicable to this project.**
1.47	Status of any litigations/ court cases filed/pending on the project should be provided.	At present, there are no litigations/ court cases – filed/ pending regarding the proposed project.
1.48	Copy of clearances/approvals such as Forestry clearances, Mining Plan Approval, mine closer plan approval. NOC from Flood and Irrigation Dept. (if req.), etc. wherever applicable.	Copies of the following clearances and approvals are annexed to this report: i. **Annexure 1**: NOC from Local Authority ii. **Annexure 2**: Deed of Lease iii. **Annexure 3**: Grant of Environmental Clearance by the DEIAA, Meghalaya iv. **Annexure 4**: CTO v. **Annexure 5**: Grant of Mining Lease for Thanghunai Limestone Quarry vi. **Annexure 6**: Non-Forest Land Certficate vii. **Annexure 7**: Renewal of the LOI viii. **Annexure 8:** Approval Letter of the Modified Mining Plan with Progressive Mine Closure Plan of Thanghunai Limestone

		Quarry ix. **Annexure 9:** Cluster Letter
1.49	In case of expansion of the proposal, the status of the work done/activities as per mining plan and mine closure plan and progressive reclamation of OB dump shall be detailed in EIA/ EMP report	**This is a proposal for re-appraisal of Thanghunai Limestone Quarry. Hence, this ToR condition is not applicable to this project.**
1.50	Details on Public Hearing should cover the information relating to notices issued in the newspaper, proceedings/minutes of Public Hearing, the points raised by the general public and commitments made by the proponent and the time bound action proposed with budgets in suitable time frame. These details should be presented in a tabular form. If the Public Hearing is in the regional language, an authenticated English Translation of the same should be provided.	Details on Public Hearing/Consultation will be incorporated in the Final EIA-EMP Report after successfully conducting the Public Hearing/Consultation.
1.51	PP shall carry out survey through drone highlighting the ground reality for atleast 10 minutes	A drone survey highlighting the ground reality will be carried out and details shall be incorporated in the Final EIA-EMP Report.
1.52	Detailed Chronology of the project starting from the first lease deed alloted/Block allotment/ Land acquired to its No. of renewals, CTO /CTE with details of no. renewals, previous EC(s) granted details and its compliance details, NOC details from various Govt bodies like Forest NOC(s), CGWA permissions, Power permissions, etc as per the requisites respectively to be furnished in tabular form.	A detailed chronology of the project is provided in **Chapter 2** of this EIA-EMP Report. **Table and Page No.:** Table 2.6 on Page Nos. 2-8 and 2-9.
1.53	The first page of the EIA/ EMP report must mention the peak capacity production, area, detail of PP, Consultant (NABET acrreditation) and Laboratory (NABL / MoEF & CC certification)	The first page of this EIA-EMP Report contains all the mentioned details.
1.54	The compliances of ToR must be properly cited with respective chapter section and page no in tabular form and also mention sequence of the respective ToR complied within the EIA-EMP report in all the chapter,s section.	All compliances to the ToR conditions have been properly cited with respective Chapter Nos., Sections and Page Nos. mentioned in a tabular form.
	Additional Terms of Reference	
1.	Site photographs together with photographs and other related details of site visits by resource persons of NABET accredited consultant of project proponent, with their names and profession/designation, together with date(s) of visit, date(s) of data collection including names of instrument/machine actually used in the field, during preparation of EIA	Incorporated in Chapter 12 of this EIA-EMP Report.

	report, is to be clearly highlighted in the EIA/EMP report.	
2.	Boundary pillars with the height not less than 2.5 feet above the ground level and 1.5 feet below ground and minimum 8 inches on all face of pillar should be erected.	Duly complied by the Project Proponent. Refer **Annexure 19** of this EIA-EMP Report.
3.	GPS coordinates of each pillar should be carved/painted clearly on the pillars with red colour.	Duly complied by the Project Proponent. Refer **Annexure 19** of this EIA-EMP Report.

Chapter 1 – INTRODUCTION

1.1. PURPOSE OF THE REPORT

The purpose of this Environmental Impact Assessment (EIA) is to study the potential environment impacts and to assess the technical feasibility, economic viability and sustainable development of the already operational "Thanghunai Limestone Quarry" which is located in Thanghunai, Nongtalang Elaka, Amlarem C&RD Block, West Jaintia Hills District, State: Meghalaya for an area of 3.00 Ha and for re-appraisal by the State Environment Impact Assessment Authority (SEIAA) of Meghalaya. Limestone mining is one of the important economic activities for setting up of basic infrastructure facilities, roads, housing, ports, railways, irrigation projects, power infrastructure, etc. It has great potential for employment and overall development of any region while contributing to the state exchequer.

The project proponent plans to continue development of the mine by adopting systematic and scientific quarrying methods for the sustainable development of this project, giving due importance to safety, environment and the local communities.

The project proponent has engaged **M/s NOVOMINE INDIA PRIVATE LIMITED** (NABET Accredited EIA Consultant Organisation) to prepare the Environmental Impact Assessment Report and Environment Management Plan as per the approved ToR granted by the State Environment Impact Assessment Authority of Meghalaya. EIA has been carried out for the core and buffer areas of the mining area including one season baseline monitoring from December 2023 to February 2024 (winter season).

The SEAC of Meghalaya in its meeting held on 28th February, 2024 recommended for grant of Terms of Reference (ToR) for the preparation of an EIA/EMP report after due screening, examination, and deliberation of the documents submitted by the Project Proponent & observations by using the project site's .kml file through Google Earth. Subsequently, the SEIAA of Meghalaya issued the ToR vide **File No. ML/SEAC/SEIAA/PP/WJH/18/2024** dated 3rd July 2024 to Smt. Plenty K Pyngrope (**Refer Appendix I**).

As per the MoEF&CC's EIA Notification dated **14th September 2006 vide S.O. 1533** and all subsequent amendments till date, the project is classified as **"Category – B2"** [Sl. No. 1(a) of Schedule: "List of project or activities requiring prior Environmental Clearance"]. Thus, EIA studies

were not required for the project. However, as per the NGT order dated **13th September 2018** and subsequent Office Memorandum of the MoEF&CC vide **F. No. L-11011/175/2018-IA-II (M)** dated **12th December 2018**, which states that *"if a cluster or an individual lease size exceeds 5 Ha., the EIA-EMP including Public Hearing be made applicable in the process of grant of prior environmental clearance."* Following this, the project is characterized at par with **"Category – B1"** projects by the SEIAA/SEAC of Meghalaya, making EIA-EMP applicable in the process of grant of prior environmental clearance.

This Draft EIA/EMP report has been prepared to comply with the proposed Terms of Reference (ToR) conditions stipulated by SEIAA of Meghalaya, to successfully assess, predict, analyse, and mitigate the negative environmental impacts on the study area (10 km from boundary of the project site) that may emanate due to the continuation of mining.

1.2. IDENTIFICATION OF PROJECT & PROJECT PROPONENT

1.2.1. Identification of the Project

The project proponent has identified the project site considering the mineral deposit (deposit of limestone) in the mine lease area for Thanghunai Limestone Quarry. The details of the statutory clearances, permissions, approvals, consents, etc. under various Acts, Rules, and legislations and their statuses are listed below:

- The No Objection Certificate for this project was granted by the Office of the Jaintia Hills Autonomous District Council, Jowai vide Letter **No. JHADC/FOR/19/2017/782-85** dated **30th October 2017** (**Refer Annexure 1**).
- Consent to Operate (CTO) for this project has been received from the Meghalaya State Pollution Control Board vide Letter **No. MPCB/ONLINE-CTO-2017/2018-19/**42 on **4th April 2018** (**Refer Annexure 4**).
- The Mining Lease for this project was granted by the Divisional Forest Officer, Jaintia Hills Territorial Division, Jowai vide letter **No. JH/P.K.P/ML/2018-19/LS/959/B/154** dated **17th April 2018** (**Refer Annexure 5**).
- The mining lease area is a privately owned land that was formerly granted Environmental Clearance by the District Environment Impact Assessment Authority

(DEIAA) of Meghalaya vide **Letter No. GEN-198/Mining Plan/PPyngrope/2018/146** dated **26th March 2018** (**Refer Annexure 3**). However, the project is being put forward for re-appraisal by the SEIAA/SEAC of Meghalaya following MoEF&CC's OM vide **No. F. No. IA3-22/11/2023-IA.III (E-208230)** dated **28th April 2023**.

- As per letter vide **No. JH/PKP/ML/LS/2018-19/959/B/826** dated **22nd December 2023** issued by the Divisional Forest Officer (Territorial), Jaintia Hills Division, Jowai, Government of Meghalaya, the project falls under a non-forest land (**Refer Annex 6**).
- Renewed Letter of Intent (LoI) was granted to **Smt. Plenty K Pyngrope** for granting of mining lease for limestone from the Office of the Divisional Forest Officer Jaintia Hills (T) Division, Jowai, Government of Meghalaya vide Letter No. **JH/PKP/ML/LS/2018-19/959/B/1920** dated **16th January 2024** over an area of 3.0 ha (**Refer Annex 7**).
- The Modified Mining Plan with Progressive Mine Closure Plan was approved by the Divisional Mining Officer, West Jaintia Hills, Jowai vide letter **No. DMO-J/78/MM/Mining Plan/2022-23/20** dated **31st January 2024** (**Refer Annex 8**).
- Besides the approval of the Modified Mining Plan with Progressive Mine Closure Plan, the project proponent has obtained a cluster certificate from the Divisional Mining Officer, West Jaintia Hills, Jowai vide Letter **No. DMO-J/78/MM/Mining Plan/2022-23/21** dated **31st January 2024** (**Refer Annex 9**). As per the cluster certificate, 7 Approved Mining Plans with a total area of 21.86 Ha. are lying within 500 m from the periphery of this Approved Modified Mining Plan of Thanghunai Limestone Quarry. Summarized details of the project are given in **Table 1.1** below.

Table 1.1: Summarized details of the Thanghunai Limestone Quarry

Name of the Project	Thanghunai Limestone Quarry
Type of Project	Re-appraisal for Opencast Limestone Mining Project
Bounding Latitudes	25°13'03.48"N to 25°13'12.18"N
Bounding Longitudes	92°04'43.48"E to 92°04'50.27"E
Project Area	3.00 Ha.
Life of the project	12 years remaining (The expected life of mine

	is 17 years - first 5 years have been worked and the remaining mineable reserve of 16,21,598 Tonnes will be extracted in the next 12 years with an average annual production of 1,48,887 Tonnes)

1.2.2. Identification of the Project Proponent

Name of the Applicant : Smt. Plenty K Pyngrope

Address of the Applicant : Bakur Village, Dawki, West Jaintia Hills District, Meghalaya

1.3. BRIEF DESCRIPTION OF THE PROJECT – NATURE, SIZE, LOCATION, AND IMPORTANCE TO THE COUNTRY, REGION

The proposal is for re-appraisal by the SEAC/SEIAA of Meghalaya for mining of minor mineral (limestone) through open cast semi-mechanized method. The Modified Mining Plan with Progressive Mine Closure Plan which describes the nature, size, location of the project is prepared by RQP Ashok Kumar Sarkar. The Mining Plan was prepared under the provisions of The Meghalaya Minor Mineral Concession Rules of 2016 *(MMMCR, 2016)* for extraction of limestone with due consideration of environmental parameters so as to obtain EC for this project. The mine lease area is for 3.00 Ha. with the proposal of total production capacity of 148908 T, in which the average annual production is 148887 T. The expected life of mine is about 17 years (of which the first 5 years have been worked). The average estimated cost of the project is ₹25 Lakhs. As per the Approved Modified Mining Plan with Progressive Mine Closure Plan of Thanghunai Limestone Quarry, the project is expected to employ about 37 persons (25 skilled, 7 semi-skilled, and 5 unskilled).

Mineral wealth of the state of Meghalaya provides multiple employment opportunities to the people of the state. Mining is one of the major core sector industries which plays a crucial role in the process of the state's socio-economic development. The state has a total reserve of ~ 15100 MT of limestone (cement, metallurgical and chemical grade) *(Minerals of Meghalaya: Department of Mining and Geology)*. Limestone is a basic building and construction material that is widely

used for constructing houses, bridges and roads. It is cheaper than the RCC construction material due to its easy workability. It has high demand in the market due to increased domestic, industrial and other infrastructural activities. As a result of continuation of the mining project, the demand-supply position will remain balanced. Demand of Limestone in the region will be partially fulfilled by this project.

The overview of the project such as nature, size and location are further depicted in **Table 1.2** below.

Table 1.2: Overview of the Project

<table>
<tr><th>Particulars</th><th>Details</th></tr>
<tr><td>Project Name</td><td>Thanghunai Limestone Quarry</td></tr>
<tr><td>Location</td><td>Thanghunai, Nongtalang Elaka, West Jaintia Hills District, Meghalaya</td></tr>
<tr><td>GPS Co-ordinates of the Project</td><td>
<table>
<tr><th rowspan="2">Boundary Pillar No.</th><th colspan="2">Location (co-ordinates)</th></tr>
<tr><th>Latitude (N)</th><th>Longitude (E)</th></tr>
<tr><td>1</td><td>25°13'03.70"</td><td>92°04'45.92"</td></tr>
<tr><td>2</td><td>25°13'07.90"</td><td>92°04'49.26"</td></tr>
<tr><td>3</td><td>25°13'08.50"</td><td>92°04'49.71"</td></tr>
<tr><td>4</td><td>25°13'09.12"</td><td>92°04'50.12"</td></tr>
<tr><td>5</td><td>25°13'10.61"</td><td>92°04'50.27"</td></tr>
<tr><td>6</td><td>25°13'11.41"</td><td>92°04'48.85"</td></tr>
<tr><td>7</td><td>25°13'12.18"</td><td>92°04'48.00"</td></tr>
<tr><td>8</td><td>25°13'11.46"</td><td>92°04'47.72"</td></tr>
<tr><td>9</td><td>25°13'11.54"</td><td>92°04'46.65"</td></tr>
<tr><td>10</td><td>25°13'10.77"</td><td>92°04'45.75"</td></tr>
<tr><td>11</td><td>25°13'09.97"</td><td>92°04'44.28"</td></tr>
<tr><td>12</td><td>25°13'08.24"</td><td>92°04'43.75"</td></tr>
<tr><td>13</td><td>25°13'06.61"</td><td>92°04'43.48"</td></tr>
</table>
</td></tr>
</table>

	14 | 25°13'06.17" | 92°04'43.88" 15 | 25°13'06.40" | 92°04'44.13" 16 | 25°13'03.48" | 92°04'44.46" 17 | 25°13'03.53" | 92°04'45.17" 18 | 25°13'03.82" | 92°04'45.89"
Toposheet No.	83 C/4 – (Key plan prepared from the satellite image generated from Google Earth Pro as the Toposheet is restricted for common public use).
Mine area	3.00 Ha. (Private Leased Land)
Mineral Reserves (Balance)	16,21,598 Tonnes
Proposed Production Capacity	1,48,887 TPA (Average annual production)[1] 1,48,908 TPA (Targeted Peak Production during upcoming LoM)
Life of Mine	12 years (of which the first 5 years have been worked). as per the approved Modified Mining Plan
Method of Mining	Opencast Semi-Mechanized Mining
No. of Working Days	300 days
Estimated Project Cost	₹ 25.00 L
EMP Cost	**Capital Cost (₹ L)** | **Recurring Cost (₹ L)** 9.00 | 6.00
Power Requirement	None as mining shall be carried out only in one shift from sunrise till sunset. Solar lighting equipment provisions shall be made available for low-power lighting needs in the mine office.
Highest and Lowest Elevation	**Highest Elevation** = 719 m RL **Lowest Elevation** = 709 m RL
Nearest Habitation/Town	Nongtalang village in Amlarem block is about 4.0 km towards SW direction from the ML area via road.

[1] Subject to vary in the upcoming Plan Period

<table>
<tr><td>Nearest Airport</td><td>Shillong Airport is about 104 km towards the N direction from the ML area via road.</td></tr>
<tr><td>Nearest Railway Station</td><td>Guwahati Railway Station is about 192 km towards the N direction from the ML area via road.</td></tr>
<tr><td>Nearest Highway</td><td><table><tr><th>S. No.</th><th>Highway</th><th>Distance (m)</th><th>Direction</th></tr><tr><td>1</td><td>NH 206</td><td>~210</td><td>South</td></tr></table></td></tr>
<tr><td>International/State Boundary</td><td>✓ Indo-Bangladesh International Boundary is at ~4.11 km (aerial distance) towards South direction from the Mine Lease boundary
✓ Meghalaya-Assam State Boundary is at ~70 km (aerial distance) towards East direction from the Mine Lease boundary</td></tr>
<tr><td>Nearest Dispensary/Health Centre/Govt. Hospital</td><td>✓ Padu State Dispensary in Amlarem block is at a distance ~22 km towards NW direction from the mine lease boundary via road.
✓ Nongtalang CHC in Nongtalang village, Amlarem block, is at a distance of ~4.4 km towards SW direction from the mine lease boundary via road.</td></tr>
<tr><td>Educational Facilities</td><td>• Nongtalang College in Amlarem block is at a distance of ~4.2 km towards South direction from the mine lease boundary via road.</td></tr>
<tr><td>Water demand and supply</td><td>Total water demand is about 10 KLD, Source: nearby village through water tankers</td></tr>
<tr><td>Nearest Tourist Place</td><td>• Dawki River view point is about ~7 km (aerial distance) towards SW direction from the mine lease boundary.</td></tr>
<tr><td>Ecologically Sensitive Zones (ESZ)/Ecologically Sensitive Areas (ESA)</td><td>None within the study area</td></tr>
<tr><td>Seismic Zone</td><td>Zone V
(As per the Seismic Zonation Map of India, Bureau of Indian Standards, 2002)</td></tr>
</table>

***(Source:** Pre-Feasibility Report, Thanghunai Limestone Quarry)*

1.3.1. Importance of the project to the Country and Region

Mineral wealth of the state of Meghalaya provides multiple employment opportunities to the people of the state. Mining is one of the major core sector industries which plays a crucial role in the process of the state's socio-economic development. The state has a total reserve of ~15100 MT of limestone (cement, metallurgical and chemical grade) *(Minerals of Meghalaya: Department of Mining and Geology)*. Limestone is a basic building and construction material that is widely used for constructing houses, bridges and roads. It is cheaper than the RCC construction material due to its easy workability. It has high demand in the market due to increased domestic, industrial and other infrastructural activities. As a result of continuation of the mining project, the demand-supply position will remain balanced.

Thus, keeping in mind this requirement, mining of limestone is necessary for the durability of buildings, bridges, and roads and to beautify by carving as per the requirement of the consumer.

Demand-Supply Gap

Limestone is one of the essential components for building and infrastructural development projects. It has high demand in the market due to increased domestic, industrial and other infrastructural activities. As a result of continuation of the mining project, the demand-supply position will remain balanced. Demand of Limestone in the region will be partially fulfilled by this project.

Imports vs. Indigenous Production

There will be no import for the project. There will be indigenous inputs in the entire mining project. This mining project is not prospecting any export.

The Lessee would like to sell the mineral in domestic markets, as per requirement. No export is proposed.

1.4. SCOPE OF STUDY

The EIA process is a crucial tool for ensuring that potential environmental impacts of a project are identified, assessed, and mitigated before, during, and after construction. The broad scope that has been followed in preparing the EIA for Thanghunai Limestone Quarry can be explained in the following four stages:

i. **Characterizing the Baseline Environment:** This involves collecting data on the existing environmental conditions at the project site and surrounding areas. This data has been used as a benchmark to compare potential impacts from the project. It includes ambient air quality, water quality, ambient noise levels, land use, flora and fauna, and the socioeconomic characteristics of the local community.

ii. **Identifying and Quantifying Environmental Impacts:** In this stage, the potential impacts of the project on the environmental attributes identified in the baseline study were assessed. This involved considering two phases of the project, from operation to post-closure. The assessment quantified the significance of these impacts, considering factors like duration, reversibility, and magnitude.

iii. **Evaluating Pollution Control and Preparing an Environmental Management Plan (EMP):** Based on the identified impacts, potential pollution control measures were evaluated. The Environmental Management Plan (EMP) outlines specific actions to avoid, minimize, mitigate, or compensate for adverse environmental effects. The EMP also includes monitoring plans to track the effectiveness of these measures.

iv. **Developing a Post-Project Monitoring Program:** This final stage establishes a program to monitor the environmental effects of the project after it is operational again. The monitoring program should track environmental quality against the established baselines and ensure compliance with regulatory limits set by the Meghalaya State Pollution Control Board (MSPCB) and the State Environment Impact Assessment Authority (SEIAA) of Meghalaya.

The overall content of this draft EIA report has been prepared by following the generic structure prescribed in **Appendix III of the S.O. 1533** dated **14th September, 2006**; the MoEF&CC's EIA

Guidance Manual for Mining of Minerals released in 2010, and the standard and additional ToR issued by the SEIAA of Meghalaya vide **File No. ML/SEAC/SEIAA/PP/WJH/18/2024** dated 3rd July 2024. A copy of the ToR grant letter is enclosed as **Appendix I**.

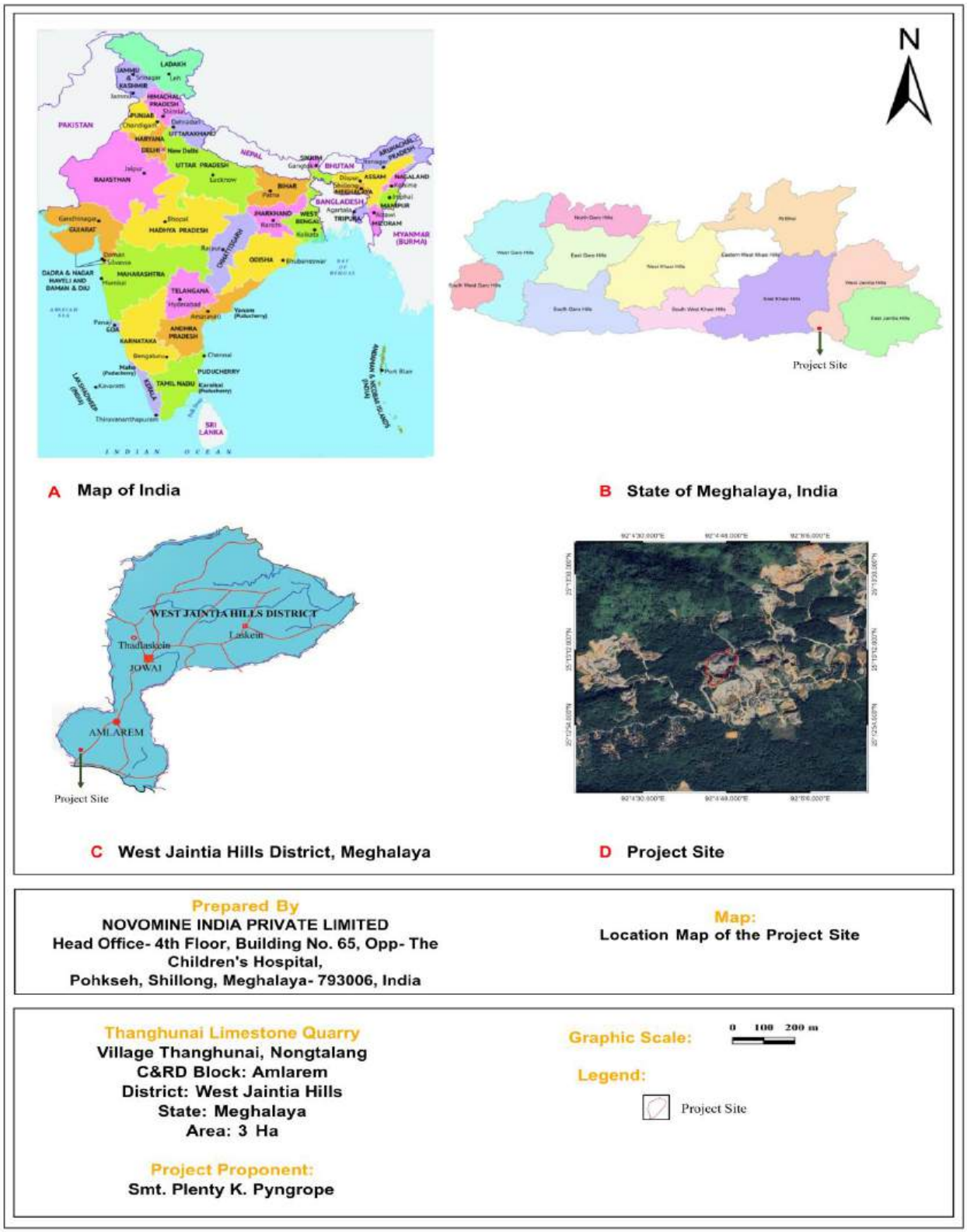
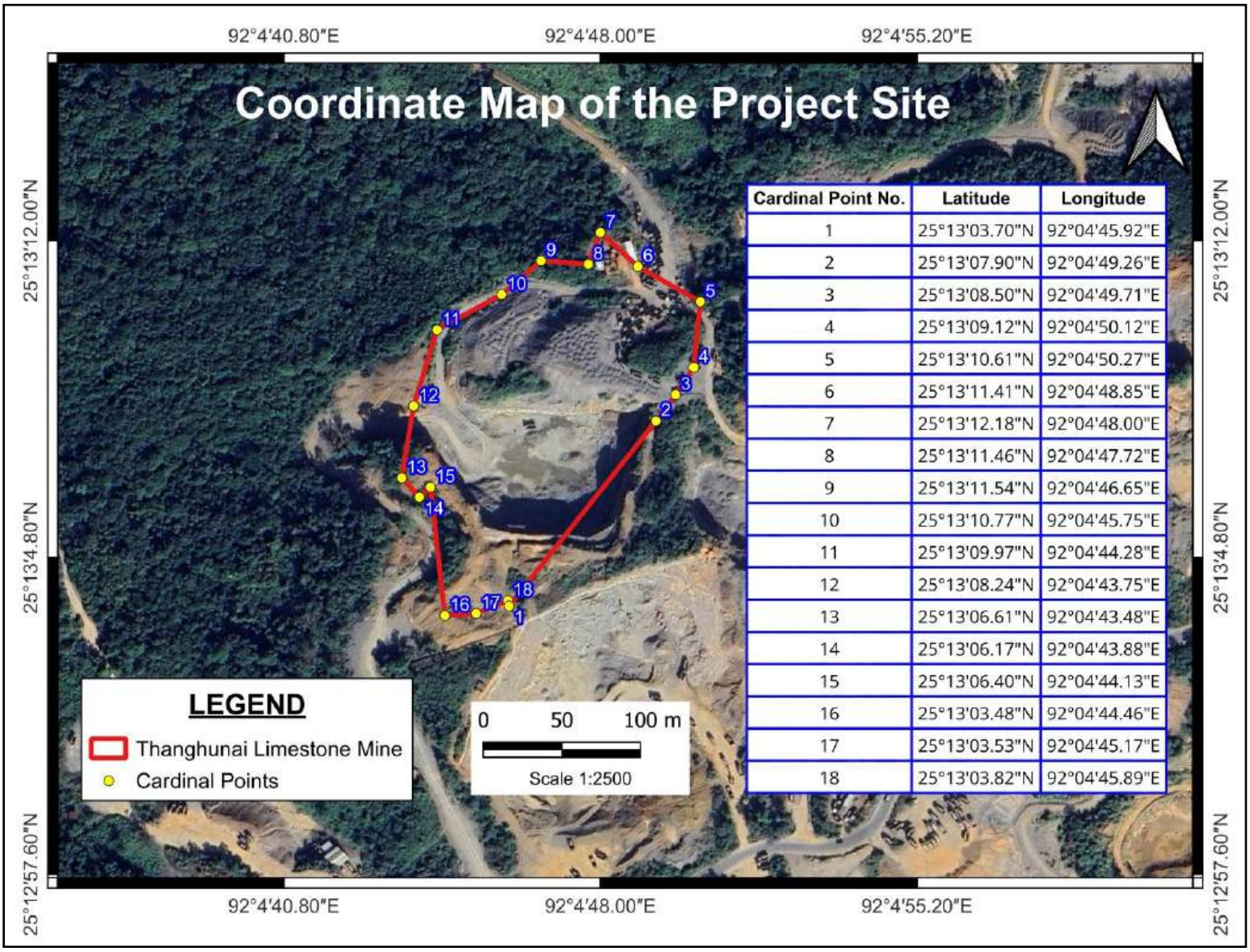


Fig 1.1: Location Plan of Thanghunai Limestone Quarry



Cardinal Point No.	Latitude	Longitude
1	25°13'03.70"N	92°04'45.92"E
2	25°13'07.90"N	92°04'49.26"E
3	25°13'08.50"N	92°04'49.71"E
4	25°13'09.12"N	92°04'50.12"E
5	25°13'10.61"N	92°04'50.27"E
6	25°13'11.41"N	92°04'48.85"E
7	25°13'12.18"N	92°04'48.00"E
8	25°13'11.46"N	92°04'47.72"E
9	25°13'11.54"N	92°04'46.65"E
10	25°13'10.77"N	92°04'45.75"E
11	25°13'09.97"N	92°04'44.28"E
12	25°13'08.24"N	92°04'43.75"E
13	25°13'06.61"N	92°04'43.48"E
14	25°13'06.17"N	92°04'43.88"E
15	25°13'06.40"N	92°04'44.13"E
16	25°13'03.48"N	92°04'44.46"E
17	25°13'03.53"N	92°04'45.17"E
18	25°13'03.82"N	92°04'45.89"E

Fig 1.2: Coordinate Plan of Thanghunai Limestone Quarry

Chapter 2 – PROJECT DESCRIPTION

2.1. TYPE OF PROJECT

Present proposal pertains to opencast semi-mechanized mining with drilling and blasting of limestone in the district of West Jaintia Hills, Meghalaya. The mine lease area of 3.0 Ha. is located at Thanghunai, Nongtalang Elaka, West Jaintia Hills, Meghalaya and is classified as **"Category – B2"** [Sl. No. 1(a) of Schedule: "List of project or activities requiring prior Environmental Clearance"]. Thus, EIA studies were not required for the project as per the MoEF&CC's EIA Notification dated **14th September 2006 vide S.O. 1533** and all subsequent amendments till date. However, as per the NGT order dated **13th September 2018** and subsequent Office Memorandum of the MoEF&CC vide **F. No. L-11011/175/2018-IA-II (M)** dated **12th December 2018** which states that *"if a cluster or an individual lease size exceeds 5 Ha., the EIA-EMP including Public Hearing be made applicable in the process of grant of prior environmental clearance"*. Following this, the project is characterized at par with **"Category – B1"** projects by the SEIAA/SEAC of Meghalaya, making EIA-EMP applicable in the process of grant of prior environmental clearance.

The estimated project cost is ₹25 Lakhs. The expected Life of Mine is 12 years with a maximum peak capacity of 148908 TPA which will be achieved in the 8th year of operations.

All stipulations of environment, forestry, and mining shall be duly complied by the Project Proponent.

2.2. NEED FOR THE PROJECT

Mining is one of the major core sector industries which plays a crucial role in the process of Meghalaya's socio-economic development. The state has a total reserve of ~ 15100 MT of limestone (cement, metallurgical and chemical grade) *(Minerals of Meghalaya: Department of Mining and Geology)*. Limestone is a basic building and construction material that is widely used for constructing houses, bridges and roads. It is cheaper than the RCC construction material due to its easy workability. It has high demand in the market due to increased domestic, industrial and other infrastructural activities. As a result of continuation of the mining project, the demand-supply position will remain balanced. Demand of Limestone in the region will be partially fulfilled by this project as a result of continued extraction of the mineral - the demand-supply position will remain balanced.

2.3. PROJECT LOCATION AND LAYOUT

The mine lease area is located at Thanghunai, Nongtalang Elaka, Amlarem C&RD Block, East Jaintia Hills District, Meghalaya. The bounding coordinates of the mine lease area are Latitudes 25°13'12.18"N to 25°13'03.48"N and Longitudes 92°04'43.48"E to 92°04'50.27"E.

The details of location of the project are furnished in **Tables 1.1: Summarized details of the Thanghunai Limestone Quarry** and **1.2: Overview of the Project** in Chapter 1 of this EIA-EMP report. The details of coordinates of the mine lease area and the geographical coordinates of the site superimposed on Google Earth satellite image are given in **Table 2.1** of this chapter and **Figure 1.2 Coordinate Plan of Thanghunai Limestone Quarry** of Chapter 1.

The project location details are shown in **Figures 1.1: Location Plan of Thanghunai Limestone Quarry**, and **1.2: Coordinate Plan of Thanghunai Limestone Quarry** of Chapter 1.

Table 2.1: GPS Coordinates of Boundary Pillars at Thanghunai Limestone Quarry

Boundary Pillar No.	Location (co-ordinates)	
	Latitude (N)	Longitude (E)
1	25°13'03.70"	92°04'45.92"
2	25°13'07.90"	92°04'49.26"
3	25°13'08.50"	92°04'49.71"
4	25°13'09.12"	92°04'50.12"
5	25°13'10.61"	92°04'50.27"
6	25°13'11.41"	92°04'48.85"
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8	25°13'11.46"	92°04'47.72"
9	25°13'11.54"	92°04'46.65"
10	25°13'10.77"	92°04'45.75"
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12	25°13'08.24"	92°04'43.75"
13	25°13'06.61"	92°04'43.48"

14	25°13'06.17"	92°04'43.88"
15	25°13'06.40"	92°04'44.13"
16	25°13'03.48"	92°04'44.46"
17	25°13'03.53"	92°04'45.17"
18	25°13'03.82"	92°04'45.89"

Fig 2.1: Views of the project site of Thanghunai Limestone Quarry

Table 2.2: Details of Environmental Settings in and around the proposed project

S. No.	Particulars	Details
1	Location	Thanghunai, Nongtalang Elaka, West Jaintia Hills District, Meghalaya
2	Elevation Range	Highest Elevation = 719 m RL Lowest Elevation = 709 m RL
3	Present Land Use at the mine lease area	Forest Land: 0 Ha. Private Land: 3.00 Ha.
4	Nearest Tourist Location	Dawki River view point is ~7 km (aerial distance) towards SW direction from the mine lease boundary.
5	Defence installations	None
6	Archaeological features	None within the study area
7	Eco-Sensitive Zones (ESZ)	None within the study area
8	Reserved/Protected Forests	None within the study area
9	Nearest source of surface water body	Wah Amkshar (tributary of Wah Umngot that flows at a distance of 3.7 km towards the NW of the block)
10	Seismic Zone	**Zone V** as per IS 1893 (Part 1): 2002

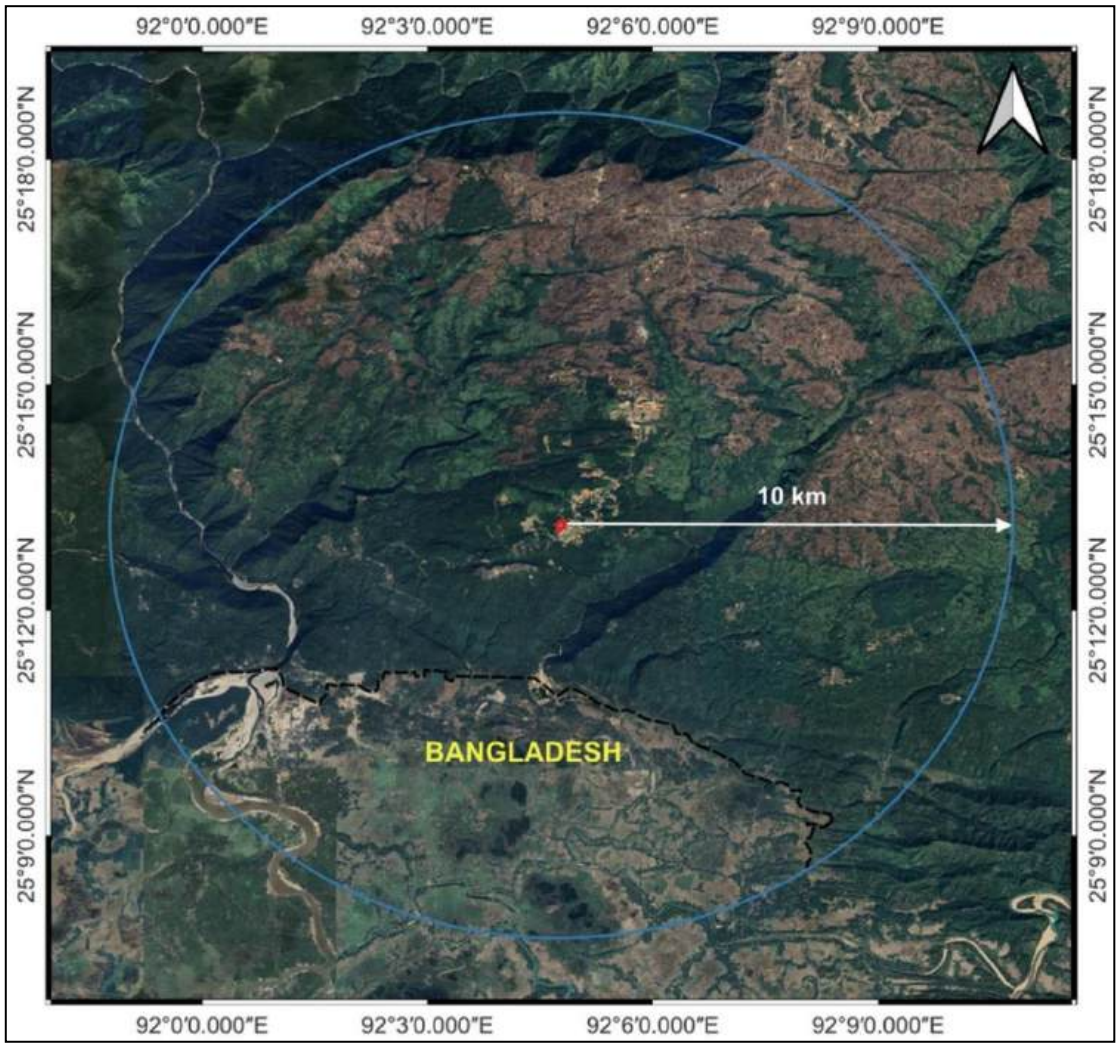


Fig 2.2: Study Area Map of 10 Km Radius - Thanghunai Limestone Quarry

Nongtalang village in Amlarem block is about 4.0 km towards SW direction from the ML area via road. The project site is conveniently accessible via NH 206, located 210 m away towards South from the site. There is also a well-established haul road that provides sufficient transportation capacity for trucks and dumpers to transport materials to and from the project site. The 10 km radius study area map from the boundary of the project site is elaborated in **Figure 2.2** and details of environmental settings of the project are given in **Table 2.2** above.

2.4. SIZE OR MAGNITUDE OF OPERATION

The size and magnitude of the project is given in **Table 2.3** below:

Table 2.3: Size or magnitude of the project

S. No.	Particulars	Details
1	Area of the project	3.0 Ha.
2	Mineable Reserve	1621598 T
3	Average Annual Production	135133 TPA
4	Production of Gritty Soil	6519 T (for LoM)
5	Life of Mine (LoM)	12 Years
6	Employment Potential	37 (25 skilled, 7 semi-skilled, and 5 unskilled)
7	Machinery Required for limestone transportation	4 Tippers of 10 MT capacity each

2.4.1. Mining Technology

Opencast semi-mechanized mining will be adopted to extract limestone. The targeted peak production of limestone is about 148908 T.

Table 2.4 below provides a brief overview of the scope of operations (Mine Design Parameters) in the project.

Table 2.4: The Mine Design (Physical) Parameters

Parameter	Description
Average depth of the quarry	60 m
Individual Bench Slope	70°
Width x Height of the Benches	6 m x 6 m
Overall Pit Slope	45°

2.5. PROPOSED SCHEDULE FOR APPROVAL AND IMPLEMENTATION

The project will be implemented after completion of essential administrative procedures, including issuance of environment clearance (EC) from the State Environment Impact Assessment Authority (SEIAA) of Meghalaya and Consent to Establish and Consent to Operate (CTE and CTO) from the

Meghalaya State Pollution Control Board (MSPCB). The project implementation shall be done as per the conditions stipulated in the approved Modified Mining Plan with Progressive Mine Closure Plan and Environmental Clearance (EC).

The first 5 years have been worked and the remaining mineable reserve of 16,21,598 Tonnes will be extracted in the next 12 years with an average annual production of 1,35,133 TPA. The average annual production may vary from the yearly production in the upcoming plan period. Proposed production in the next 5 years would be 618125 Tonnes. Targeted Peak production during upcoming LoM is 148908 T. Mining operations will be carried out using an opencast semi-mechanised method, employing 37 persons a day. To transport the mined material, 4 tippers of 10 MT capacity each will be utilized. Future production programme has been planned as per the details given in **Table 2.5** below.

Table 2.5: Year-wise development of Thanghunai Limestone Quarry

Year	Production of Limestone in Tonnes	Removal of Gritty Soil in Tonnes
1st **	22640 (January 2024 to March 2024)	2678
2nd	148465	2041
3rd	148430	0
4th	148759	0
5th	148878	0
6th	148907	0
7th	148907	0
8th	148908	1200
9th	148907	0
10th	148907	600
11th	148907	0
12th	110983	0
Total	**1621598**	**6519**

** (Achieved Production from April 2023 to December 2023 – 126156 T) *(**Source:** As per the approved Modified Mining Plan with Progressive Mine Closure Plan of Thanghunai Limestone Quarry)*

The project will be executed after getting the necessary statutory clearances and a timeline for the same has been furnished in **Table 2.6** below.

Table 2.6: Tentative schedule of obtaining statutory clearances/already obtained till grant of EC

S. No.	Description	Tentative Schedule/Date
1	Execution of Deed of Lease	2nd June, 2017
2	No Objection Certificate from the Office of the Jaintia Hills Autonomous District Council: Jowai, vide letter **No. JHADC/FOR/19/2017/782-85**	30th October, 2017
3	Forest Clearance from the Office of the Divisional Forest Officer, Jaintia Hills Territorial Division: Jowai vide letter No. **JH/S.Quarry/2009-10/476/B/1091**	31st October, 2017
4	Letter of Intent (LOI) for granting mining lease from the Office of the Divisional Forest Officer, Jaintia Hills (T) Division: Jowai vide letter No. **JH/ MMMCR-2016/2016-17/869/B/1107**	1st November, 2017
5	Grant of Environmental Clearance by the Office of the Deputy Commissioner: West Jaintia Hills District, Jowai vide Letter No. **GEN-198/ Mining Plan/PPyrgrope/2018/146**	26th March, 2018
6	Consent to Establish by the Meghalaya State Pollution Control Board vide Letter **No. MPCB/CON-02-2018/2017-2018/84**	29th March, 2018
7	Consent to Operate by the Meghalaya State Pollution Control Board vide Letter **No. MPCB/ONLINE-CTO-2017/2018-2019/42**	4th April, 2018
8	Rectification of the Coordinates of the Mining Lease and Forest Clearance from the Office of the Divisional Forest Officer, Jaintia Hills Territorial Division: Jowai vide letter No. **JH/PKP/ML/LS/2018-19/959/B/826**	22nd December, 2023
9	Following MOEF&CC's OM vide No. F. No. IA3-22/11/2023-IA.III (E-208230), initiation to put forward the project for re-appraisal by the SEIAA/SEAC	28th April, 2023
10	Renewal of Letter of Intent (LOI) from the Office of the Divisional Forest Officer (Territorial), Jaintia Hills Division: Jowai vide letter No.	16th January, 2024

	JH/PKP/ML/LS/2018-19/959/B/1920	
11	Approval of the Modified Mining Plan and Mine Closure Plan (after end of Plan Period of first 5 years), from the Divisional Mining Officer, West Jaintia Hills, Jowai vide letter **No. DMO-J/78/MM/Mining Plan/2022-23/20**	31st January, 2024
7	Submission of Draft EIA/EMP for Public Consultation	
8	Conduct of Public Consultation by the project proponent at a prescribed venue	–
9	Submission of Final EIA/EMP for grant of EC	–
10	Approval/Grant of Environmental Clearance from SEIAA, Meghalaya	–

2.6. MINING TECHNOLOGY AND PROCESS DESCRIPTION

2.6.1. Mining Technology

Under the prevailing geo-mining conditions, opencast semi-mechanized mining will be carried out with drilling and blasting during the proposed plan period in the area as the deposit is massive and compact in nature. Jack hammer drill machine will be deployed for drilling of shot holes ranging from 39 mm to 34 mm diameter. Breaking of limestone at the required site will be done manually. Muffle blasting will be adopted as a precautionary measure to control fly rocks. Excavation and handling of gritty soil will be done by excavator.

The benching system of 6 m x 6 m will be practiced in the area in order to comply with the provisions of Metalliferous Mines Regulations, 1961. Bench slope angle for stabilization of the benches will be maintained at 45°.

2.6.2. Mining Process

The deposit in this area is massive and compact in nature. It is proposed to carry out Open Cast Semi-Mechanized mining in this area. Jack hammer drill machine will be deployed for drilling of shot holes ranging from 39 to 34mm diameter and breaking of limestone at the required size will also be done manually. For blasting of holes with burden and spacing of 0.8m x 1.0m in a staggered grid pattern would be adopted. Muffle blasting will be adopted as precautionary measure to control fly rocks. Excavation and handling of gritty soil, if necessary, will be done by excavator. The maximum bench height is kept 6.0 meters width at ultimate stage by maintaining

an overall pit slope of 45°.

2.6.2.1. Drilling and Blasting

Blasting is one of the most critical activities of any mining operation. For forming the working benches, drilling and blasting is done in the stone deposit over the specified floor level. The depth of drilling and the quantity of explosives to be charged are determined so that after the blasting is carried out, the breakage of stone will be up to the proposed floor levels.

In this mine, shallow - hole drilling would be in practice. Holes would be drilled in hard formation by Jack hammer drill having diameter from 39 mm to 34 mm. The holes are generally made up to 1.76 m (including 0 16 m sub-grade drilling to break the toe) depth. Burden and spacing would be maintained at 0.8 m and 1.0 m depending upon the compactness of formation The pattern of delay blasting will take into account existence of any natural cleavage layout and sequence of firing of the blast-holes pattern proposed for blasting.

The distribution of charge in the blast hole will be bottom charge is to column charge in the ratio of 15:85.

Blast holes shall be initiated by non-electric (NONEL) down-the-hole (DTH) delay detonators. NONEL trunk-line delay detonator will be used for trunk line connections. The shots will be fired using exploder approved by DGMS. In case of non-availability of detonators provision will be kept for ordinary fuse blasting.

Diesel-operated air compressors of 120 cfm capacity. - 4 Nos and Air operated Jackhammer Drills of 1800 to 2000 RPM – 4 Nos., will be utilised for drilling of blastholes.

A Flowchart showing the sequence of mining process details as described above has been furnished below:

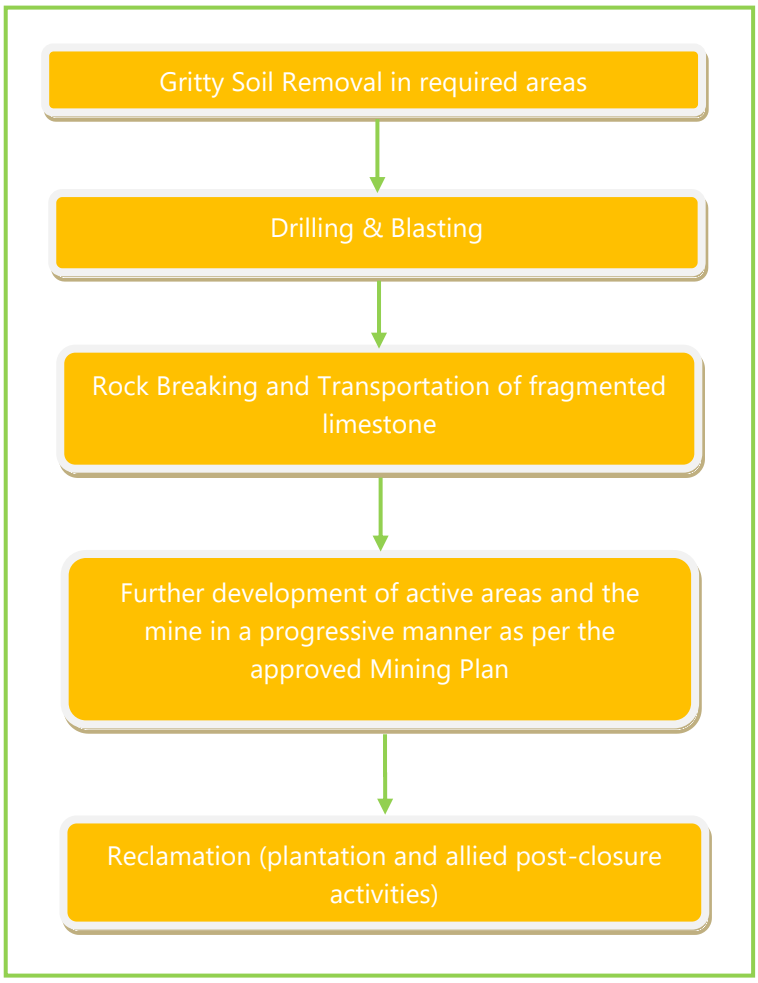


Fig 2.3: Mining Process Flow Chart

2.7. PROJECT DESCRIPTION

The project site is located around **210 m** away towards north of **NH 206** which connects it to District HQ Jowai around 42 km away. Nearest railway station, i.e., the Guwahati Railway Station is situated around 192 km away by road in the N direction. Shillong Airport which is the nearest airport from the lease area is about 104 km away by road in the NNW direction.

The Modified Mining Plan with Progressive Mine Closure Plan was prepared by Shri Ashok Kumar Sarkar (RQP) and was approved by the Divisional Mining Officer, West Jaintia Hills, Jowai of the Directorate of Mineral Resources (DMR), Government of Meghalaya on 31st January 2024 (**Refer Annex 10**).

The mining operations will be opencast semi-mechanized with drilling and blasting with maximum production of 148908 T. Mining will be continued from NE of the area and advanced towards the

central part attaining further depth. The year-wise development/production programme from the mine for the next 12 years is shown in **Table 2.5** above and details of advancement and formation of benches is described below.

Bench Design and Formation:

Since the mine will be worked in semi-mechanized method, bench height will be restricted to the statutory 6mx6m due to compactness of the hard Limestone and as per the DGMS norms. Bench slope angle for stabilization of the benches will be maintained at 45^0.

Bench Development and Overburden Management over the next 5 years:

Mining will be continued from north-east of the area and advanced towards central part attaining further depth. Details of advancement and formation of benches are shown in Development Plan & Section (**Plate: 5**) in the scale of 1:1000.

1st year: Production will be started from eastern land of the area with one bench having benching dimension of 6m X 6m up to the RL 713m. The generated gritty soil will be dumped in the south-western corner of the lease area afterwards which will be used for road maintenance and greenbelt development. For haulage of the stone, ramp will be maintained at the quarry face. Details of calculations are given below:

SOIL REMOVAL 1ST YEAR						
BENCH RL(m)	**SECTION**	**SECTIONAL AREA(m2)**	**LENGTH OF INFLUENCE(m)**	**VOLUME (m3)**	**T.F**	**GRITTY SOIL (TONNES)**
719-713	A-A'	31	72	2232	1.2	2678
TOTAL				**2232**		**2678**

LIMESTONE PRODUCTION 1ST YEAR						
BENCH RL(m)	**SECTION**	**SECTIONAL AREA(m2)**	**LENGTH OF INFLUENCE(m)**	**VOLUME (m3)**	**T.F**	**LIMESTONE (TONNES)**
719-713	A-A'	129	65	8385	2.7	22640
TOTAL				**8385**		**22640**

2nd year: - During 2nd year, working will be continued in the same quarry extending further east and in downwards with two benches having benching dimension of 6m X 6m up to 713m RL. The generated gritty soil will be dumped in the south-western corner of the lease area afterwards which

will be used for road and greenbelt development. For haulage of the stone, ramp will be maintained at the quarry face. Details of calculations are given below:

SOIL REMOVAL 2ND YEAR						
BENCH RL(m)	**SECTION**	**SECTIONAL AREA(m2)**	**LENGTH OF INFLUENCE(m)**	**VOLUME (m3)**	**T.F**	**GRITTY SOIL (TONNES)**
719-713	A-A'	27	63	1701	1.2	2041
TOTAL				**1701**		**2041**

LIMESTONE PRODUCTION 2ND YEAR						
BENCH RL(m)	**SECTION**	**SECTIONAL AREA(m2)**	**LENGTH OF INFLUENCE(m)**	**VOLUME(m3)**	**T.F**	**LIMESTONE (TONNES)**
719-713	A-A'	120	65	7800	2.7	21060
713-707	A-A'	321	147	47187	2.7	127405
TOTAL				**54987**		**148465**

3rd year: - During 3rd year, working will be done in the same quarry with two benches and in downwards with two benches having benching dimension of 6m X 6m up to 701m RL. There is no generation of gritty soil onwards this year of production. For haulage of the stone, ramp will be maintained at the quarry face. Details of calculations are given below:

LIMESTONE PRODUCTION 3RD YEAR						
BENCH RL(m)	**SECTION**	**SECTIONAL AREA(m2)**	**LENGTH OF INFLUENCE(m)**	**VOLUME (m3)**	**T.F**	**LIMESTONE (TONNES)**
713-707	A-A'	409	107	43763	2.7	118160
707-701	A-A'	111	101	11211	2.7	30270
TOTAL				**54974**		**148430**

4th year: - During 4th year, mining will be operated in the same quarry in further extension towards east with one bench having benching dimension of 6m X 6m up to the reduced level 701m. For haulage of the stone, ramp will be maintained at the quarry face. Details of calculations are given below:

LIMESTONE PRODUCTION 4TH YEAR						
BENCH RL(m)	**SECTION**	**SECTIONAL AREA(m2)**	**LENGTH OF INFLUENCE(m)**	**VOLUME (m3)**	**T.F**	**LIMESTONE (TONNES)**
707-701	A-A'	388	142	55096	2.7	148759
TOTAL				**55096**		**148759**

5th year: - During 5th year, working will be continued in the same quarry with further extension and in downwards with two benches having benching dimension of 6m X 6m up to the reduced level 695m. For haulage of the stone, ramp will be maintained at the quarry face. Details of calculations are given below:

LIMESTONE PRODUCTION 5TH YEAR						
BENCH RL(m)	**SECTION**	**SECTIONAL AREA(m2)**	**LENGTH OF INFLUENCE(m)**	**VOLUME(m3)**	**T.F**	**LIMESTONE (TONNES)**
707-701	A-A'	127	92	11684	2.7	31547
701-695	A-A'	388	112	43456	2.7	117331
TOTAL				**55140**		**148878**

*(**Source:** As per the approved Modified Mining Plan with Progressive Mine Closure Plan of Thanghunai Limestone Quarry)*

Notes on Conceptual Plan for the Lease Period:

Mining will be continued in a similar manner with the help of machinery and manual manpower for digging, excavation and removal of limestone in conjunction with shot hole drilling by jack hammer drill. Mining operation shall be carried out in compliance with the provisions of the MMR, 1961.

During plan period the area will be worked out maintaining a 7.5m Safety Barrier. The voids created by mining will be reclaimed after the exhaustion of mineable reserve.

The project requires involvement of transportation systems like loading/excavating machines, power, water, manpower and supporting services like mine office, rest shelter, canteen, washroom facility and other temporary infrastructure. The detailed description of the proposed HEMM configuration is presented in **Table 2.7** below:

Table 2.7: Details of HEMM and other machinery

S. No	Type of machine	No	Size/ capacity	Motive power	hp
1	Excavators	1	0.6 cu.m	Diesel	115
2	Compressors	4	120 cfm	Diesel	-
3	Jackhammer Drills	4	--	Compressed Air	--
4	Tippers	4	10 MT	Diesel	98.5
5	Rock Breaker	1	--	Diesel	--
6	Water Tanker	1	--	Diesel	--

(All machines will be deployed on a hire basis) (***Source:*** *As per the approved Modified Mining Plan with Progressive Mine Closure Plan of Thanghunai Limestone Quarry)*

2.7.1. Requirement of Manpower

For mines safety under the provisions of the Metalliferous Mines Regulations of 1961 (MMR 1961) under the Mines Act of 1952, whenever the number of workers employed is more than 10, it is preferred to have a qualified Mines Mate to keep all the production workers directly under his control and supervision. The following manpower is proposed for quarrying limestone during the remaining 12 years to achieve the proposed production and to comply with the provisions of the government norms.

This project has generated and will continue to generate direct & indirect employment in the locality. About 37 people were directly employed and some persons were also benefitting indirectly and employed in allied industries such as transportation of the mineral and overburden/topsoil, mine maintenance, HEMM maintenance, etc. Manpower that shall be required during the project's operational phase is given in **Table 2.8** below:

Table 2.8: Manpower Required

Employees	Proposed
Manager	1
Supervisor	1
Blaster	1
Blaster Helper	1

Storekeeper	1
Attendance Clerk cum Register Keeper	1
Excavator Operator	1
Compressor Operator	4
Jackhammer Drill Operator	8
Tipper Driver	4
Rock Breaker Operator	1
Water Tanker Driver	1
Miners (Semi Skilled)	7
Unskilled	5
Total	**37**

(***Source:*** *As per the approved Modified Mining Plan with Progressive Mine Closure Plan of Thanghunai Limestone Quarry*

Requirement of power, water and proposed infrastructure are summarised in **Table 2.9** below.

Table 2.9: Requirements of Energy, Water and Infrastructure

Power/Energy Requirement	**Electric power will be made available through DG sets and provision for solar plant will be kept.**	
Water Requirement	The water required for the project will be met by a combination of arrangements which include the water pumped and desilted from the mine workings (temporary sumps – in the process of mining, water will be accumulated in the dip end places of the surface voids due to natural seepage as well as rainwater), water collected from the proposed rainwater harvesting infrastructure cum settling tanks, and nearby rivers such as Wah Amkshar, Um Krem, etc. The total water requirement is 10 KLD. The use wise water requirement is presented below.	
	Details	**KLD**
	Dust Suppression	3
	Drinking and domestic	Water requirement for drinking & domestic purposes per person in the mine is 50 L/day. Therefore, requirement is 37x50 = 1850

		L/day (~2 KLD)
	Green Belt Development/Plantation	3
	Cleaning of HEMMs, and other machinery	2
	Total	**10**
Infrastructure	**Existing:** The workers are mostly native people living in a close proximity of the project area and will work in shifts during day time only, thus there is no requirement of major infrastructural facilities at the site. Physical infrastructure such as a mine office with provisions for first-aid and drinking water, rainwater harvesting cum settling tanks & welfare amenities such as rest shelters, conventional toilets with soak pits, etc.	

2.7.2. Land Use

The land use pattern of the mine lease area across different phases: existing, after plan period, and after life of the mine is tabulated below: (**Table 2.10**).

Table 2.10: Land Use Pattern of Mine Lease Area

Existing Land Use Pattern		
S. No.	**Category**	**Area in Ha.**
1	Mined-out land including road	0.84
2	Greenbelt in Safety Barrier	0.24
3	Dump with parapet wall and garland drains	0.20
4	Balance unused area	1.72
Total		**3.00**
Land Use Pattern after 5 Years Plan Period		
S. No.	**Category**	**Area in Ha.**
1	Mined-out land including road	2.23
2	Greenbelt in Safety Barrier	0.28
3	Dump with parapet wall and garland drains	0.07
4	Balance unused area	0.42
Total		**3.00**

Land Use Pattern after Life of Mine		
S. No.	**Category**	**Area in Ha.**
1	Mined-out land including reclamation	2.44
2	Greenbelt (within Safety Barrier)	0.56
3	Balance unused land	0.00
Total		**3.00**

(***Source:*** *As per the approved Modified Mining Plan of Thanghunai Limestone Quarry)*

2.8. DESCRIPTION OF MITIGATION MEASURES INCORPORATED INTO THE PROJECT TO MEET ENVIRONMENTAL STANDARDS

Environmental mitigation measures for this project have been discussed in detail in **Chapter 4**.

2.9. ASSESSMENT OF NEW & UNTESTED TECHNOLOGY FOR THE RISK OF TECHNOLOGICAL FAILURE

The technology described and proposed in this Draft EIA Report is time tested, and there is no such new and untested technology for risk of technological failure known till so far. Hence, not described here.

2.10. FEASIBILITY DRAWINGS PROVIDING INFORMATION IMPORTANT FOR EIA PURPOSE

i. A detailed water balance (**Figure 2.4**) describing the use of water in the proposed project

ii. A Mine Layout Plan (**Figure 2.5**) describing the conceptualised layout for the proposed project.

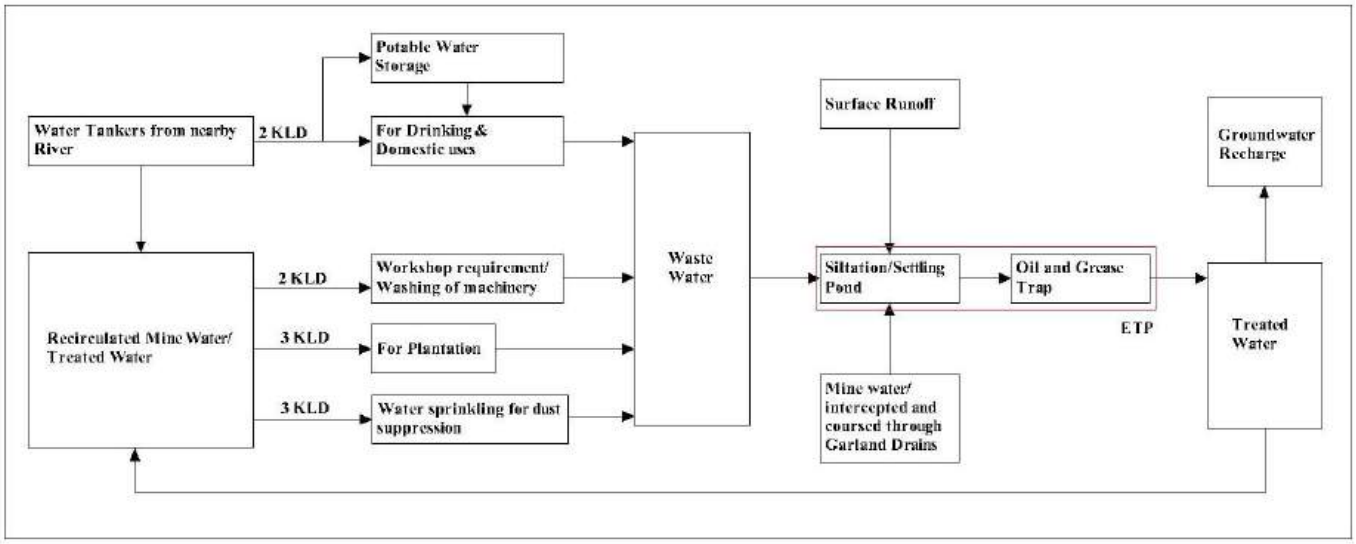


Fig 2.4: Detailed Water Balance Diagram proposed for Thanghunai Limestone Quarry

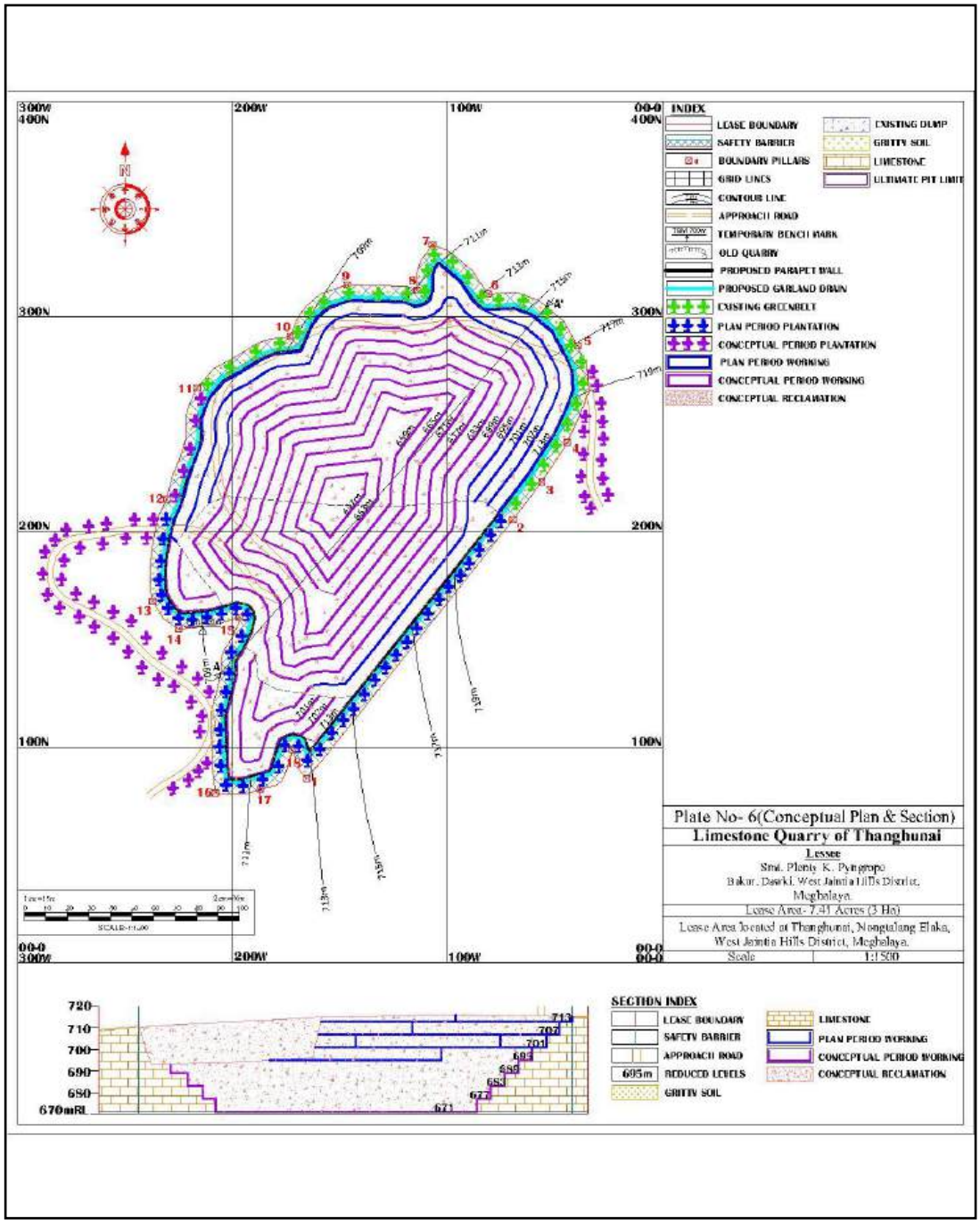


Fig 2.5: Conceptual Plan and Section of Thanghunai Limestone Quarry

Chapter 3 – DESCRIPTION OF ENVIRONMENT

3.1. INTRODUCTION

Baseline environmental studies were carried out in and around Thanghunai Limestone Quarry project to determine the baseline environmental trends and anticipated impacts of mining in the area once the project commences after receiving all statutory clearances. This is done to formulate an effective and comprehensive Environmental Management Plan (EMP).

3.2. STUDY AREA, PERIOD, SCOPE OF BASELINE ENVIRONMENTAL STUDIES

3.2.1. Study Area

As per the EIA Notification of 2006 vide S.O. 1533(E), and subsequent amendments made till date, the proposed project is classified as **"Category – B2"** [Sl. No. 1(a) of Schedule: "List of project or activities requiring prior Environmental Clearance"]. Thus, EIA studies were not required for the project as per the MoEF&CC's EIA Notification dated **14th September 2006 vide S.O. 1533** and all subsequent amendments till date. However, as per the NGT order dated **13th September 2018** and subsequent Office Memorandum of the MoEF&CC vide **F. No. L-11011/175/2018-IA-II (M)** dated **12th December 2018** which states that *"if a cluster or an individual lease size exceeds 5 Ha., the EIA-EMP including Public Hearing be made applicable in the process of grant of prior environmental clearance"*. Following this, the project is characterized at par with **"Category – B1"** projects by the SEIAA/SEAC of Meghalaya, making EIA-EMP applicable in the process of grant of prior environmental clearance.

3.2.1.1. Core Zone

The core zone consists of 3.00 Ha. of land, located in the south of West Jaintia Hills District of Meghalaya, India. It is covered in Toposheet No. 83C/4 (R.F 1:50,000) of Survey of India, the Datum is WGS-84 & lies between Latitudes 25°13'12.18"N to 25°13'03.48"N and Longitudes 92°04'43.48"E to 92°04'50.27"E. The Toposheet for the core area is restricted for public use.

3.2.1.2. Buffer Zone

The 10 km buffer zone of this project lies within Survey of India Toposheet Nos. 78O/15, 78O/16 (Restricted for Public Use), 83C/3, and 83C/4 (Restricted) and is covered in Amlarem

C&RD Block of West Jaintia Hills district in the state of Meghalaya (Refer **Annexure 11**). The district lies in **Zone V** of seismic activity. The study area is primarily composed of rough and uneven land formations. Yet, this topography is disrupted by the dramatic geographical features created by its river systems. The Umngot, Myntdu, Myntang, and countless other fast-flowing streams have carved deep canyons, precipitous cliffs, and narrow valleys throughout the district (*District Disaster Management Authority, 2018*).

The study area map showing core and buffer zones is given in **Figure 3.1**.

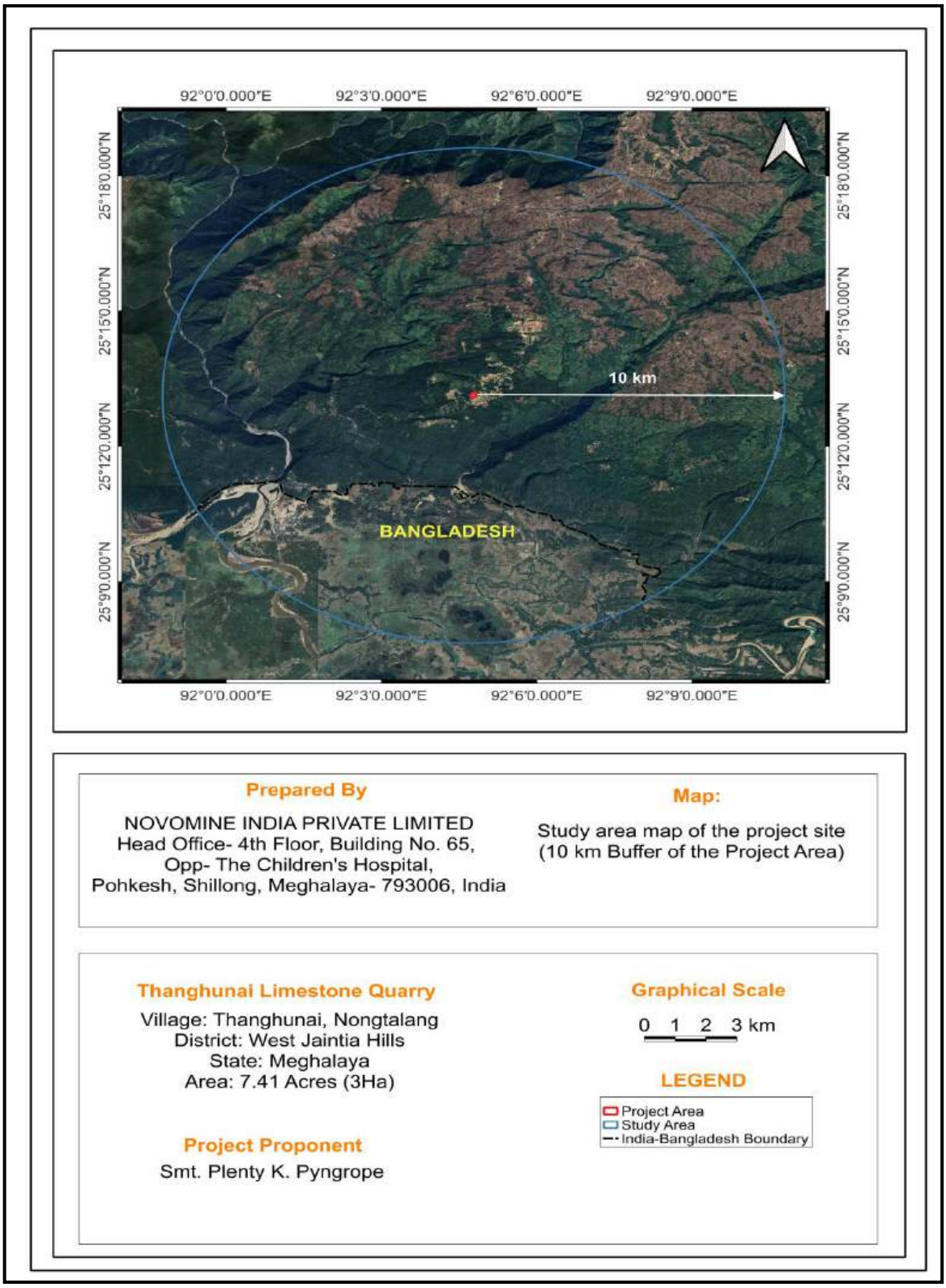


Fig 3.1: Study Area Map showing the core and buffer zones of Thanghunai Limestone Quarry

3.2.2. Study Period

Baseline data was collected for one season during the winter period (December 2023 – February 2024) in accordance to BIS, CPCB guidelines, IMD specifications, and MoEFCC's EIA Guidance Manual for Mining of Minerals.

3.2.3. Scope

The scope of baseline data collection including attributes, monitored components, sampling period, frequency and measurement methods are detailed in **Table 3.1** below.

Table 3.1: Scope of Baseline Data (BLD) Collection Study

S. No.	Activity	Monitored Parameters	Sampling Period, Frequency & Measurement Method
1	**Air environment –** A. Micro-Meteorological Study	i. Wind speed & direction ii. Temperature range iii. Rainfall iv. Relative Humidity range	**Sampling Period:** One season (3 months) **Frequency:** Continuous hourly observations for one season **Measurement Method:** IS 5182 Part 1-20, collation with secondary data from IMD, and CPCB guidelines
	B. Ambient Air Quality (AAQ) monitoring in the core and buffer zones	**Particulate Matter (PM)** i. Particulate Matter <10 µm (PM10) ii. Particulate Matter <2.5 µm (PM2.5) **Gaseous Pollutants (GP)** i. Sulphur Dioxide (SO_2) ii. Nitrogen Dioxide (NO_2)	**Sampling Period:** 24-hourly sample samples for PM and 8-hourly samples for GP; averaged for 24 hours **Frequency:** Twice a week for one season **Measurement Method:** PM10: Gravimetric (High-Volume

			Sampler) PM2.5: Gravimetric (Fine Dust Sampler) SO_2: Improved West & Gaeke Method NO_2: Modified Jacob & Hochheiser Method (Na-Arsenite)
	C. Mineralogical Composition of Particulate Matter	i. Silica Content and ii. Heavy Metals such as Hg, Pb, Cr, As, etc., and iii. Particle Size Distribution	**Frequency:** Once in a season for all the monitoring stations **Measurement Method:** As per CPCB National Ambient Air Quality Standards (NAAQS)
	D. Traffic Density Study	i. Traffic density on major roads/coal transportation roads near the proposed project site with regard to the number of two-wheelers, three-wheelers, four-wheelers, and heavy vehicles	**Frequency:** Once in a season for 24-hours duration **Measurement Method:** Manual Counting
3	**Noise –** A. Hourly equivalent noise levels	In accordance with the Noise Pollution (Regulation & Control) Rules, 2000, IS-9989 (1981) and IS-4954 (1968) standards	**Frequency:** 24-hourly equivalent sound levels – Leq, Leq (Day), and Leq (Night) for one day in a season per location **Measurement Method:** Integrated sound level meter

2	**Water environment –** A. Ground Water Quality	Important physico-chemical and biological characteristics as per IS-10500, 1993 and 2012 Standards	**Frequency:** One grab sample per location in a season.
	B. Surface Water Quality	Physico-chemical and biological characteristics as per IS-2296, 1982 standards and as per CPCB's Designated Best Use Water Quality Criteria	**Frequency:** One grab sample per location in a season.
	C. Phreatic Surface Levels	Water levels in the existing wells within the study area radius of the project	**Frequency:** Once in a season **Measurement Method:** Piezometer/Water Level Indicator
4	**Land Environment –** A. Land Use Pattern	The land-use/land cover classification as per the MoEF&CC's EIA Guidance Manual for Mining of Minerals, 2010.	**Frequency:** Once in a season **Measurement Method:** The land use / land cover study was done using Sentinel 2A (10 m spatial resolution), Landsat 8, and Google Earth Pro data to get output at an appropriate scale as per MoEF&CC guidelines.
	B. Soil Quality	i. Particle size distribution ii. Texture iii. Organic carbon iv. pH v. Electrical Conductivity vi. Exchangeable Cations and	**Frequency:** Grab samples collected from each station (nearby villages) as per BIS specifications once in a season **Measurement Method:**

		Cation Exchange capacity (CEC) vii. Alkali metals viii. Sodium Adsorption Ratio (SAR) of soils ix. Heavy metals in soil x. Infiltration rate in mm/hr xi. Water Holding Capacity xii. Porosity xiii. NPK Content in soil	BIS specifications and soil analysis reference books such as S.K Maiti's Handbook of Methods in Environmental Studies (2011)
5	**Ecological and Biological Environment –** A. Flora	i. Study of existing floral species within the study area by Ecology and Biodiversity (EB) experts ii. Description of vegetation in the core and buffer zones iii. Biodiversity of plant species – plant dominance, density, frequency, abundance, etc. iv. Information on the dependence of the indigenous people on minor FPs v. Location of Protected Areas such as National Parks, Wildlife Sanctuaries, Biosphere Reserves, Reserve Forests, etc., if any	**Frequency:** Once in a season

		vi. Wildlife migratory routes in the core and buffer zones, if any.	
	B. Fauna	i. Study of existing faunal and avi-faunal species within the study area by EB experts ii. Schedule classification of the species as per the Wildlife Protection (Amendment) Act, 2022 iii. List of wildlife species/avifauna in the study area as per Table 4.15 in the MoEF&CC's EIA Guidance Manual for Mining of Minerals, 2010	**Frequency:** Once in a season
6	Socio-economic Environment	i. Various primary socio-economic data such as population, literacy levels, employment percentages, infrastructure resource base, economic status, health status, morbidity patterns, education, etc. through primary data collection methods such as questionnaires, and schedules.	**Frequency:** Once in a season

3.3. DESCRIPTION OF PRESENT ENVIRONMENTAL STATUS

3.3.1. Micro-Meteorological Study

3.3.1.1. Importance of micro-meteorological study

The concentration and quality of air pollutants is characterised by such qualities of the ambient air mass into which they are emitted as wind speed, direction of movement, and other similar attributes. Pollutant concentrations will rise if the atmosphere is still and they are unable to disperse. On the other hand, pollution produced will be quickly distributed throughout the atmosphere and result in lower concentrations close to the pollution source if a strong, turbulent wind is blowing. In the study of air quality monitoring, measures of wind direction, speed, temperature, humidity, and rainfall are crucial factors. Thus, measuring meteorological data is crucial for comprehending how a region's weather affects air pollution concentrations. However, due to the fluctuations of meteorological data with time, interpretations are only valid for long-term reliable data sources such as the IMD (India Meteorological Department). The nearest AWS station from the project site is in Jowai of West Jaintia Hills, Meghalaya, approximately 36 km (aerial distance) from the project boundary and the nearest Automatic Rain Gauge Station (ARG) is in Amlarem of East Jaintia Hills district of Meghalaya, approximately 7.6 km (aerial distance) from the project boundary.

3.3.1.2. Analysis of Long-Term IMD Data

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. The climate condition of the region over 30 years are tabulated in **Table 3.2** below:

Table 3.2: Meteorological Conditions in the Study Area

Sl. No.	Parameter	Season	Months	Monthly Total (mm)	Heaviest fall in 24 hours (mm)	No. of Rainy Days
1	**Rainfall in mm**	Winter (Dec to Feb)	December	21.8	189.7	0.9
			January	17.8	97	1.6
			February	59.8	376.9	2.9
			Seasonal Total	**99.4**	**376.9**	**5.4**
		Summer (Mar to May)	March	341.4	587.4	8.5
			April	846.7	644.2	16.7
			May	1383.9	**812**	20.1
			Seasonal Total	**2572**	**812**	**45.3**
		Monsoon (Jun to Sept)	June	2589.6	**1563.3**	25.3
			July	3093.3	838.2	28.2
			August	1818.6	853.4	24.5
			September	1154.8	985.5	19.1
			Seasonal Total	**8656.3**	**1563.3**	**97.1**
		Post Monsoon (Oct to Nov)	October	464.4	**594**	7.9
			November	64.7	332.2	1.8
			Seasonal Total	**529.1**	**594**	**9.7**
		Annual Total		**11856.8**	**1563.3**	**157.5**
2	**Mean Daily Temperature in ^{O}C**	**Season**		**Months**	**Mean Highest (^{O}C)**	**Mean Lowest (^{O}C)**
		Winter (Dec to Feb)		December	20.8	5.4
				January	19.6	3.6
				February	21.2	5
				Seasonal	**20.53**	**4.67**

			Mean		
		Summer (Mar to May)	March	24.5	8
			April	25	10.5
			May	26.1	12.4
			Seasonal Mean	**25.2**	**10.3**
		Monsoon (Jun to Sept)	June	26.3	15.2
			July	26.2	16.4
			August	27.2	16.5
			September	27	15.7
			Seasonal Mean	**26.68**	**15.95**
		Post Monsoon (Oct to Nov)	October	26.8	12.1
			November	24.7	8.6
			Seasonal Mean	**25.75**	**10.35**
		Annual Mean	**24.62**	**10.78**	**31.1**
3	**Cloud Cover (Oktas of sky)**	**Season**	**Months**	**All cloud 08:30**	**Low cloud 17:30**
		Winter (Dec to Feb)	December	1.8	2.8
			January	2	2.9
			February	2.4	3.1
			Seasonal Mean	**2.07**	**2.93**
		Summer (Mar to May)	March	3.3	3.5
			April	5.1	4.8
			May	5.8	5.4
			Seasonal Mean	**4.73**	**4.57**
		Monsoon (Jun to Sept)	June	7	5.4
			July	7.1	6.6

			August	6.9	6.2
			September	6.3	5.8
			Seasonal Mean	**6.83**	**6**
		Post Monsoon (Oct to Nov)	October	3.8	4.2
			November	2.4	3.2
			Seasonal Mean	**3.1**	**3.7**
		Annual Mean	**4.49**	**4.49**	**3.33**
4	**Relative Humidity in (RH) %**	**Season**	**Months**	**8:30hrs**	**17:30hrs**
		Winter (Dec to Feb)	December	59	79
			January	60	76
			February	60	73
			Seasonal Mean	**59.67**	**76**
		Summer (Mar to May)	March	64	72
			April	77	82
			May	83	86
			Seasonal Mean	**74.67**	**80**
		Monsoon (Jun to Sept)	June	93	91
			July	95	93
			August	92	90
			September	88	90
			Seasonal Mean	**92**	**91**
		Post Monsoon (Oct to Dec)	October	72	85
			November	59	79
			Seasonal Mean	65.5	82
		Annual Mean		**75.17**	**83**

3.3.1.3. On-Site Micro Meteorological Data

1 hourly continuous meteorological data were collected from the project area during the study period. The brief data are represented in **Table 3.3** below:

Table 3.3: On-Site Micro-Meteorological Data for Thanghunai Limestone Quarry

Month	Temperature (^{O}C)			Humidity (%)			Wind Speed (km/hr)		
	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
1st–31st Dec 2023	28.1	10.7	17.7	100	32.1	72.7	40.7	0.0	5.6
1st–31st Jan 2024	24.9	8.4	15.1	100	28.7	69.4	16.6	0	5.5
1st–29th Feb 2024	26.7	9.5	17.1	100	23.7	64.3	18.4	0	6.0

i. **Temperature:** Temperature of the area varied from 8.4^{O}C to 28.1 ^{O}C.

ii. **Relative Humidity:** Humidity of the area varied from 23.7% to 100%.

iii. **Wind Speed:** Wind speed was in the range of 0.0 kmph to 40.7kmph.

iv. **Wind direction:** Wind rose diagram (**Figure 3.2**) form the monitored data shows that the predominant wind direction during the study period was mainly from North to South.

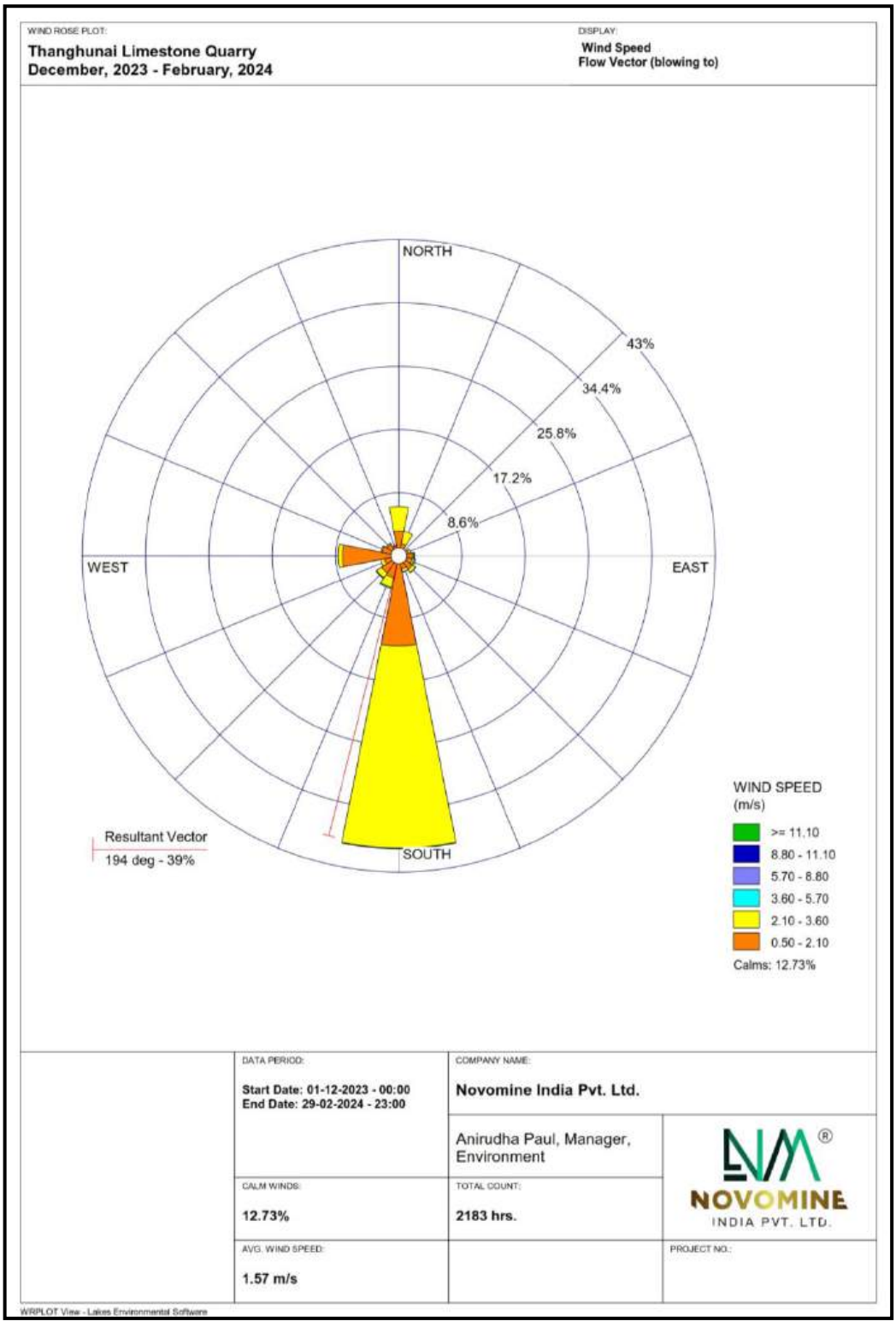


Fig 3.2: Seasonal (December 2023 - February 2024) Wind Rose Diagram for Thanghunai Limestone Quarry

3.3.2. Ambient Air Quality

According to the Terms of Reference (ToR) issued by the SEIAA of Meghalaya vide **File No. ML/SEAC/SEIAA/PP/WJH/18/2024** dated **3rd July 2024**, various ambient air quality parameters, such as particulate matter/dust less than 10 µm (PM_{10}), particulate matter less than 2.5 µm ($PM_{2.5}$), sulphur dioxide (SO_2), and nitrogen oxides (NOx), have been identified as critical parameters relating to project activities for representing baseline status of ambient air quality within the study area. Six ambient air quality (AAQ) monitoring stations were selected in the project's core zone and buffer zone (10 km radius study area) to evaluate the baseline ambient air quality. The core zone of the project is represented by **one ambient air quality (AAQ) sampling location**, while the buffer zone is made up of **five such locations**. **Table 3.4** provides the summarized observed values for each air pollutant at different sampling locations. **Fig 3.3** provides a visual representation of the ambient air quality sampling station locations.

Table 3.4: Summarized results of AAQ Baseline Data for Thanghunai Limestone Quarry and its study area (December 2023 – February 2024)

Station Code	Location	Distance (km)	Direction	PM_{10}	$PM_{2.5}$	SO_2	NOX
				µg/m^3			
CA-1	**Project Site**	0.0	-	68.0	41.0	14.6	20.8
BA-1	**Amjajer Roko**	2.3	NE	58.5	35.0	12.0	18.4
BA-2	**Nongtalang**	1.91	SW	59.6	24.0	11.6	18.6
BA-3	**Nongtalang College (Permanent Campus)**	0.80	E	52.0	29.5	6.4	13.2
BA-4	**Sohkha Shnong**	5.1	W	53.5	33.5	10.9	17.9
BA-5	**Pamtbuh Village**	7.2	NE	48.7	23.5	10.6	16.9
Standard Concentration (24 hrs)				**100**	**60**	**80**	**80**

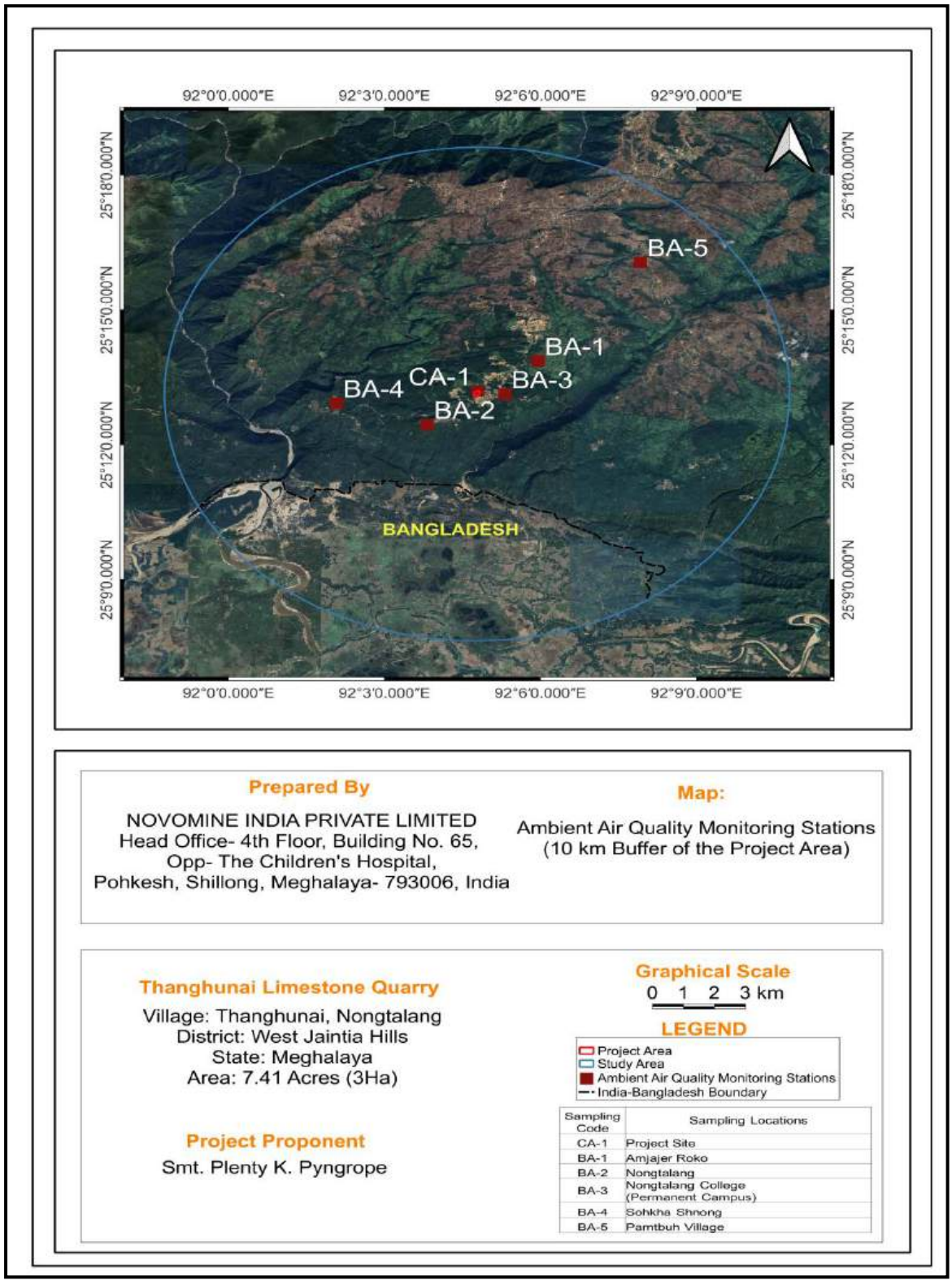


Fig 3.3: Ambient Air Quality Monitoring Stations Map for Thanghunai Limestone Quarry

3.3.3. Traffic Density Study

3.3.3.1. Linked End Use

Basket Linkage: Thanghunai Limestone Quarry is not linked to any end use project/plant. The extracted mineral (limestone) from the block shall be for sale in the open market, and to be utilized in the sectors of steel manufacturing, construction, in kilns, and other such industries that are based on demand of the mineral.

Distance of End Use Plant from the Site: Not applicable as it is basket linkage.

3.3.3.2. Transportation of Mineral

Transportation of Run of Mine (ROM) will be carried out by dumpers/conventional trucks of 10-12 T payload capacity within the mine lease area and beyond, through existing roads and highways. The trucks/dumpers will directly enter the lease from the southern and south-eastern corner of the mine boundary for limestone transportation from the stackyard/working area and no additional land will be utilized for transportation of the mineral outside the Mining Lease.

Mode of Transport: It is proposed that point sale of the limestone that shall be produced from the mine be at the pit head. The produced mineral will be transported as per requirement, and customers will also be transporting the material to their destination consumption centers via roads using conventional goods carrying trucks.

NH-206 (Jowai-Dawki road) is at a distance of around 0.25 km connected by an un-metalled road from the egress point of the mine. This may be considered as an approach road connecting the haul road within the ML from to the major transportation route. There are several other metalled roads connecting NH-206 which may be used in case of increasing traffic for transportation. Existing Road network has been provided in **Fig 3.4** below. Roads leading out of the quarry shall be further developed and widened by the time the mine reaches its peak/rated production capacity again after reopening.

3.3.3.3. Traffic Study

A traffic survey was carried out to estimate probable impacts on the local traffic in the area that may occur due to the proposed mining operations at selected locations through manual counting method. The survey was carried out for 24 hrs. (hourly interval) from 7:00

AM to next day 7:00 AM, for different types of vehicles near the proposed site. The incremental traffic load due to mine operations is summarized below as per the *IRC 064: Guidelines for Capacity of Roads in Rural Areas:*

Table 3.5: Summary of the incremental traffic load due to mine operations

Description	Details
Peak Production	**148908 T**
Proposed Number (No.) of Working Days	**300**
Required transportation of extractable material per day	**496.36 T**
Working hours (*Work will be carried out in Single Shift*)	**8-10 hours/day**
Truck Payload Capacity (for carrying limestone outside the ML)	**20 T**
Maximum number of Trips (to and fro)	**(496.36/20) x 2 ≈ 50**
No. of Passenger Car Units (PCUs) deployed per day {considering an equivalence factor of 2.5 for tippers/dumpers}	**50 x 2.5 = 125**
No. of PCUs to be deployed per hour	**125/10= 12.5 ≈ 13**

Observed PCUs on NH-206 (in vicinity of the Mining Lease):

Type of Vehicle	Equivalent PCU factor	No. of vehicles observed/hr	Volume (PCUs/hr)
Two-wheeler	0.5	10	**5**
Passenger Car, Pickup vans etc.	1	10	**10**
Light Commercial Vehicles	1.4	10	**14**
Bus/Truck	2.5	20	**50**
Total volume of PCUs/hour			**79**

Road	Existing PCUs on the road	V (Volume in PCUs/hour)	C (Capacity in PCUs/hour)	Calculated V:C ratio	Level of Service (LOS)
Approach Road out of ML	0	0+13=13	50	0.260	**A**
NH-206 (within 1 km)	**75**	**79+13=92**	**1000**	**0.092**	**A**

The LOS of **"A" (<0.3)** for adjoining Local/Collector streets (transport channels leading to and in the vicinity of NH-206) represents a condition of free-flow with average travel speeds usually about 90 per cent of the free-flow speed for the arterial class roadways. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is high. The general level of comfort and convenience provided to the road users is excellent.

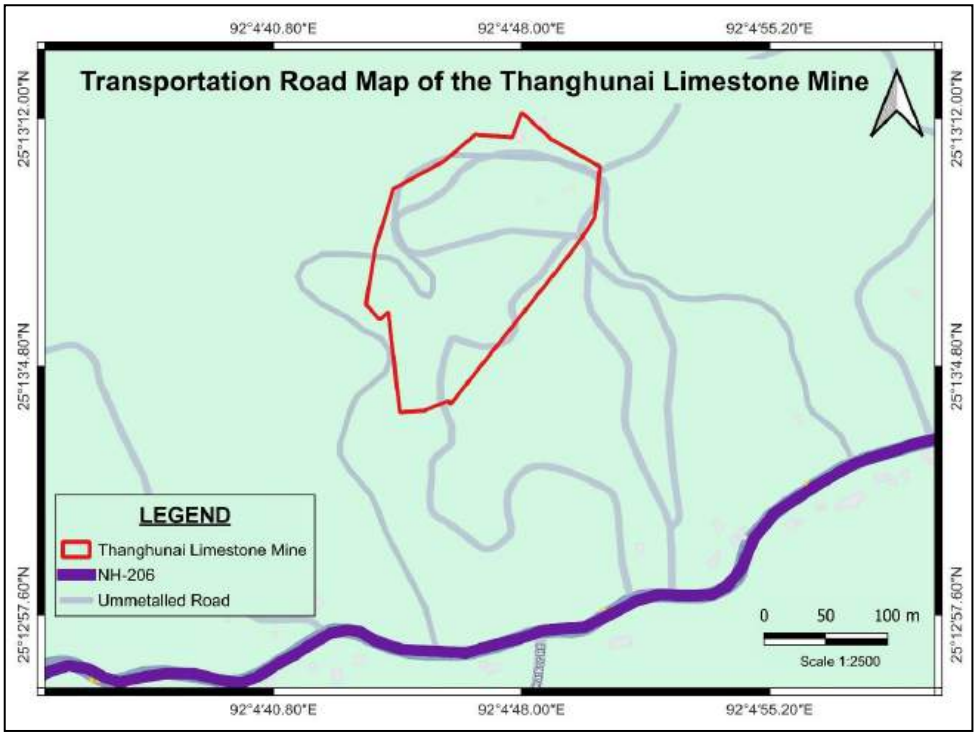


Fig 3.4: Limestone Transportation Road Map for Thanghunai Limestone Mine

3.3.4. Ambient Noise Level

An exhaustive survey on ambient noise levels was carried out **to study the hourly equivalent noise levels** in accordance with the Noise Pollution (Regulation & Control) Rules, 2000, IS-9989 (1981) and IS-4954 (1968) standards. Ambient noise levels at the spot were measured for 24 hours on an hourly basis by using a high precision Integrated Sound Level Meter to represent the baseline status of ambient noise levels within the study area. Six ambient noise level (ANL) monitoring stations were selected in the project's core zone and buffer zone (10 km radius study area) to establish the area's baseline ambient noise level status. The core zone of the project is represented by **one ambient noise sampling station**, while the buffer zone is made up of **five stations**. **Table 3.6** provides the summarized observed values for the ambient noise levels at different sampling locations whereas, **Figure 3.5** provides a visual representation of the ambient noise level sampling station locations. The same is graphically represented as **Figure 3.6**.

From the data collected, it can be interpreted that the ambient noise levels measured during day time and night time (as per CPCB standards) in the core as well as in the buffer zone of Thanghunai Limestone Quarry are within the stipulated standards.

Table 3.6: Summarized results for Baseline ANL Data for Thanghunai Limestone Quarry and its study area (December 2023 – February 2024)

Code	Location	Distance in km	Direction	Day Leq (dBA)	Day Limits (dBA)	Night Leq (dBA)	Night Limits (dBA)
CN-1	**Project Site**	0.0	-	53.1	75	42.6	70
BN-1	**Amjajer Roko**	2.3	NE	52.2	55	39.6	45
BN-2	**Nongtalang**	1.91	SW	52.9	55	45.3	45
BN-3	**Nongtalang College (PC)**	0.80	E	51.6	55	44.5	45
BN-4	**Sohka Shnong**	5.1	W	50.4	55	41.0	45
BN-5	**Pamtbuh Village**	7.2	NE	43.5	55	37.9	45

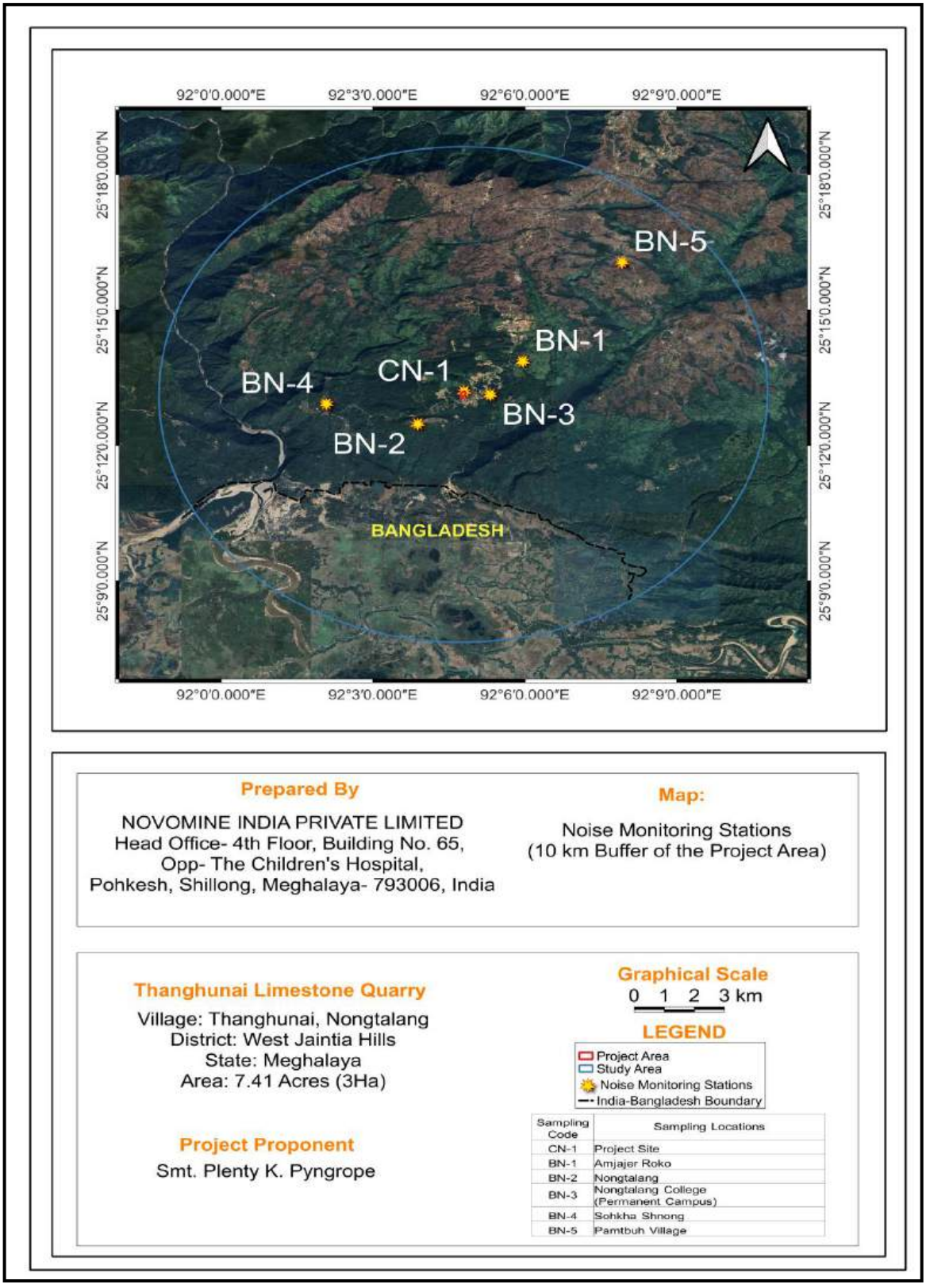


Fig 3.5: Ambient Noise Level Monitoring Stations Map for Thanghunai Limestone Quarry

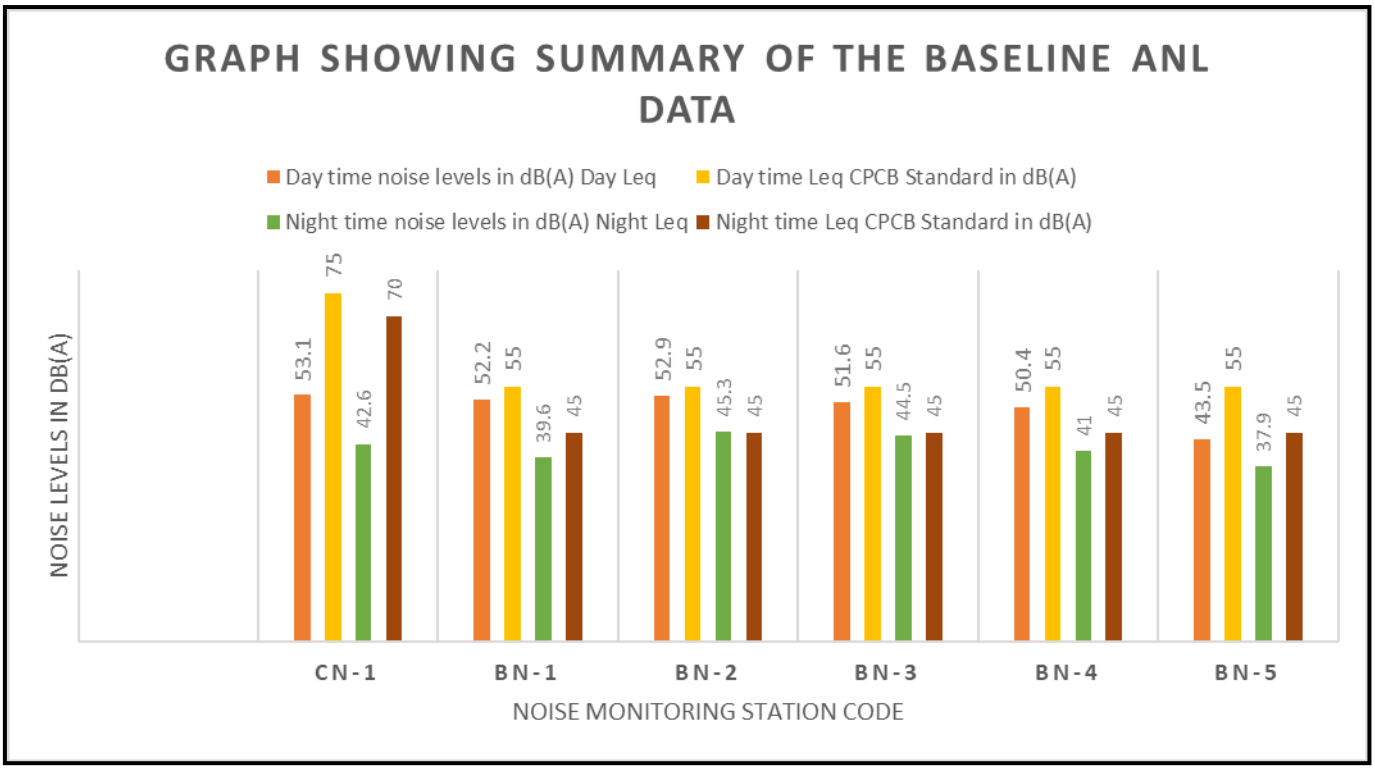


Fig 3.6: Graphical Representation of ANL data (daytime and nighttime) along with CPCB standards for Thanghunai Limestone Quarry

3.3.5. Geology

3.3.5.1. Regional Geology

In a regional scale, the area forms a part of the Meghalaya Plateau exposing geological milieu representing Precambrian to Tertiary sequence in this part of West Jaintia Hills District of Meghalaya. Regional statigraphic succession and geology of the study area based on GSI publication is presented in **Table 3.7** below.

Table 3.7: Regional Statigraphic Succession

Geological Age	Group Name	Formation Name	Rock types
Palaeocene to Eocene	Jaintia	Kopili Sylhet Therria	Argillaceous sediments Dominantly limestone with Ferruginous sandstone Dominantly sandstone with coal partings
Up to Cretaceous	Ultrabasic		
Cretaceous **Jurassic**	Khasi Sylhet trap	Mahadek	Conglomerate with coarse, feldspathic, S.St with clay bands Volcanic trap with vesicles of zeolite and agate
Pre-Cambrian	Khasi Greenstone Shillong group		Epidiorite, Meta-dolerite, diorite dykes Thick pile of quartzite

Proterozoic& Archaean	Gneissic Complex		Para & ortho- gneiss, migmatite, mica schist & other meta-sedimentary bands

3.3.5.2. Geology of the Mine Lease Area

The proposed mining area is small and exposes only the limestone of the Sylhet limestone Formation. **Table 3.8** provides a glimpse of the geology that is seen in the area.

Table 3.8: Local Geological Set-Up

Geological Age	Group Name	Formation Name	Summarized rock types
Recent	Newer alluvium	Unclassified	Unconsolidated soil, scree material
Eocene	Jaintia	Sylhet (=Shella)	Top part with grey/white limestone Bottom part with dark /steel grey limestone.

3.3.6. Hydrogeology

The hydrogeological formation of the project district is comprised of Granite Gneiss and intrusive of Archean-Proterozoic, Quartzite of Paleo-Meso-Proterozoic of Shillong group, Granite of Neo Proterozoic- early Proterozoic, Sandstone and Limestone of Paleocene-Eocene age. The presence of weak planes like fractures and joints in these hard rock formation forms the principal aquifer in the area. Ground water exploration has been carried out in different parts of the district to delineate the potential aquifers and their geometry and to determine the hydrogeological parameters of the aquifer systems. Study of dug wells, bore wells, springs and exploration data reveals occurrence of ground water in the study area is mainly of weathered and fractured Quartzite, Granite, Granite Gneiss, Sandstone and Limestone and the presence of phreatic/shallow and deep fractured aquifers in the district.

3.3.6.1. Occurrence of groundwater in shallow aquifers

The depth of shallow aquifer in the district ranges from 2 to 40 meters. This shallow aquifer occurs under unconfined to semi-confined conditions. Ground water from shallow aquifer is exploited through different types of ground water extraction structures such as dug wells (Kachha dug wells and ring well). This dug well tapped the unconfined aquifer generally down to 2 to 6 meters. This unconfined aquifer extends up to 40 meters which is the weathered portion.

3.3.6.2. Occurrence of groundwater in deeper aquifers

The deeper aquifer occurs as semi-confined to confined condition where ground water is found in the fractured zone of consolidated Quartzite, Granite, Granite Gneiss, Intrusive rock, Sandstone and Limestone. The drilled depth of exploratory wells tapping this aquifer ranges from 74.2 to 202.5m bgl. The number of fractures and its zones encountered varies in all the places which show the complexity of the hydrogeology of consolidated hard rock formation.

3.3.6.3. Springs

A spring is defined as a localized natural discharge of ground water appearing at the surface as a current of flowing water through well-defined outlets. A total of 25 springs were established and monitored to know the type, discharge and their behavior. It is found that most of these springs were depression and topographic or fractured springs. It is observed that the discharge of springs in this area ranges from dry to 36.6 litre/minute during pre-monsoon and 0.06 to 40.2litre/minute during post-monsoon season.

3.3.6.4. Depth to Water Level

Study of water level and its behavior both in phreatic and confined condition were carried out. A total of 3 Dug wells were established as key wells for periodical monitoring to know the water level trend and its behavior in phreatic conditions. The depth to water level in these dug wells was ranging from 0.51 to 1.67 m bgl during the pre-monsoon season and 0.31 to 1.6 m bgl during the post-monsoon season and the average water level fluctuation is 1.14 m. It is observed that the ground water development in the region, in which lease area falls is in the **"SAFE"** category (*Report on 'Aquifer Mapping and Management Plan of West Jaintia Hills District, Meghalaya' 2017-18 by the Central Ground Water Board, India*).

3.3.6.5. Flood Hazard

The area is much above the High Flood Level (HFL) and there is no record of flooding around the mine lease area. Mining operations will be conducted above the local ground water table after conducting a detailed hydrogeological study during the post-monsoon season.

3.3.7. Drainage Pattern

3.3.7.1. Drainage Pattern of the district

The drainage system of the district is controlled by its topography. Drainage pattern of dendritic, rectangular types is found in the area which indicates both topographic and structural control. Broadly, there are mainly two watersheds in the district, one river flowing in the northern direction toward the Brahmaputra and the other in the south, towards the Surma valley in Bangladesh. The important rivers flowing to the Brahmaputra are Kopili, Myntang and Mynriang and the main rivers flowing to the Surma valley are Myngngot (Umngot), Myntdu, Wah Prang, Wah Lukha and Wah Simlieng. The drainage pattern is sub parallel to parallel. It is being controlled by joints and faults as indicated by the straight courses of the rivers and streams with deep gorges.

3.3.7.2. Drainage Pattern of the study area

There is no naturally-occurring surface water body within the mine block. The nearest surface water body is Wah Kudengrim river that flows at a distance of about 3.7 km NW direction from the project boundary.

There are innumerable first order and second order streams signifying the high density of drainage systems in the study area. The noteworthy rivers flowing within the study area are Wah Umngot flowing about 9.3 km from lease area towards WNW and Um Sangot flowing about 8.5 km from lease area towards ENE.

Natural drainage pattern of the area will not be altered due to mining activity.

3.3.8. Groundwater Quality

The physico-chemical characteristics of groundwater quality are depicted in **Table 3.9** and the locations are depicted in **Figure 3.7**.

Table 3.9: Results of Groundwater Quality Baseline Data at specific stations in the study area (December 2023 – February 2024)

Parameters	Unit	Permissible	Ground Water Samples			
		Limit*	GW1	GW2	GW3	GW4
Colour	Hazen	5	<1	<1	<1	<1
Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
pH	-	6.5 to 8.5	6.9	6.98	6.88	6.72
Total Dissolved Solid	mg/l	500 (2000)	428.8	458.3	465.2	470.2
Electrical Conductivity at 25°C	µS/cm	-	623.3	605.1	619.5	624.3
Turbidity	NTU	5 (10)	0.6	0.7	0.4	0.7
Total Hardness ($CaCO_3$)	mg/l	300 (600)	260.1	265.2	278.3	268.7
Total Alkalinity ($CaCO_3$)	mg/l	200 (600)	151.6	150.0	163.0	168.0
Chloride as Cl	mg/l	250 (1000)	35.5	35.1	43.3	39.1
Sulphate as SO_4	mg/l	200 (400)	2.7	21.3	20.8	22.3
Nitrate as NO_3	mg/l	45	3.73	4.06	4.12	4.01
Fluoride as F	mg/l	1.0 (1.5)	0.45	0.48	0.55	0.50
Boron as B	mg/l	0.5 (1)	<0.1	<0.1	<0.1	<0.1
Calcium as Ca	mg/l	75 (200)	38.3	48.5	41.8	47.9
Magnesium as Mg	mg/l	30 (100)	23.2	20.2	22.6	24.3
Arsenic as As	mg/l	0.01	<0.01	<0.01	<0.01	<0.01
Cadmium as Cd	mg/l	0.003	<0.001	<0.001	<0.001	<0.001
Chromium as Cr^{6+}	mg/l	0.05	<0.03	<0.03	<0.03	<0.03
Copper as Cu	mg/l	0.05 (1.5)	<0.02	<0.02	<0.02	<0.02
Iron as Fe	mg/l	0.3 (1)	0.04	0.05	0.06	0.07
Selenium as Se	mg/l	0.01	<0.001	<0.001	<0.001	<0.001
Zinc as Zn	mg/l	5.0 (15)	<0.05	<0.05	<0.05	<0.05

Cyanide as CN	mg/l	0.05	<0.005	<0.005	<0.005	<0.005
Phenolic compound	mg/l	0.001 (0.002)	<0.001	<0.001	<0.001	<0.001
Polynuclear aromatic Hydrocarbons (as PAH)	mg/l	0.0001	<0.03	<0.03	<0.03	<0.03
Total Coliform	MPN/ 100 ml	Nil	Absent	Absent	Absent	Absent
***Standard: IS 10500: 2012** **Ground water sampling stations:** **GW1: Nongtalang Thymmai village (1.8 Km, SW Direction from the Project Site)** **GW2: Amjajer Roko village (2.3 Km, NE Direction from the Project Site)** **GW3: Sohkha Shnong (4.5 Km, W Direction from the Project Site)** **GW4: Amlarem village (6.8 Km, NNE Direction from the Project Site)**						

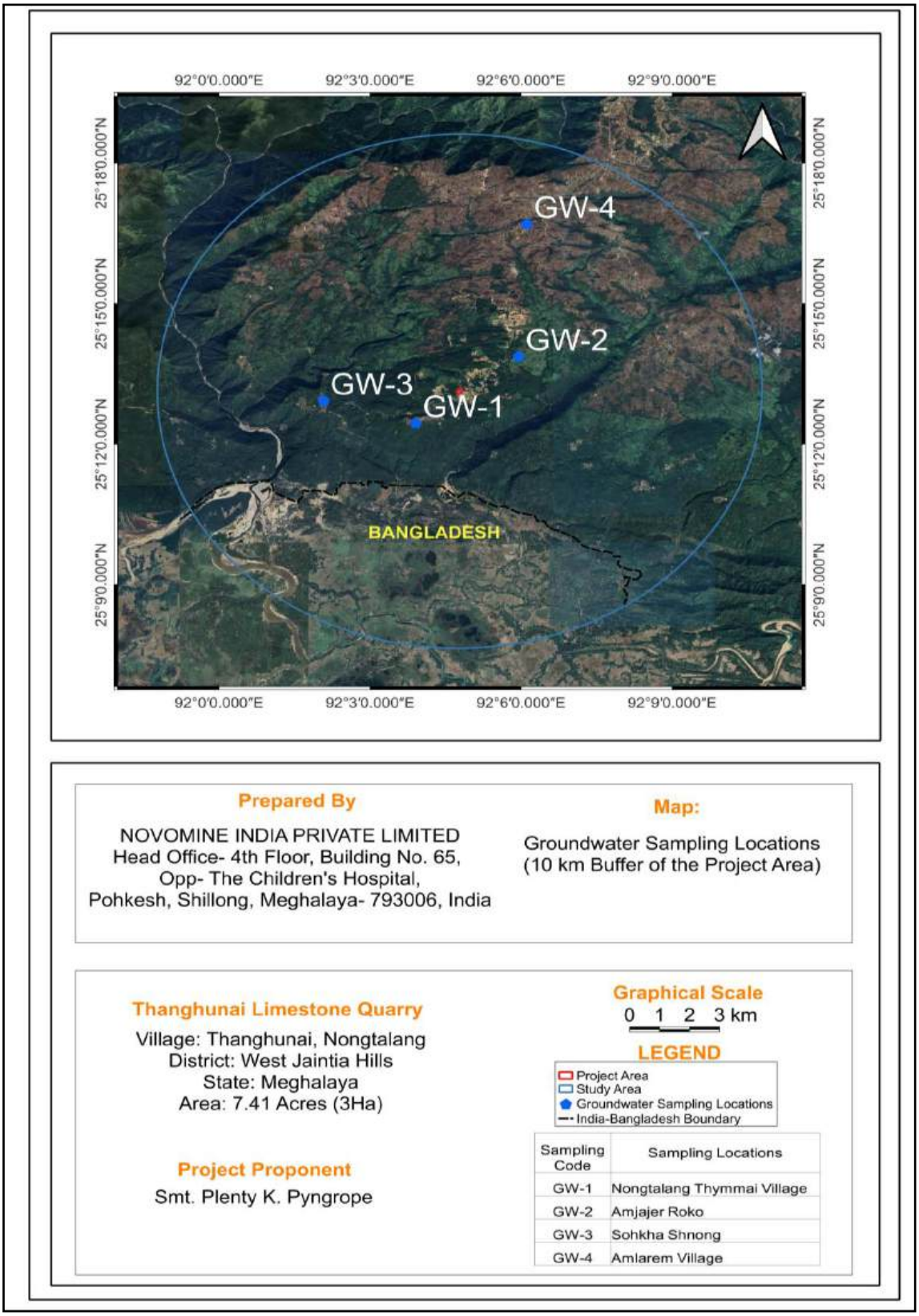


Fig 3.7: Groundwater Quality Sampling Stations for Thanghunai Limestone Quarry

3.3.9. Surface Water Quality

The surface water samples were collected from two locations of the river Wah Umngot (up-stream and down-stream) and from one location from the river Wah Amkshar. The surface water quality as analysed and the parameter wise results are given in **Table 3.10**. The locations are depicted in **Figure 3.8**.

Table 3.10: Results of Surface Water Quality Baseline Data at specific stations in the study area (December 2023 – February 2024)

Parameters	Unit	Permissible Limit*	Surface Water Samples		
			SW1	SW2	SW3
pH	-	6.5 to 8.5	7.3	7.5	6.8
Colour	Hazen	300	<1	<1	<1
Odour	-	Un-objectionable	Agreeable	Agreeable	Agreeable
Total Dissolved Solid	mg/l	1500	293.3	299.1	270.0
Dissolved oxygen	mg/l	4.0	7.6	7.7	7.2
Biochemical Oxygen Demand (BOD) 3d, 25°C	mg/l	3	2.5	2.8	3.2
Free ammonia as NH_3	mg/l	-	<1	<1	<1
Arsenic as As	mg/l	0.2	<0.01	<0.01	<0.01
Mercury as Hg	mg/l	-	<0.005	<0.005	<0.005
Lead as Pb	mg/l	0.1	<0.005	<0.005	<0.005
Chromium as Cr^{6+}	mg/l	0.05	<0.03	<0.03	<0.03
Copper as Cu	mg/l	1.5	<0.02	<0.02	<0.02
Cadmium as Cd	mg/l	0.01	<0.001	<0.001	<0.001
Zinc as Zn	mg/l	15.0	<0.03	<0.03	<0.03
Selenium as Se	mg/l	0.05	<0.001	<0.001	<0.001
Cyanide as CN	mg/l	0.2	<0.005	<0.005	<0.005
Chloride as Cl	mg/l	600	60.3	64.1	54.2
Nitrate as NO_3	mg/l	50	2.62	2.72	2.12
Fluoride as F	mg/l	1.5	0.25	0.30	0.27
Sulphate as SO_4	mg/l	400	28.2	25.6	22.5
Iron as Fe	mg/l	50	0.17	0.15	0.14

Calcium as Ca	mg/l	-	28.2	24.7	28.8
Magnesium as Mg	mg/l	-	6.7	6.8	6.2
Phenolic Compounds	mg/l	0.005	<0.001	<0.001	<0.001
Polynuclear aromatic Hydrocarbons (as PAH)	ppb	-	Absent	Absent	Absent
Total Coliform	MPN/ 100 ml	Nil	Absent	Absent	Absent
Faecal Coliform	MPN/ 100 ml	Nil	Absent	Absent	Absent
***Standard 2296: 1992 Class – C, Inland Surface Water Quality Standard** **Surface water sampling stations:** **SW1: Wah Umngot (US)** **SW2: Wah Umngot (DS)** **SW3: Wah Amkshar**					

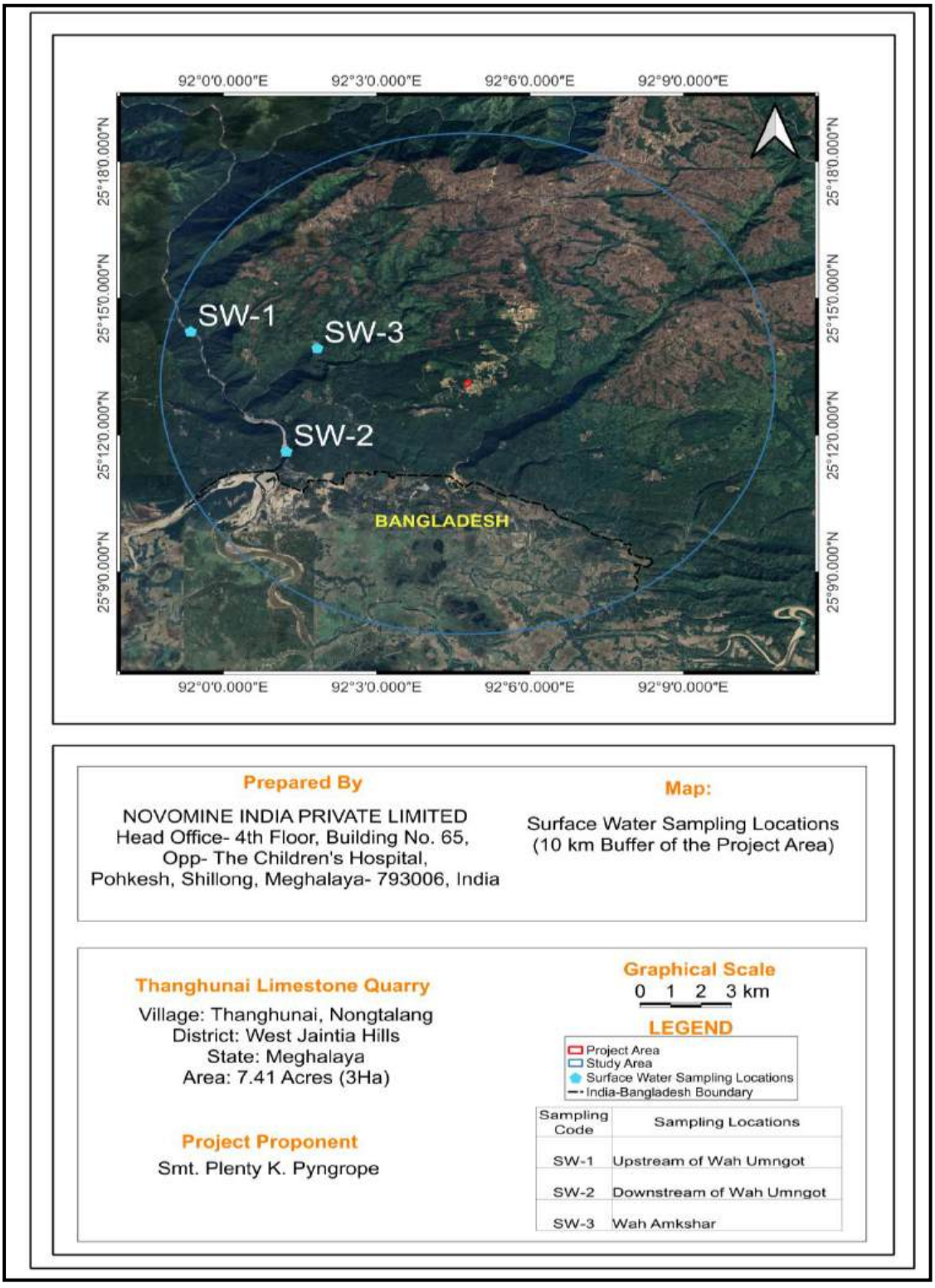


Fig 3.8: Surface Water Quality Sampling Stations for Thanghunai Limestone Quarry

3.3.10. Soil Quality

Soil quality within the core and buffer zones has been evaluated with respect to physical and chemical parameters. The physico-chemical properties of soil, which are important for plant growth and agricultural productivity such as, soil texture, bulk density, moisture content, water holding capacity, soil pH, Electrical Conductivity, Organic Matter and nutrients such as Nitrogen, Phosphorus, Potassium, organic matter, Sodium, Calcium, and Magnesium were analysed for **five soil samples** in the study area. The soil quality as analysed from the samples collected from different sampling locations are given in **Table 3.11** and depicted in **Figure 3.9**.

Table 3.11: Physico-chemical properties of soil

Sl. No.	Parameters	Unit	S-1: (Core Zone)	S-2: Nongtalang	S-3: Amtapoh	S-4: Amlarem	S-5: Pantbuh
		Direction	-	SW	N	NNE	NE
		Distance in Km	0.0	1.8	3.6	6.8	7.4
1	pH	----	6.45	6.67	6.34	6.82	6.62
2	Electrical Conductivity	µmhos /cm	340.0	352.9	371.0	346.0	366.0
3	Soil Texture	----	Loamy Sand	Clay Loam	Loamy Sand		
4	Clay	%	8	31	10	5	7
5	Silt	%	7	41	8	15	12
6	Sand	%	85	28	82	80	81
7	Bulk density	gm/cm^3	1.56	1.53	1.34	1.51	1.44
8	Moisture	%	6.5	7.1	6.3	7.0	6.9
9	Infiltration Rate	cm/hr	48	36	42	40	46
10	Nitrogen as N	mg/100g	26.7	27.8	28.7	24.8	26.1
11	Phosphorus as P	mg/100g	0.81	0.80	0.81	0.81	0.83
12	Potassium as K	mg/100g	0.53	0.70	0.66	0.76	0.63
13	Organic Carbon	%	1.51	1.42	1.51	1.50	1.70

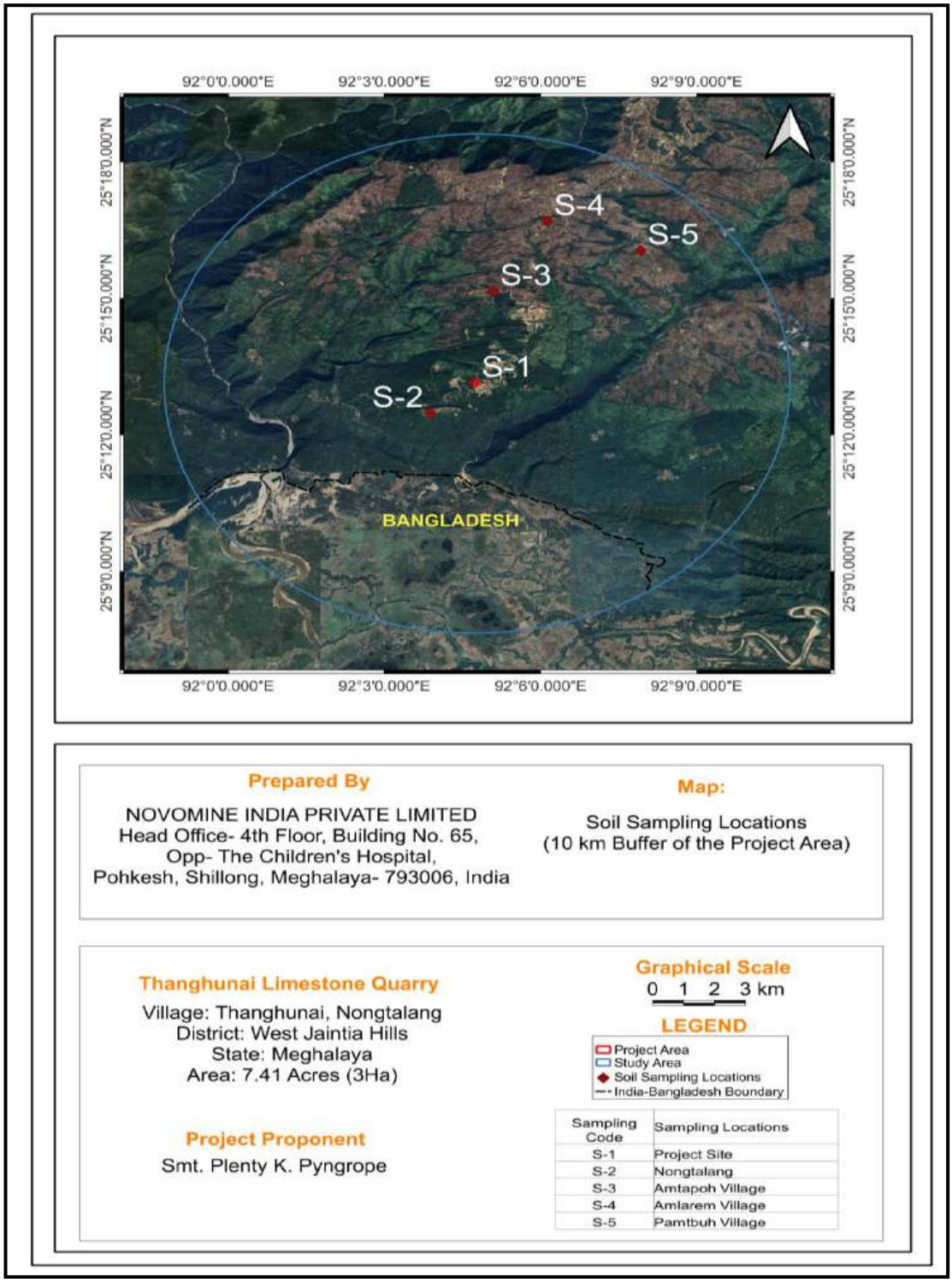


Fig 3.9: Soil Quality Sampling Stations for Thanghunai Limestone Quarry

3.3.11. Land Environment

The land-use distribution of the study area is given in **Table 3.12**. This table can be meaningfully interpreted from the Land Use Land Cover map of the study area in **Figure 3.11** and from the pie chart in **Figure 3.10**. Further, a map showing the core zone delineating the ML area's physical features such as its land use in the form of haul roads, plantation areas, excavated areas, locations of the overburden and topsoil dump sites, etc. is provided in **Figure 3.12**.

Table 3.12: Details of Land Use and Land Cover (LULC) of the study area

Land use	Study Area	
	Area in hectare	**%**
Built-up Area (Urban/Rural)	593.92	2.33
Mining Area	239.88	0.94
River/Stream/Canal	400.36	1.58
Ponds	24.02	0.10
Barren/Rocky/Fallow Land	4814.73	18.92
Agricultural Land	204.30	0.80
Forest/Vegetation	19165.34	75.33
Total Area in hectare	**25442.55**	**100.00**

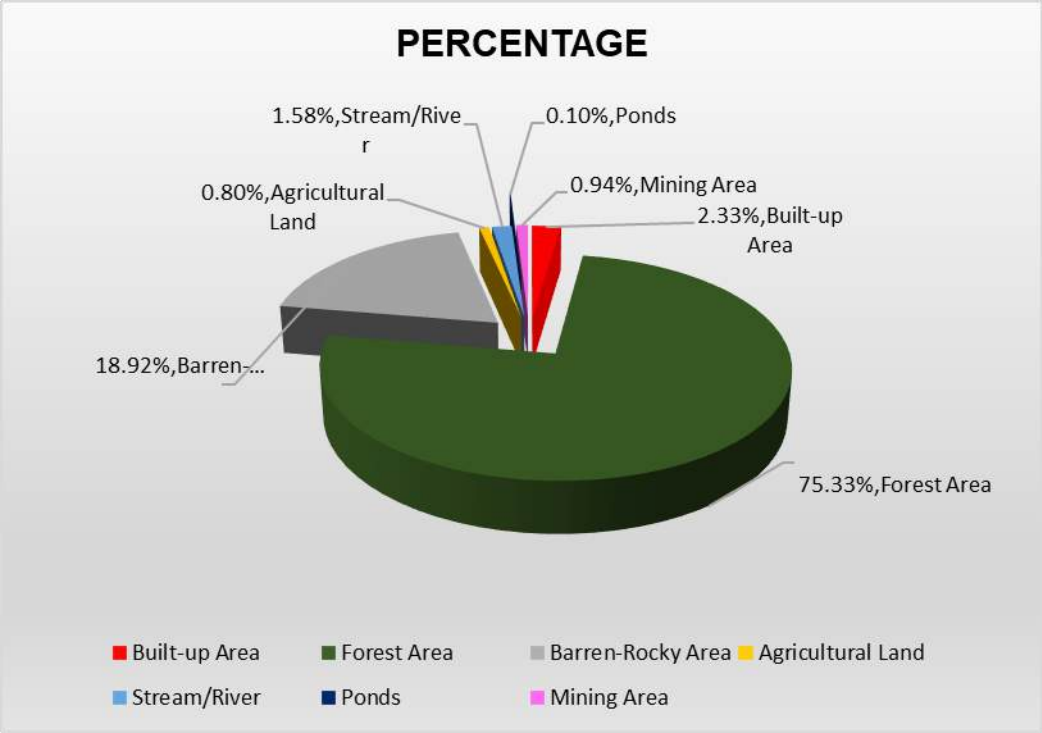
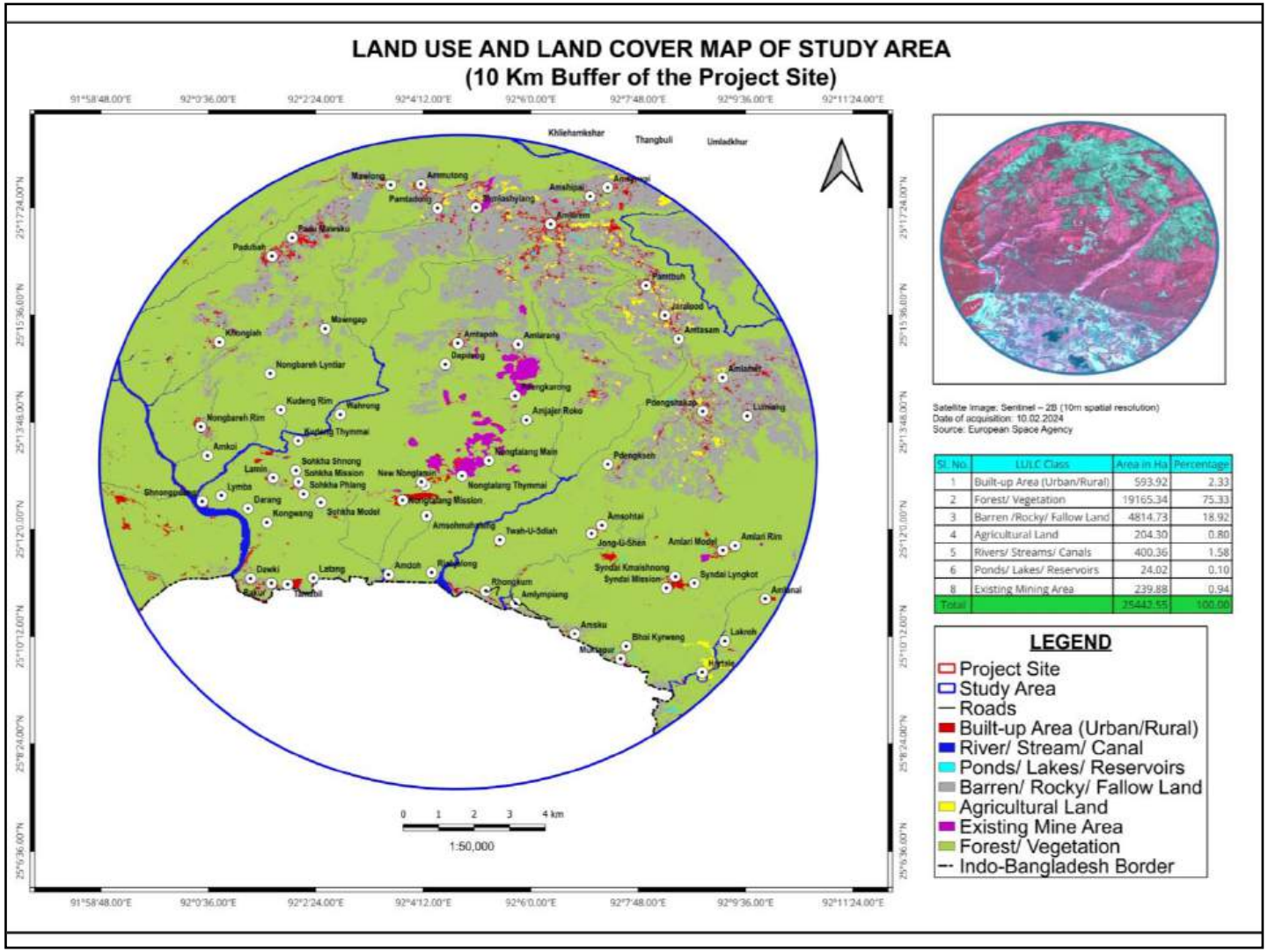


Fig 3.10: Pie Chart showing Land Use/ Land Cover details of the study area

Results:

The pie chart clearly illustrates the land use distribution in the study area. Forest/vegetation comprises approximately 75.33% of the area, followed by Barren/Rocky/Fallow land that comprises approximately 18.92%. Built-up areas and Stream/River Bodies occupy about 2.33% and 1.58%, respectively. The remaining portion consists of active mine area (0.94%), agricultural area (0.80%), and ponds (0.10%).



Sl. No.	LU/LC Class	Area in Ha	Percentage
1	Built-up Area (Urban/Rural)	593.92	2.33
2	Forest/ Vegetation	19165.34	75.33
3	Barren /Rocky/ Fallow Land	4814.73	18.92
4	Agricultural Land	204.30	0.80
5	Rivers/ Streams/ Canals	400.36	1.58
6	Ponds/ Lakes/ Reservoirs	24.02	0.10
8	Existing Mining Area	239.88	0.94
Total		25442.55	100.00

Fig 3.11: Land Use Pattern Map of the Study Area

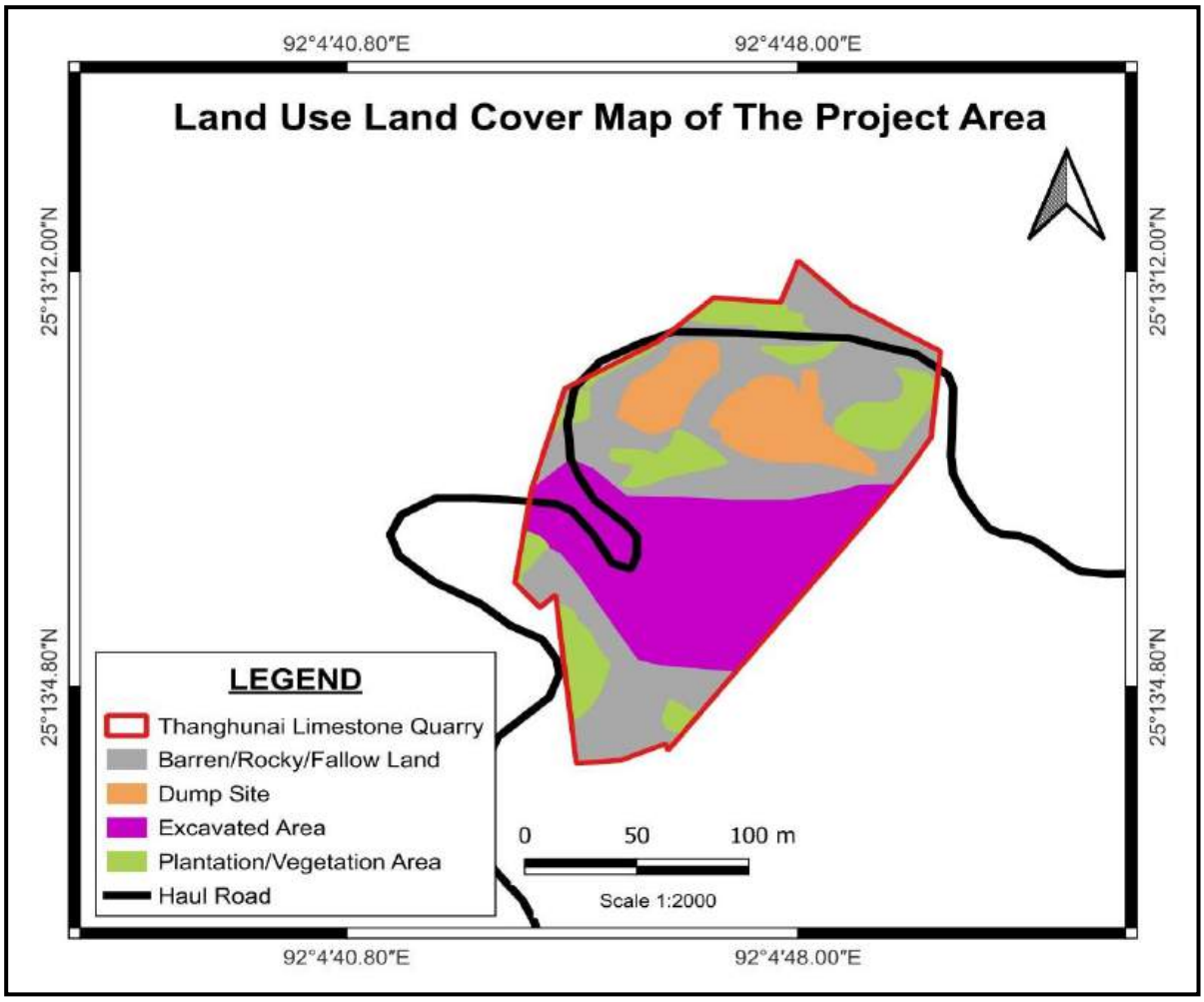


Fig 3.12: Land Use Pattern of the Core Area

3.3.12. Ecological and Biological Environment

3.3.12.1. Scope and Objective

The primary scope of the ecological and biological baseline survey is to:

i. Assess and predict the likely environmental impacts on the local biodiversity, once the project commences.

Some of the primary objectives of the ecological and biological baseline survey are as follows:

i. To enumerate the current floral and faunal resources in and around the project area, and how this project may be implemented keeping in mind these conditions, and

ii. To assess and identify potential impacts of the project on the region's ecological and biological diversity.

3.3.12.2. Study Period

The baseline study period of the proposed project was from December 2023 – February 2024 (winter season).

The study of ecology and biodiversity is to assess biodiversity in terms of forest type and distribution, composition and abundance of plants and animals and ecosystem functions in our dynamic environment. Documenting local species that are ecologically important may be helpful in mine closure and restoration and planning of the greenbelt development.

An ecological survey of the study area was conducted, particularly with reference to the list of species prepared from the secondary data collected from the Forest Department, Working Plan of the area, and available publications and reports and to update it through extensive field studies, consultation with locals, NGOs, and officials of various government departments.

3.3.12.3. Environmental Sensitivity

The environmental sensitivity as per Part-III of Appendix-I (Paragraph-6) of Form-I provides for sensitive receptors within a 15 km radius of the ML area. **Table 3.13** and **Figure 3.13** also provides the spatial locations of these receptors within a 10 km radius of the ML area.

Table 3.13: Environmentally Sensitive Locations within 10 km of the Study Area

S. No.	Particulars	Distance (km)	Direction
Streams			
1	Kudengrin River	3.75	WNW
2	Wah Umngot	6.20	WSW
Water Falls			
3	Amlymphung Water Falls	2.60	E
4	Amkrem Water Falls	4.46	N
5	Kyndong Lai Teng Water Falls	5.14	NNE
6	Amtasam Water Falls	7.71	ENE
7	Krang Shuri Water Falls	8.77	NNE

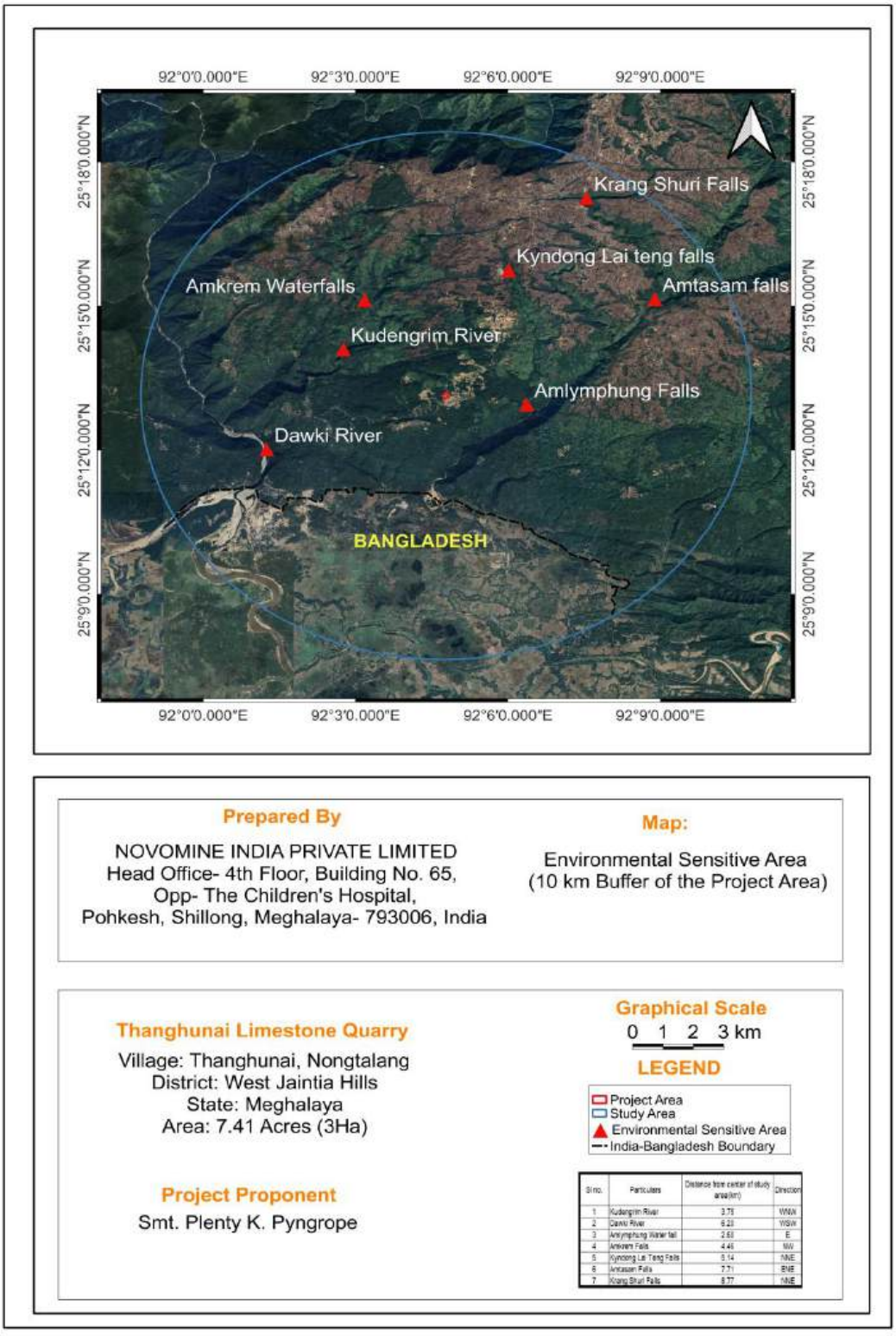


Fig 3.13: Map displaying the environmentally sensitive locations within Thanghunai Limestone Quarry's study area

3.3.12.4. Biodiversity in the Study Area

A detailed biological study of the study area i.e., 10 km radius of the project has been carried out to identify the composition of flora and fauna. For evaluation of floral composition of the area, the study was divided according to habitat types followed by the random sampling, 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. The study area does not contain any protected or reserved forest or notified eco-sensitive zone (ESZ).

For faunal diversity, data collection via random sampling, opportunistic observations, direct sightings, and indigenous knowledge of the local communities was carried out. For enumeration of avifauna, only early morning (6.30 AM – 8.00 AM) and late afternoon (4.00 PM – 5.00 PM) hours were selected for surveying.

A. Flora

Core Zone: Due to rocky terrain and poor soil content, the plant density in the core zone is very low with patches of *Saccharum arundinaceum*, *Trema orientalis*, and *Schima wallichii.*

Buffer Zone: Due to heavy rainfall in the region, the buffer area is a mixture of scrub forests predominated by scanty shrubs and bushes, and trees mainly of deciduous nature. The detailed list of trees which was commonly found in the study area and cross-checked with the secondary data is given in **Table 3.14.**

Table 3.14: List of identified terrestrial flora in the study area of Thanghunai Limestone Quarry

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 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, Garcinia acuminata, Gmelina arborea, Grewia disperma, Hevea brasiliensis, Hydnocarpus kurzii, Lagerstroemia parviflora, Leucaena leucocephala, Licuala peltata, Litsea asebifera, Litsea citrita, Litsea laeta, Litsea salicifolia, 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, Symplocosracemosa, Syzygium cumini, Terminalia bellerica, Terminalia chebula, Terminalia myriocarpa, Tetrameles nudiflora, Toona ciliata, Toona febrifuga, Travesia palmata, Trema orientalis, Villebrunea frutescens, Vitex negundo, Vitex pedunculata, 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., Coixlacryma-jobi, Datura metal, Dendrocalamush amiltonii, 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, Sidarhombifolia, 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.*

B. Fauna

Core Zone: During the study, it was found that the faunal diversity in the core zone has avifauna species like crow, pigeon, sparrow parrot, etc.

Buffer Zone: The buffer zone has a variety of animal species. The detailed list of animals which was commonly found in the study area and cross-checked with the secondary data is given in **Table 3.15**.

Table 3.15: List of fauna identified in the study area of Thanghunai Limestone Quarry

Mammals: *Canis aureus, Cannomys badius, Callosciurus erythraeus, Crocidura attenuate, Suncus murinus, Felis chaus, Funambulus pennant, Funambulus palmarum, Herpestes edwardsi, Lepus nigricollis, LutraLutra, 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, Eudynamys scolopaceus, Milvus migrans, Francolinus pondicerianus, Hirundo rustica, Dendronanthus indicus, Passer domesticus, Psittacu lakrameri, Pycnonotus cafer, Scolopax rusticola, Alcedo atthis, Streptopelia chinensis.*
Reptiles & Amphibians: *Amolops afghanus, Bufo parietalis, Bufo stomaticus, Bufo idesmeghalayana, 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*
Insects: *Acrida turrita, Acontia marmoralis, Orthetrum luzonicum, Agriocnemis pygmaea, Apis cerana, Ariadne merione, Ceriagrion coromandelianum, Euploca core, Eurema brigitta, Graphium sarpedon, Halpe kumara, Holochlora indica, Ischnura aurora, Matapa druna, Musca domestica, Papilio arcturus, Periplaneta Americana, Pseudagrion rubriceps, Apodemia mejicanus, Vespa orientalis.*
Mollusca: *Bellamya bengalensis, Cypraea limacina, Turbo marmoratus.*

3.3.12.5. Endangered Species

There are no endangered species of flora and/or fauna within the study area of Thanghunai Limestone Quarry.

3.3.13. Socio-Economic Environment

The socio-economic profile of the area offers valuable insights into various aspects such as population growth rate, population density, gender ratio, work participation rate, and a description of the vulnerable population within the study area. This information helps to understand the demographic characteristics, economic activities, and social dynamics of the local population residing in the vicinity of the limestone mine.

3.3.13.1. Demographic Profile

There is no habitation within the project area which has been taken on lease by the project proponent. Hence, there are no R&R issues involved with this project.

There are 66 villages in the study area and all the villages fall under Amlarem CD block of West Jaintia Hills. These villages have 5211 households accumulating 28902 populations. According to the survey, gender ratio of study area was 977.6 in 2011. The details are given in **Table 3.16**.

Table 3.16: Demographic Profile of the study area

Description	Total	% of total population
No. of households	5211	
Total population	28902	100
Male Population	14385	49.77
Female Population	14517	50.23
Females/1000 males	1009	-
Family size, persons/family	5.55	-
Schedule Caste	444	1.54
Schedule Tribe	25886	89.56
Others	2572	8.90
Total literates	17166	59.39
Male literate	8455	29.25
Female literate	8711	30.14

3.3.13.2. Occupational Structure

Employment pattern and occupation are the two main indicators of the economic profile. A summary of employment pattern and occupation for the study area is presented in **Table 3.17**.

Table 3.17: Occupational Structure in the study area

Total Workers	Male	Female	Main Workers	Male	Female	Marginal Workers	Male	Female
12561	7504	5057	8347	5496	2851	4214	2008	2206

Description	Total	% of Population
Break-Up of Main Workers		
Cultivator	2503	29.98
Agricultural labour	1644	19.69
Household industries	73	0.87
Other workers	4127	49.44
Total	**8347**	**100.00**
Break-Up of Marginal Workers		
Cultivators	488	11.58
Agricultural labour	1340	31.79
Household industries	50	1.18
Other workers	2336	55.43
Total	**4214**	**100.00**

3.3.13.3. Infrastructural Facilities

Educational Facilities

Block name	Pre-Primary school	Primary school	Middle school	Secondary school	Senior Secondary school	Degree college
Amlarem	85	82	27	14	5	0

Health Facilities

Primary Health Centre	Community Health Centre	Maternity and Child Welfare Centre
2	1	3

Banking and Post-Office Facilities

Post-Office	Commercial Bank	Co-operative Bank	Self Help Group
3	3	3	25

Telecommunication Facilities

Landline	PCO
11	5

Chapter 4 – ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1. DETAILS OF ENVIRONMENTAL IMPACTS

Mining activities cause adverse impacts on the surrounding environment unless proper environmental management plan is adopted.

In this chapter, an attempt is made to quantify or quality the possible environmental impacts on various features such as air quality, water use and quality, land-use, ecological considerations, soil quality and socio-economic factors. The above-mentioned aspects have been studied to identify the impacts of the proposed production from the mine. The magnitude and significance of the environmental pollution caused by mining depends on method of mining, scale and concentration of mining activity. On the basis of the impact analysis, the mitigating action and future monitoring requirement are focused in the Environmental Management Plan for counting or minimizing adverse impacts. The impact identification matrix is given in **Table 4.1**.

4.2. IMPACT OF THE PROJECT

For this project, we have used impact matrices that present the impacts of various activities during the project's operational phase in **Table 4.1**.

Table 4.1: Impact Identification Matrix

ENVIRONMENTAL ATTRIBUTES	PROJECT ACTIVITIES								
	Transport of Raw Materials	Storage of mineral and overburden	Movement of Machinery	Excav-ation	Blasti-ng	Drilling	Handling of O/B	Operat-ion of DG Sets	Effluent Generat-ion
AMBIENT AIR QUALITY	–		–	–	–	–	–	–	
WATER QUALITY		–					–		–
SOIL				–	–	–	–	–	–
AMBIENT NOISE & VIBRATION	–		–	–	–	–	–		
LAND USE PATTERN							–		
SW HYDROLOGY									
GW HYDROLOGY									
GEOLOGY				–					
SHW									
OCCUPATIONAL HEALTH & SAFETY	–	–	–	–	–	–	–	–	
ECOLOGY & BIODIVERSITY	–		–	–	–	–		–	–
SOCIO-ECONOMIC	+		+	+	+	+	+	+	–

–	**Anticipated Adverse Impacts**
+	**Anticipated Beneficial Impacts**
	No Impacts

4.3. IMPACT AND MEASURES FOR MINIMIZING/NULLIFYING NEGATIVE EFFECTS

4.3.1. Ambient Air Quality

4.3.1.1. Impacts

Negative impacts on the ambient air quality due to limestone mining depends on the following factors:

i. Intensity of mineral extraction operations
ii. Mode of transportation within and outside the ML area
iii. Emissions load contributed from other industrial and mining activities in the vicinity of the mine

The intensity of mine operations is directly related to the rate of mineral production from mining. Production details are furnished in **Chapter 2**.

Shovels and tippers of different capacities are engaged mainly for extracting and transporting the mineral and overburden from the mining area. Particulate matter (PM10) is the most significant pollutant that is emitted from the surrounding mines. The details of HEMMs are provided in **Chapter 2**.

a. Transportation of the mineral and overburden

The limestone excavated from this mine will be transported through 10-12 T Tippers.

b. Loading of mineral

After sizing, the mineral will be transported by Tippers.

Water sprinkling and fine mist arrangements at the appropriate places will be provided to contain the emissions. The existing baseline concentrations of air pollutants are within the limits prescribed by the CPCB for industrial/mixed areas and for rural/residential areas.

Air pollution sources at Thanghunai Limestone Quarry can be classified into three categories, viz., area sources, line sources, and instantaneous point sources. Extraction of limestone by various activities in the mining area is a type of area source; transportation of the mineral and overburden from the mining area to other locations is a type of line source; and blasting, which is usually done during the daytime by deep holes is a type of point source of air pollution. Even though blasting leads to the generation of NOx, it is instantaneous and

intermittent.

4.3.1.2. Mitigation Measures

i. 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,

ii. 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.

iii. Blasting will be done during favorable atmospheric conditions and will be avoided during high windy periods, night times and temperature inversion periods.

iv. To avoid secondary blasting rock breaker will be used.

v. Optimum bucket size loading equipment will be used which will reduce the number of buckets 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.

vi. Water sprinkling over blasted pile of ROM will be done which will reduce dust generation during loading.

vii. 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.

viii. Overloading of the dumpers and tippers will be avoided.

ix. The vehicles deployed for material transportation shall be spillage proof to avoid or minimize the spillage of the material during transportation.

x. Personnel working on the drills and other mining activities will be provided with dust mask and other necessary Protective Equipment. Health check-ups will be done biannually to monitor the health of the workers.

xi. Plantation of local thriving species will be done in the 7.5m statutory boundary for arresting dust.

xii. Regular maintenance of vehicles and machinery will be done.

xiii. Vehicles/equipment will be periodically subjected for emission tests and will have valid POLLUTION UNDER CONTROL certificates.

xiv. Excavators and dumpers will have dust proof cabins to minimize dust exposure of workers.

xv. No impacts are expected on micro-climatic conditions of the project due to this small-scale mining activity.

xvi. Monitoring to ensure compliance with emission limits would be carried out during operation.

xvii. Air Pollution Control Equipment (APCEs) shall be proposed to be implemented as part of the EMP. Design details for the same are mentioned below:

Design Details of of Air Pollution Control and Monitoring Equipment (APCEs)

Given the inherent dust generation in opencast mining, a multi-pronged approach has been proposed to be implemented to minimize fugitive dust emissions from various mining operations as part of the project's Environmental Management Plan. These strategies will focus on:

i. Avoiding dust generation from drilling operations by adopting and implementing wet-drilling methods,

ii. Use of appropriate explosives (NONELs) for blasting and avoiding overcharging of blast holes in overburden,

iii. Installation of water/mist spraying arrangements at all critical (transfer) points to avoid dust generation due to limestone and OB transportation,

iv. Strategic plantation of indigenous grass species such as *Cymbopogon flexuosus* L. (lemongrass), *Neyraudia* sp., *Saccharum ravennae*, *Imperata cylindrica* (Cogon grass), etc. and other native plants (shrubs) on OB dump slopes, soon after their formation,

v. Haul roads are the major source of fugitive dust in the opencast mines. Hence, water spraying on haul roads and the permanent transport routes shall be done at required frequencies. At least **1 water sprinkler of 10-15 KL standard capacity**, shall be deployed for water spraying on haul roads and in material transfer points,

vi. Black topping/paving of permanent internal roads to reduce dust from being airborne,

vii. The use of a **mobile mist spray/fog cannon machine** for dust suppression, and

viii. Establishing a three-row plantation around the quarry and overburden (OB) dumps, to

prevent dust dispersion.

ix. Providing Personal Dust Samplers (PDS) to mine workers working in fugitive dust prone areas.

A. Design Details of the Multi-layered Dust Barrier Through Plantation:

To prevent dust dispersion, a three-row plantation will be established around the quarry and overburden (OB) dumps. This initiative will be complemented by a comprehensive 0.56 Ha. greenbelt development encompassing the quarry area, mine infrastructure, reclaimed areas, and OB dumps. This multi-tiered approach will create a robust barrier to effectively mitigate dust dispersion:

i. The first layer (inside layer) will consist of grasses, herbs, and shrubs
ii. The second layer (middle layer) will consist of smaller trees
iii. The third layer (outside layer) will consist of big trees.

The plantation matrix that shall be adopted for the greenbelt development involves pits of 0.3 m x 0.3 m size with a spacing of 1.5 m x 1.5 m (for the first layer), 2 m x 2 m (for the second layer), and 2.5 m x 2.5 m (for the third layer). Moreover, earth filling and manure shall also be required for proper nutritional balance and nourishment of the plant saplings. In addition to this, creepers and climbers will also be planted around the trees to regulate the area's natural insulation capacity.

B. Design Details of 15 KL water sprinkler proposed to be deployed in the mine:

Water Pump	
Type	Centrifugal Pump
Capacity	50 m^3/hr @1500 rpm and 40 m Head
Drive	Hydraulic motor through flexible coupling
Piping	
Suction	80 mm
Discharge	50 mm
Valves	Butterfly type
Sprinkling	

	Constant, pressurized sprinkling; sprinkling velocity maintained by a centrifugal pump

Fig 4.1

Sample Representative Image of Komatsu India Private Limited's Truck Mounted Water Sprinkler (Capacity: 80 KL)

Note. www.odisharay.com. Accessed 12 June, 2024

C. Design Details of ENVIS/CLOUD TECH fog cannon dust suppression systems:

The dust suppression system utilizes a nozzle system capable of both manual and automatic water mist adjustment. This allows for real-time optimization based on on-site airborne dust conditions, ensuring efficient dust suppression.

i. The system is fitted with a booster pump integrated in the machine for developing adequate pressure at the nozzles. Flow rate of the booster pump is 3.0 to 6.0 m^3/hour.

ii. The system is fitted with required number of nozzles and fan motor of 25 KW rating, to get the required throw of 70 m under no wind conditions covering an area of approximately 500 m^2 in a fixed position.

iii. The system rotates ~ 0° to 300° and above for all round spraying with a provision to

set the degree of rotation as per the site requirement. Provision is also available to set the rotation of the system in automatic mode at the local control station and with wireless control station, about 100 m away.

iv. The system is equipped with a facility for barrel titling from -100 to 450 (+/- 50) from the horizontal for spraying at 15 – 25 m height.

v. The machine is provided with a pressure gauge to measure the pressure developed at the nozzles end and a flow meter for actual measurement of water consumption/hour.

vi. The machine is trolley mounted (with provision for towing).

vii. The size of the water molecule in the mist arrests dust of ~40 microns size particle.

viii. The machine operates with minimal water consumption.

A Fog Cannon Dust Suppression System is shown below in **Figure 4.2**.

Fig 4.2

Sample Representative Image of the proposed Fog Cannon Dust Suppression System

Note. www.cloudtec.in. Accessed 12 June, 2024

D. Design Details of Personal Dust Samplers (PDS)

Traditional dust monitoring methods struggle to accurately assess worker exposure in mines due to constant worker movement throughout their shifts. Personal dust samplers address this challenge by providing a portable, light-weight, battery-powered solution for measuring both total dust and respirable dust particles over an entire 8-hour shift.

They are equipped with GLA-500 PVC membrane filters to assess airborne respirable dust concentrations at various locations within the mine. Studies have revealed that a combination of good ventilation and wet drilling practices effectively controlled dust levels in certain areas in underground and opencast mines. However, other locations required alternative measures, such as worker rotation schedules, to manage dust exposure. Design specifications and other technical details of a Personal Dust Sampler are given below:

i. Either one of the two DGMS Approved Personal Dust Sampler shall be approved for use in this opencast mine, namely: **Personal Dust Sampler model Side Kick-51MTX with NiMH battery pack** and/or **Personal Dust Sampler model CIP-10**
ii. It is a compact, light-weight, and handy device and has a portable carrying case,
iii. It is attached to the worker through a belt and clip during working hours and does not hinder his/her day-to-day activities performed during the course of the shift,
iv. It is capable of continuous sampling for a minimum of 8 hours (1 working shift), while maintaining a constant flow rate throughout the sampling period,
v. It is designed to capture respirable particulate matter that a mine worker may inhale during his/her shift inside the mine. It also allows for the calculation of the particulate matter concentration in mg/m^3, providing valuable data to assess an individual's exposure level.
vi. The flow rate can be maintained as per the breathing rate of the worker. For measuring the respirable fraction of dust, a separate cyclone can be attached to the sampler. The cyclone is designed for a cut off of particle size of 5µm as recommended by the DGMS. Glass fibre filter of 37 mm diameter is used for sampling. The air after passing through the cyclone gets deposited over the filter

paper. The filter paper can be analysed further to determine the constituents of dust.

vii. The device can perform efficiently within a temperature range from 5 - 40°C and 0-95% RH,

A Personal Dust Sampler is shown below in **Figure 4.3**.

Fig 4.3

Personal Dust Sampler (Model: APM 800)

Note. https://envirotechindia.com/. Accessed 12 June, 2024

4.3.1.3. Proposed measures to conserve energy

As of 2024, there are no LNG/CNG refuelling stations in the vicinity of the mine lease area or within the project state of Meghalaya. Hence, currently there is no possibility to substitute any of the mining machineries and/or trucks with LNG/CNG fuel. However, some energy conservation measures, as detailed below may be adopted in the mine after conducting comprehensive cost-benefit analyses and audits within one year of restarting of mining operations. The measures are listed as follows:

i. **Installation of re-winded/old and conventional motors with energy-efficient motors:** By minimizing internal energy losses, Energy Efficient Motors (EEM) achieve significantly higher operating efficiency. Key design enhancements include: utilizing

superior magnetic materials, maximizing core volume, reducing electrical resistance through thicker conductors, employing thinner laminations, optimizing air gap dimensions, adopting copper rotor bars, and incorporating advanced bearing and cooling systems.

Indian EEMs consistently surpass standard motors by 3-4 percentage points in efficiency. Aligned with Bureau of Indian Standards (BIS) regulations, these motors maintain peak efficiency across a 75-100% load range, offering substantial benefits in variable load applications. Power factor typically matches or exceeds that of standard motors.

4.4. IMPACT AND MEASURES FOR MININIMIZING/NULLIFYING THE EFFECTS ON AMBIENT NOISE LEVELS AND GROUND VIBRATIONS

4.4.1. Impacts due to noise generation

During mining operations, various machinery (HEMMs) and transport vehicles are expected to contribute to the generation of noise. As distance from the noise source increases, the noise level naturally decreases due to the spreading of sound waves. Additionally, atmospheric conditions and interactions with surrounding objects further contribute to noise reduction along transmission paths. The machinery and other equipment intended for use in the mine shall serve as sources of noise input. Noise generation is assumed to occur at a height of 1 meter above ground level and spread over flat terrain without any obstacles.

In this mine, factors such as undulating terrain, vegetation, mine structures, and atmospheric conditions like air absorption, wind, temperature, and humidity will act as important noise obstructions. Despite this, the projected noise levels are expected to remain within the national CPCB standards, indicating that the project's impact on ambient noise levels in the study area, if any, shall be minimal. Having said that, the main sources of noise pollution in the mine may be due to the following:

i. Mechanization of the mine
ii. Operation of diesel-powered machines such as DG sets, water withdrawal pumps, drilling machines, dumpers, excavators, etc.

iii. Blasting

iv. Truck movements

4.4.1.1. Physiological impacts due to noise exposure

Noise pollution presents a significant health hazard to individuals employed in mining operations. The detrimental effects of noise pollution depend not only on the intensity and frequency of the sound but also on the duration of exposure and the individual's age. Thus, prolonged exposure to high noise levels can significantly impact the health of workers. Those working for more than 4-4.5 hours per shift at active working faces in the mine are at risk unless appropriate mitigation measures are implemented. The adverse effects of prolonged exposure to high noise levels may include annoyance, hypertension, fatigue, permanent hearing loss, high blood cholesterol, and other related health issues.

Table 4.2: Permissible limits of noise levels (in Db(A) Leq)

Area Code	Category of Area/Zone	Limits in dB (A) Leq*	
		Day Time	Night Time
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silence zone	50	40

Note:

1. Day time shall mean from 6.00 am to 10.00 pm
2. Night time shall mean from 10.00 pm to 6.00 pm

*(**Source:** Schedule, The Noise Pollution (Regulation & Control) Rules, 2000)*

4.4.2. Noise levels in and around proposed project site

The baseline noise data indicates that the values in core zone as well as in buffer zone are well within the CPCB prescribed limits for respective zones. Most of the mining machineries will work only in the quarry which is below ground level. Hence, the noise generated inside the quarry will not propagate to the surface. Moreover, the proposed overburden dumps will act as a barrier for noise propagation to the nearby village areas. There may be minimal increase in the background noise levels due to the proposed mine due to plying of HEMM and other associated mining operations.

4.4.3. Impacts due to the generation of ground vibrations

Ground vibration, fly rock, air blast, noise, dust and fumes are some of the negative effects of blasting on environment. The explosive energy sets up a seismic wave in the ground, which may cause significant damage to structures and disturbance to human occupants. It can cause major damages to the pit configuration too. When an explosive charge is fired inside the blast hole, it is instantly converted into hot gases, which exert intense pressure on the blast hole walls. High intensity shock waves propagate radially in all the directions and cause the rock particles to oscillate. This oscillation is felt as ground vibration. The existing mining operations using deep hole drilling and blasting using delay detonators produce ground vibrations. Blasting, in addition to easing the hard strata, generates ground vibrations and instantaneous noise. Ground vibration from mine blasting is expressed by amplitude, frequency and duration of blast.

The oscillation of rock particles is called Particle Velocity and its maximum value is called Peak Particle Velocity (PPV), which is measured in mm/s. As the distance from blast site increases, the PPV value is likely to reduce. The ground vibration generated by blasting during the mining operations will be within the standards prescribed by DGMS by adopting controlled blasting technique including suitable blast design.

Anticipated ground vibration resulting from mining operations in the region may stem from the operation of various machinery such as excavators, drilling and blasting equipment, as well as heavy transportation vehicles. However, blasting shall emerge as the primary source of ground vibrations from this mine. The most noticeable effects of these vibrations may be observed on residential houses in the villages surrounding the mining lease area, in this case, the villages and vicinity of Thanghuai and Nongtalang. Hutments are particularly susceptible to cracking and damage caused by the ground vibrations induced by blasting, whereas reinforced concrete framed structures exhibit greater resilience. Consequently, ground vibrations may instill a sense of discomfort among residents of the nearby village communities. Another environmental impact of blasting activities may be the potential occurrence of fly rocks. These rocks pose risks of injury to individuals or animals, as well as infrastructural damage. Moreover, blast induced ground vibration may create socio-economic problems for the mine workers as well as the people residing in vicinity of these mines. As only 20-30% of energy of commercial explosives used in the

mines is utilized for fragmenting the rock, the rest of energy is transmitted through the earth in the form of ground vibrations resulting in damage to the surrounding structures *(Directorate General of Mines Safety, Circular No. 7, 1997, pg. 1)*.

The maximum explosive charge per delay that can be used for blasting, without causing any significant ground vibration in the nearby villages in the proposed mine are calculated using the following empirical equation.

The empirical equation used for assessment of peak particle velocity (PPV) is:

$$V = 417.8 \{D/ (Q^{0.5})\}^{-1.265}$$

Where

V = Peak particle velocity in mm/s

D = Distance between location of blast and gauge point

Q = Quantity of explosive per blasting

Table 4.3: Permissible Peak Particle Velocity (PPV) at the foundation level of structures in mining areas in mm/s

Type of Structure	Dominant Excitation Frequency, Hz		
	<8 Hz	**8-25 Hz**	**>25 Hz**
A. Buildings / Structures not belonging to owner Domestic houses / structures (Kuchha brick and cement)	5	10	15
Industrial buildings (RCC and framed structures)	10	20	25
Objects of historical importance and sensitive structures.	2	5	10
B. Building belonging to owner with limited span of life			
Domestic houses / structures (Kuchha brick and cement)	10	15	25
Industrial buildings (RCC and framed structures)	15	25	50

*(**Source:** Director General of Mines Safety (DGMS) circular 7 of 1997)*

4.4.4. Measures against Noise Pollution and Ground Vibrations

4.4.4.1. Measures against Noise Pollution

The noise within the mine shall be maintained at levels that adhere to the occupational noise exposure limit set by the CPCB. To achieve this, implementation of the following approaches for noise reduction have been proposed:

i. Prevention at source

i. Isolation of source

The following noise control measures are proposed to be taken to mitigate unwanted noise pollution that may generate from various mining operations:

i. In this project, it has been proposed to implement controlled blasting methods employing millisecond delay detonators and relay systems to reduce both noise levels and blast vibrations.

ii. Any adverse effects that may arise due to secondary blasting can be mitigated through careful consideration of blast design, spacing, and burden management.

iii. Careful planning of blast timings keeping factors such as favourable atmospheric conditions, and mine working timings in mind.

iv. Greenbelt development in three rows in and around the mine lease area.

v. Avenue plantation along the mine transport roads.

vi. Engines of HEMM and other mine machinery and transport vehicles shall be properly maintained to reduce noise generation. Provision of incorporating silencers into the dumpers and other vehicles shall be suggested to control noise propagation.

vii. Shift timings shall be stringently supervised by the Site Manager/Engineer to prevent overexposure of the workers to high noise levels. A separate budget shall be kept for quarterly health check-ups of all the workers which shall also include audiometric tests.

viii. All workers operating HEMM in environments with noise levels exceeding 90 dB(A) shall be equipped with protective gear such as earplugs, and earmuffs. Additionally, soundproof and dustproof cabins shall be installed in machinery such as dozers, shovels, dumpers, feeder breakers, etc.

4.4.4.2. Measures against Ground Vibrations

The following precautions are proposed to be implemented to control and mitigate ground vibrations/noise as a result of blasting activities, movement of Heavy Earth Moving Machinery (HEMMs), etc.:

Blasting Techniques:

i. **Optimized Blast Design:** The pattern of initiation and firing affects the fragmentation and muck profile of the blast. Blasting patterns shall be optimally designed with minimal explosive use, proper burden and spacing of holes, and precise detonation sequencing. This reduces the energy transmitted to the ground.

ii. **Pre-splitting:** Shallow holes may be drilled along the perimeter of the blast zone and detonate them before the main blast. This creates a clean fracture, reducing the vibration transmitted to surrounding areas.

iii. **Controlled Blasting Techniques:** Use of techniques like cushioned/muffled blasting, air decking, and half second/millisecond delays to minimize the peak particle velocity (PPV), the primary measure of ground vibration intensity.

iv. **Nonel Initiation Systems:** Employing Nonel (Non-electronic) detonators instead of detonating cord for improved control over the detonation sequence, leading to reduced vibration and noise.

v. **Proper detonation and initiation of charge:** In order to ensure uniform fragmentation thus, resulting in better vibration-controlled vibrations, the proper distribution of explosive charge in the borehole shall be ensured. Normally the major portion of the explosive charge is placed in the bottom of the hole, where the confinement of the explosive is greatest and it has to do maximum work. A combination of high density and medium density explosives help to distribute the explosive energy.

vi. **Decking** is also practised for spacing of the explosive charge more uniformly in the hole. After the bottom charge (usually 1.3 times the burden), the balance quantity of explosives is distributed as decks separated by stemming material. Decking is also required where the strata has alternating hard and soft bands. A Cordtex detonating fuse shall be normally used for initiating the explosive charge.

vii. **Secondary Blasting:** Secondary blasting may be carried out to break any oversized boulders, produced during the primary blast to a size suitable for transportation/as per need. Pop Shooting/Plaster shooting shall be employed in this regard. However, the breaker will be a better alternative if available as no further explosives are required and generation of lesser noise.

viii. **Stemming:** Improper confinement of explosive leads to wastage of explosive energy and unregulated vibrations. As such the importance of stemming (packing) cannot be over emphasised. By normal practise, the drill gummings shall be used for stemming as they are readily available at the hole collars. A stemming length of about 0.7-1.1 times the burden is usually optimum. However, stemming length would depend on the nature of strata and the point of initiation of the charge.

ix. **Inclined Holes:** Inclined drilling, with the angle of inclination varying between 10° - 40° with the vertical, produces lesser vibrations due to blasting and an increased blasting efficiency. Difficulties caused due to back break in vertical holes are eliminated due to increased burden and spacing and the bench height can be increased while reducing the haulage levels.

Machinery and Operations

i. **Selection of Equipment:** Machinery to be chosen suited to the task size. Larger machines that may lead to more ground disturbance may not always be necessary.

ii. **Proper Maintenance:** Machinery to be regularly maintained to minimize noise generation and ensure smooth operation, reducing ground vibrations.

iii. **Haul Road Management:** Haul roads to be maintained properly to minimize bumps and vibrations caused by uneven surfaces.

iv. **Speed Limits:** Speed limits to be ensured for haul trucks and other heavy machinery to reduce ground impacts.

Monitoring and Mitigation

i. **Vibration Monitoring:** Ground vibrations to be continuously monitored during blasting to ensure they stay within permissible limits set by regulatory bodies.

ii. **Noise Monitoring:** Noise levels to be regularly monitored complying with regulations and minimize noise pollution.

iii. **Buffer Zones:** Buffer zones to be established around blasting areas to limit the impact on nearby structures and communities.

iv. **Community Communication:** To keep the neighbouring communities informed about blasting schedules and take steps to minimize disruption.

Additional Considerations

i. **Worker Training:** Workers may be trained on proper blasting procedures and safe operation of machinery to minimize environmental impacts.

By implementing these mechanisms, the proposed Thanghunai Limestone Quarry can significantly reduce ground vibrations and noise from blasting and machinery operations, creating a safer and more sustainable work environment for miners and minimizing the impact on surrounding communities.

4.4.4.3. Measures to control Fly rocks

Although there are a large number of factors that can influence fly rocks such as an irregular shape of the working face, presence of loose gravel and/or rocks on the face, long water columns in holes, etc. Thus, to minimise and mitigate the risks associated with the generation of fly rocks, the following preventive measures have been proposed:

i. Muffled blasting
ii. Dozing of loose boulders
iii. The region within a 200-500 meter radius of the blasting zone will be designated as a hazardous area/danger zone, demarcated by red flags or other suitable signage. Unauthorized access to this zone will be strictly prohibited during blasting activities.

iv. To safeguard the mine workers involved, blasting shelters will be made available near the blasting sites to offer protection during the process.

v. A warning sound will be sounded fifteen minutes prior to the actual blast, allowing individuals to evacuate the danger zone.

4.5. IMPACT ON WATER QUALITY

4.5.1. Impact of the proposed project on surface and ground water regime of the area due to mining

4.5.1.1. Topography and drainage

The area around the block represents a gently rolling topography. Karst Topography is prevalent with spiky surfaces with lots of sink holes and solution cavities. In the proposed block, elevation difference is noted from 709 meters to 719 meters. In a Regional Scale the area forms a part of the Meghalaya Plateau exposing geological milieu representing Precambrian to Tertiary sequence in this part of West Jaintia Hills District of Meghalaya. The Umngot River is about 3 Km NW from the Mine Lease area and flowing NE-SW.

4.5.1.2. Impact on surface water regime

The study area is not crossed by any large surface water channel/nallah. Some important surface water quality parameters that were examined in the baseline data were pH, DO, BOD, and total coliforms, in accordance with the CPCB water quality requirements. The surface water samples were found to have DO values ranging from 7.2 mg/L to 7.7 mg/L, whereas BOD was consistently determined to be less than or equal to 3.2 mg/L.

Problems of high suspended solids in mine water have been found as a matter of concern, which need to be treated through physical and chemical processes. Suspended solids can be removed by sedimentation.

It is expected that a greater concentration of suspended materials is probably what will have an effect on the surface water quality. The overburden dump area shall be designed, contoured, capped, and graded appropriately to avoid any runoff and soil erosion.

Moreover, in order to manage the influx of water in the rainy season (generally from June – October in Meghalaya), provisions of garland drains shall be made as follows:

i. **Near overburden dumps and stackyard:** Garland drains shall be constructed in and

around the overburden dump and stackyard so that the wash-off is re-coursed into the settling tanks. The overflow shall be further discharged for adequate treatment in the proposed ETP.

ii. **Near the working face/active area:** At any time, the method of extraction of mineral will be carried out in a dip-rise manner. During heavy rainfalls, the mine will remain closed and water accumulated at the dip end of the quarry shall be pumped out, as necessary to prevent rain water percolation and will be directed through the garland drains towards the settling tanks.

iii. **In non-working areas:** During periods of heavy rainfall in such areas, the natural topographical drainage pattern of the area shall remain untouched unless leading to the working areas of the mine. In such cases, garland drains shall be made to intercept and recourse any wash-off that may otherwise, flow into a nearby surface water channel/nallah/catchment area.

4.5.1.3. Impact on ground water regime

Information on ground water hydrogeology available with the *Department of Water Resources, Government of Meghalaya and Central Ground Water Board, State Unit Office, Shillong* are summarized in **Table 4.4** below.

Table 4.4: Hydrogeology of Meghalaya

Age	Group	Formation	Lithology	Hydrogeological Conditions	Yield (m^3/hr)
Pleistocene to Holocone	Newer (Recent) and Older Alluvium		Unconsolidated Sediments Sand, silt and clay	Thick, continuous aquifer in the western, northern and southern fringes of the State. Ground water occurs under unconfined to semiconfined conditions; Depth to water level rests at 3 to 5 m BGL (metres below ground level)	30-100
Mio-Pliocene		Duptila	Mottled clay, sandstone, shale and conglomerate	Thick, discontinuous aquifer encountered down to 250 m BGL in the West Garo Hills area.	25-150

				Groundwater occurs under semi-confined to confined conditions; Depth to water level rests at 4 to 9 m bgl	
Oligo-Miocene	Garo group	Chengapara	Coarse sandstone, siltstone, clay and marl	Thick, discontinuous aquifer encountered down to 250 m BGL in the West Garo Hills area. Groundwater occurs under semi-confined to confined conditions; Depth to water level rests at 4 to 9 m BGL	
		Baghmara	Coarse sandstone, conglomerate, silty clay and fossiliferous limestone		
		Simsang	Fine sandstone and alternation of siltstone-mudstone		
Eocene-Oligocene	Barail group	----------	Coarse sandstone, shale, minor coal lenses carbonaceous shale		
Palaeocene-Eocene	Jaintia group	Kopili	Shale, sandstone, marls and coal	Discontinuous aquifer in the cavernous limestones and sandstones area. Groundwater occurs under unconfined to semi-confined conditions; Depth to water level rests at 2 to 4 m BGL	5-15
		Shella	Alternation of sandstone, limestone		
		Langer	Calcareous shale, sandstone, limestone		
Upper Cretaceous	Khasi Group	Mahadek	Arkosic sandstone (Glauconitic)		
			Conglomerate		
		Jadukata	Conglomerate/sandstone		
Paleo-Meso Proterozoic	Shillong Group		Quarzite, phyllite, quartzsericite schist, conglomerate	Aquifer formed by weathered and fractured zones extending down to 150 m BGL. Groundwater occurs under unconfined to semi-confined conditions; Depth to water level rests at 7 to 17 m	2-10
Archaean - Proterozoic	Meghalaya Archaean Gneissic Complex		Granite gneiss, Biotite gneiss, mica schist, silliminite-quartz schist, pyroxene granulite, gabbro & diorite, acidic and basic intrusives		

*(**Source:** Department of Water Resources, Government of Meghalaya & Central Ground Water Board, State Unit Office, Shillong, 2022)*

Ground Water Resources Estimation Methodology (2015)

Ground Water Resource Estimation based on Ground Water Resource Estimation Committee Report (GEC – 2015) is the current approach utilised for groundwater resource evaluation for the district of West Jaintia Hills in Meghalaya which covers an area of 1693 km^2 *(West Jaintia Hills District | Govt. of Meghalaya | District Administration | India, n.d.)*. These computations are taken from CGWB's Report titled *"Dynamic Ground Water Resources, Meghalaya (As of March, 2022)"* that have been calculated for the year 2021-2022 (1st June, 2021 to 31st May, 2022).

Table 4.5 – Status of GW Recharge, Annual Extraction & Allocation and Net Availability in West Jaintia Hills, 2022

DYNAMIC GROUND WATER RESOURCES OF INDIA, 2022														
MEGHALAYA (in Hectare Metre – Ham)														
District	Ground Water Recharge					Total Natural Discharges	Annual Extractable Ground Water Resource	Current Annual Ground Water Extraction				Annual GW Allocation for Domestic use as on 2025	Net GW Availability for future use	Stage of Ground Water Extraction (%)
	Monsoon Season		Non-Monsoon Season		Total Annual Ground Water Recharge			Irrigation	Industrial	Domestic	Total			
	Recharge from rainfall	Recharge from other Sources	Recharge from rainfall	Recharge from other Sources										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
WEST JAINTIA HILLS	10675.48	3.26	4589.84	7.51	15276.09	1527.61	13748.48	8.5	10	595.31	613.81	679.77	13050.21	4.46

(***Source:*** *Department of Water Resources, Government of Meghalaya & Central Ground Water Board, State Unit Office, Shillong, 2022)*

Table 4.6 – Categorization of GW Quality in West Jaintia Hills, 2022

DYNAMIC GROUND WATER RESOURCES OF INDIA, 2022											
MEGHALAYA											
District	Total No. of Assessed Units	Safe		Semi-Critical		Critical		Over-Exploited		Saline	
		No.	%	No.	%	No.	%	No.	%	No.	%
WEST JAINTIA HILLS	1	1	100.0	–	–	–	–	–	–	–	–

As of 2022, the stage of groundwater extraction in the project district, i.e., West Jaintia Hills was 4.46% ≈ SAFE Category as per the quantity-based categorization of the GEC – 2015 Report.

Thus, the impact of mining on the local groundwater regime depends upon such features of the mine as the depth and rate of expansion, rate of groundwater recharge and level of groundwater extraction from the mine lease area, and other hydraulic attributes of the aquifers below the project area. It is important to mention here that there will be no groundwater extraction from within the project area of 3 Ha. to meet any of the daily water demand of the project. It is so proposed that from the average quantity of water that shall be pumped out from this mine due to rainwater seepage and wash-off, a significant portion shall be utilised and recirculated to meet the daily mine water requirements. Potable drinking water shall be sourced from nearby rivers and delivered to the mine by water tankers.

After the end of mining operations, rainwater percolation/infiltration will increase and the water levels quickly get recharged in a short time. Upon completion of the mine, the empty space in the dip-side area will progressively fill with surface run-off and rainfall, forming a useful reservoir that will continuously replenish the groundwater regime and raise the water levels within the radius of influence (ROI) surrounding the mine.

4.5.2. Measures against Water Pollution and Depletion

Water from the stratum leaks into the quarry area during quarry operations and is pumped out as mine discharge. A portion of the mine's discharge water will be used to meet project water requirements, such as those for plantation irrigation, dust control, and cleaning HEMM. Other sources of water pollution are surface run-off during heavy rains, mine effluent, and sewage. Some control measures against water pollution are as follows:

i. Garland drains of appropriate sizes and lengths shall be made and maintained till the end of LoM (12 years) along the overburden dump and quarry area to keep any surface run-off away from the nearby areas of Thanghunai and Nongtalang, and surface water bodies/vegetated areas, etc.,

ii. A Rainwater harvesting tank of appropriate size is in place to store excess rainwater during the rainy seasons, which shall ensure ground water sustainability in and around the mine lease area,

iii. The Rainwater Harvesting structure shall be designed and implemented based on the recommendations suggested by the Central Ground Water Board's State Unit Office in Meghalaya. Details of the proposed Rainwater Harvesting scheme in the mine are given as **Annexure 12** of this report,

iv. In order to control soil erosion and siltation into natural water bodies, various measures such as settling tanks, gabion walls, check dams, and sufficient size and length of garland drains are suggested. These measures are proposed based on the rainfall patterns in the area, the general ground profile, the proposed profile of internal dumps, the quarry surface, and other parameters.

v. The overburden dump shall be designed in such a manner so as to avoid surface run-off water along its slopes. This shall be achieved by developing overburden bench terraces that slope inward and have deck drains to check the run-off at pre-determined slope intervals,

vi. Grass cover shall be developed along the backward slopes to minimise any surface run-off and consequent soil loss (*Widomski & Marcin, 2011*),

vii. Water accumulated in the dip-side of the active quarry area due to rain as well as seepage shall be regularly pumped out and directed to the Effluent Treatment Plant (ETP),

viii. The water collected from washing HEMMs shall first be collected and then treated in the ETP. The treated water shall then be re-used for cleaning and washing of HEMMs, dust control, and plantation – maintaining the principal of Zero Liquid Discharge (ZLD),

ix. The sewage generated in the mine shall be in small quantities and treated in septic tanks followed by soak pits as detailed in the Govt. of India's *Central Public Health and Environmental Engineering Organisation's (CPHEEO) Advisory Manual on On-Site and Off-Site Sewage Management Practices, 2020*.

x. Surface and ground water qualities shall be monitored regularly.

4.5.2.1. Details of mitigation measures against surface run-off

Surface run-off is one of the major sources of water pollution that can contribute to siltation in the natural water bodies, increase in values of Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Turbidity, pH, etc. Precipitation in the area either recharges into the ground, evaporates or forms run-off. The run-off factor can be taken as 0.2 in the open land.

Based on the rainfall intensity, frequency, and patterns in the area, profile of the ground, proposed profile of external dumps, quarry surface, other parameters, sufficient size & length of garland drains along with toe walls/earthen embankments, settling ponds, greens in between, gabion walls, rock flow dynamics, and check dams are proposed to control the soil erosion and siltation into the natural water bodies.

The external dumps are designed in such a way so to avoid the run-off along the slopes of the external dumps by backward sloping of the terraces (at 27°-28° to the horizontal), deck drains and safe disposable drains at predetermined intervals. The schematic diagram of the disposal of run-off along the overburden dump is given in **Figure 4.4** below.

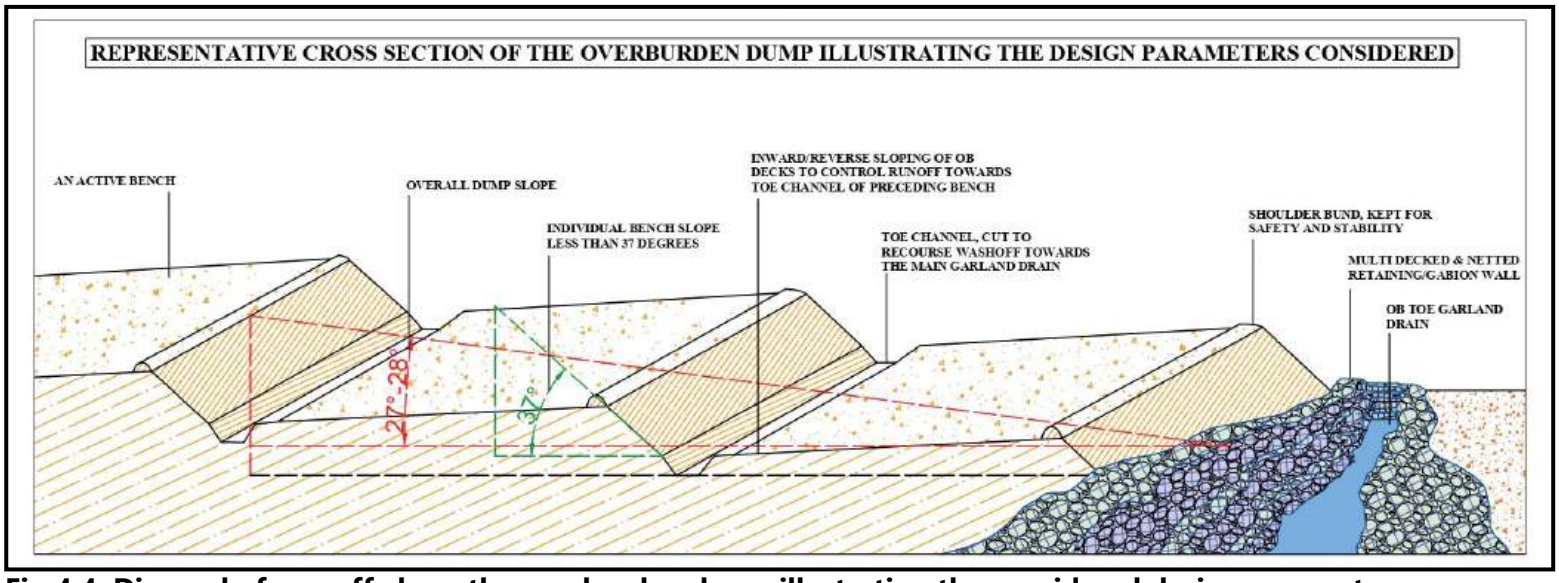


Fig 4.4: Disposal of run-off along the overburden dump illustrating the considered design parameters

4.5.2.2. Scheme for Rainwater Harvesting for Groundwater Recharge

A detailed proposal for Rainwater Harvesting and Artificial Recharge to Groundwater is given as **Annexure 12** to this report.

Development and Conceptual plans in the approved Mining Plan include the design and schematic diagram of the proposed garland drain surrounding the external dump, the retaining wall, border planting, etc. for controlling siltation and arresting the eroded material, if any. Thus, taking into consideration the above points and their **stringent implementation**, it may be concluded that the surface and ground water regimes in this area will not have any adverse negative impacts. In the unlikely event of any adverse impact on the water regimes of the surrounding areas, the project proponent will take strict and immediate action to address the issue.

4.6. IMPACT ON LAND ENVIRONMENT

4.6.1. Impact of the proposed project on land environment of the area

The total land requirement for the project is 3.00 Ha. During opencast mining, some amounts of overburden (gritty soil) will have to be rehandled and removed to facilitate extraction of the mineral. As a result, the landscape and terrain of the project area will change during operation-stage activities such as excavation, dumping of overburden, infrastructural developments of temporary structures and offices, approach roads and service facilities, etc. Initially, some natural vegetation of the area was damaged during the initial period of 5 years of mining operations which have been eventually be restored by stage-wise plantation activities in a progressive manner. Details of existing land-use, during mining land-use (next 5 years), and end of LoM land-use (end of 12 years) are furnished in the **Table 4.7**.

Table 4.7: Present Land-Use of the project

Existing Land Use Pattern		
S. No.	**Category**	**Area in Ha.**
1	Mined-out land including road	0.84
2	Greenbelt in Safety Barrier	0.24

3	Dump with parapet wall and garland drains	0.20
4	Balance unused area	1.72
Total		**3.00**
Land Use Pattern after 5 Years Plan Period		
S. No.	**Category**	**Area in Ha.**
1	Mined-out land including road	2.23
2	Greenbelt in Safety Barrier	0.28
3	Dump with parapet wall and garland drains	0.07
4	Balance unused area	0.42
Total		**3.00**
Land Use Pattern after Life of Mine		
S. No.	**Category**	**Area in Ha.**
1	Mined-out land including reclamation	2.44
2	Greenbelt (within Safety Barrier)	0.56
3	Balance unused land	0.00
Total		**3.00**

4.6.2. Measures against Land Degradation

The Land Use pattern in the lease area may change as a result of different phases of mining operations. Land reclamation shall be done along with ongoing mining operations in order to minimise the negative consequences. After the end of mining operations, approx. 0.56 Ha. of land within the safety barrier of the mine lease area shall be developed into a dense greenbelt, and the remaining backfilled areas and OB benches will be revegetated by plantation activities which will be taken up by the project proponent, any remaining void of land shall be converted to a water body – which may act as a potential source of surface water and recharge for ground water in the future for the neighbouring communities (*Sengupta, 2015*).

The following measures are proposed to be undertaken in the project:

i. Plantation of approximately 0.56 Ha. of the project area (within the safety barrier) and additional plantation over the backfilled area of the mine with native, high APTI species that are resistant and self-sustaining,

ii. Topsoil excavated from the site shall not be mixed with the overburden and shall be dumped separately at predetermined locations apropos to the greenbelt development/plantation activities, and

iii. Simultaneous back-filling of the mine voids during the ongoing mining operations.

iv. Overburden (OB) will be managed as per the approved Mining and Mine Closure Plan of Thanghunai Limestone Quarry and has been indicated in **Section 2.7 of Chapter 2**.

4.7. IMPACT ON ECOLOGY AND BIODIVERSITY

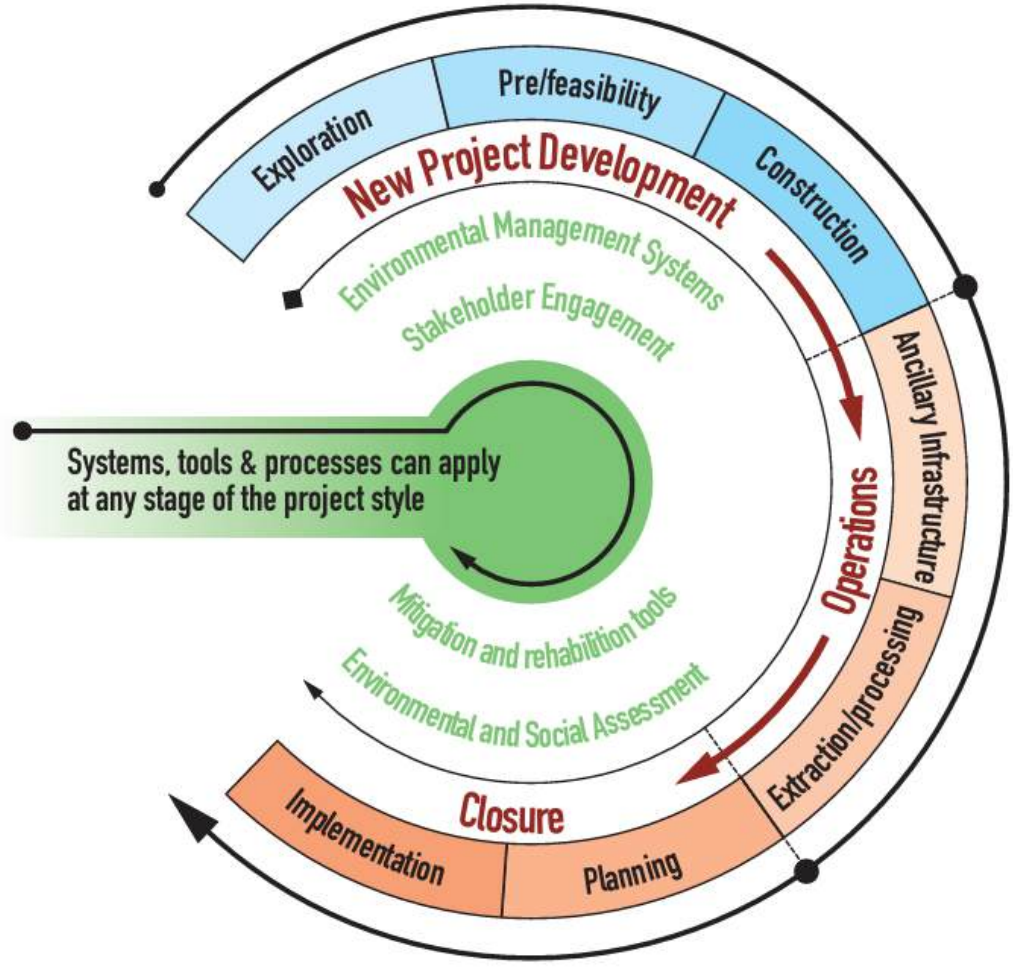
4.7.1. Impact of the proposed project on ecology and biodiversity within the core and buffer areas

This section examines the challenges posed by mining to the ecology and biodiversity in the surrounding environment. All mining activities including limestone mining are site-specific. Ores and minerals cannot be moved to another location and thus, have to be quarried from wherever the mineral deposits occur. From the point of view of the mining industry, its activities are economically and environmentally risky. They are dependent on the fluctuations and flows of the global economy. The site-specific and regional impacts vary significantly depending on the local characteristics of the environment, on the mining activity type, on the geology, and on the ore that is mined (Mononen et al., 2022).

To minimize harm to biodiversity and surrounding communities, the mitigation strategies prescribed in this section involve implementing protective measures. These measures aim to prevent negative impacts from mining activities altogether. However, if complete prevention is not achievable, such mitigation measures have been suggested that focus on decreasing the severity of these impacts to an acceptable level.

Fig 4.5

Integrating biodiversity into the mining project cycle



Note. From Good Practice Guidance for Mining and Biodiversity, by Sally Johnson, 2006, London, UK: International Council on Mining and Metals (ICMM). Copyright 2006 by www.icmm.com.

4.7.1.1. Core Area:

There is no forest area and/or wildlife inside the core area of this project.

4.7.1.2. Buffer Area:

As per the Land-Use Land Cover Map of the 10 km radius study area around the mine lease boundary, there is 19165.34 Ha. of vegetation area around the project classified under tropical evergreen and secondary cultivated vegetation (*Flora of Jowai and vicinity Meghalaya – Botanical Survey of India*). Also, there is no Protected Area and/or Ecologically Sensitive Zone (ESZ) in the buffer zone of the project.

Thus, taking into consideration the above points and the fact that the mining lease area is comparatively small, it may be concluded that the ecology and biodiversity in the study area will not have any significant negative impact as a result of this mining project.

4.7.2. Measures to nullify any impact on the vegetation within the core and buffer areas

Although the mine lease area does not have any forests, portions of the study area may have tropical evergreen vegetation (*Flora of Jowai and vicinity Meghalaya – Botanical Survey of India)*. Hence, the following safeguards shall be undertaken to protect any such vegetation:

i. Avenue Plantation: Avenue plantation is proposed to be taken up in the non-forest areas falling within a 5 km radius from the mine lease area with native plant species such as *Ficus* sp., *Clerodendrum colebrookeanum*, *Acacia auriculiformis*, etc.

ii. Plantation of angiosperms (flower and fruit bearing plants) shall be taken up to attract different types of fauna such as arthropods, reptiles, aves, and mammals.

iii. Muffled blasting techniques along with other noise and ground vibration mitigation measures shall be used to ensure negligible impact on the the surrounding ecology and biodiversity,

iv. Regular water spraying on dust generating areas such as transport points, approach and haul roads, overburden and topsoil dumps, stackyards, etc. to avoid the accumulation of fugitive dust and other pollutants on trees in the nearby areas,

v. In order to preserve the hydrological equilibrium in this area, mine water shall be effectively utilized for a variety of purposes, such as dust suppression, plantation, washing

of HEMMs, etc. The excess water shall be reused for groundwater recharge after channelling through settling ponds.

vi. Detailed studies on the biological environment jointly conducted by the QCI-NABET Accredited Ecology and Biodiversity team of the Environmental Consultancy Company that has prepared this report with support from the Meghalaya Forest Department indicated that there are no endangered, threatened, vulnerable, and/or endemic species in the core and buffer areas of the proposed project.

vii. A site and project-specific Greenbelt Development Plan has been prepared with support from the Meghalaya Forest Department. The same has been explained in detail in **Section 4.7.2.1.** of this chapter.

4.7.2.1. Greenbelt Development Plan

A progressive biological reclamation exercise will be undertaken to ensure restoration by means of revegetation in all areas impacted by mining operations during the backfilling of mine voids, road preparation, and rehandling of OB. A Greenbelt over 0.56 Ha. will be developed within the safety barrier of 7.5 meters (*indicated in* ***Table 4.7***)

Additionally, the reclaimed area of 2.44 Ha, will also be developed as a green cover, to restore and enhance the site's natural condition.

Therefore, more than **75.0 %**, of the 3 Ha within the block will be targeted for ecological reclamation at the end of the life of mine (LoM) and post closure period.

The proponent will also take steps towards the development of a nursery within the mine lease area to substantiate the availability of saplings as and when required; however, to develop the area of 3.0 Ha, native species will be acquired from the nearest available State Forest Nursery/Horticulture Department as well.

A list of species recommended in the afforestation / plantation programme of the Thanghunai Limestone Quarry is furnished in **Table No. 4.12**.

Table 4.12: Species recommended for plantation (will be dependent on sapling/seed availability with the nearest available Forest Range Office Nursery)

S. No.	Local Name	Scientific Name	Habit
1	Synsar	*Thysanolaena maxima*	Grass
2	Siej	*Bambusa tulda*	Grass
3	Soh-ngang	*Solanum indicum*	Shrub
4	Soh-pyrnou	*Leea asiatica*	Shrub
5	–	*Murraya koenigii*	Shrub
6	–	*Melastoma malabathricum*	Shrub
7	–	*Mussaenda roxburghii*	Shrub
8	–	*Clerodendrum sp.*	Shrub
9	–	*Croton caudatus*	Shrub
10	–	*Jatropha curcas*	Shrub
11	–	*Coffea bengalensis*	Shrub
12	Syntiew-dohmahi	*Clerodendron colebrookianum*	Shrub
13	Makor	*Zizyphus oenoplia*	Climber
14	Tyllen-dkhar	*Hibiscus macrophyllus*	Shrub
15	–	*Mucuna bracteata*	Climber
16	Banatulsi	*Ocimum gratissimum*	Shrub
17	Bti	*Toona cilliata*	Tree
18	Dieng jalong	*Sapium baccatum*	Tree
19	Dieng ngan	*Schima wallichii*	Tree

20	Dieng rai	*Michelia champaca*	Tree
21	Dieng laphiang	*Gmelina arberea*	Tree
22	Dieng song	*Erithrina indica*	Tree
23	Bai	*Duabanga grandiflora*	Tree
24	Soh-phan	*Artocarpus heterophyllus*	Tree
25	Soh-um	*Syzygium cumini*	Tree
26	Dieng lakhoit	*Callicarpa arborea*	Tree
27	Saphai	*Myrica esculenta*	Tree

4.8. SOCIO-ECONOMIC MEASURES

This project is anticipated to generate only positive socio-economic impacts on the people of the neighbouring communities. It shall harbour economic development to the project area including infrastructural and community developments.

The project proponent shall ensure that continuous efforts are made towards the enhancement and upliftment of living conditions of the mine workers, their families, and community people from the surrounding village areas. Similarly, the proposed mining operations will bring in additional indirect employment opportunities and will also bring in the medical and communication facilities within their reach.

Chapter 5 – ANALYSIS OF ALTERNATIVES

5.1. GENERAL

Analysis of alternatives seeks to ensure that Thanghunai Limestone Quarry has considered other feasible approaches, including alternative project locations, scales, technologies and processes, operating conditions, etc.

5.2. ANALYSIS OF ALTERNATIVES

5.2.1. Technology Alternatives

As per the existing mining operations, the proposed production enhancement of limestone mine shall be carried out through a semi-mechanized method in a systematic and scientific manner in line with the approved Modified Mining Plan with Progressive Mine Closure Plan of Thanghunai Limestone Quarry. It is based on the Meghalaya Minor Minerals Concession Rules of 2016 (MMMCR, 2016) and approved by the Directorate of Mineral Resources (DMR) under the administrative control of the Department of Mining and Geology, Shillong:

- The proposed method of mining is semi-mechanized mining by forming benches of requisite bench height within 6 m x 6 m. The mining operations will consist of 4 basic stages namely, removal of topsoil, drilling and blasting for fragmentation of mineral and overburden, excavation and loading by excavators, and reclamation of mined-out voids,
- The excavation will be carried out through a combination of air compressor-jackhammer drills, excavators, and blasting. Blasting will be carried out using ANFO and slurry explosives, and NONEL detonators,
- Deployment of HEMM at the project site shall be in line with applicable permit conditions from the concerned authority and the Disaster Management Plan as described in Chapter 7 of this report for disaster preparedness and fire safety,
- Progressive reclamation plan proposes the continued development of the greenbelt by systematic utilization of the excavated topsoil during the mining phases; the greenbelt shall occupy an area of 0.56 Ha. by the end of LoM and additional plantation areas shall also be developed along the haul roads and dump sites. The mined-out voids shall be used as a water reservoir and rainwater harvesting,

5.2.2. Site Alternatives

This involves an evaluation of alternative sites with respect to environmental and project attributes such as proximity to raw materials, infrastructural facilities, markets, etc. Of the initial 17 years of the project life, Thanghunai Limestone Quarry has completed 5 years. The project proponent is now applying for a re-appraisal of her project in accordance with MoEF&CC OM **F. No. IA3-22/11/2023-IA.III (E-208230) dated 28th April, 2023**. The project is mineral specific and there is an abundance of the mineral in the area.

5.2.2.1. Site Selection

The existing project site has the following advantages:

i. The ML area is a non-forest land, has no agricultural land in its vicinity or any RF/PF areas,

ii. No sensitive or protected areas are found within the study area of 10 km radius from the ML boundary,

iii. There are several villages outside the ML area but within the study area of the project, which will be economically benefitted by the project's continued operations.

Chapter 6 – ENVIRONMENTAL MONITORING PROGRAMME

6.1. SCOPE OF ENVIRONMENTAL MONITORING

An Environmental Monitoring Programme is an essential component of an EIA report for opencast mining projects in India. It serves as a roadmap for continuously assessing the environmental impacts of the project throughout its lifecycle, from pre-construction to operation and post-closure. This proactive approach ensures compliance with environmental regulations and minimizes potential environmental damage.

The monitoring programme for Thanghunai Limestone Quarry, shall entail a four-step process:

i. **Designing a data collection strategy:** This involves planning surveys and sampling protocols to systematically gather relevant environmental information for assessment of environmental status in relation to the project activities and subsequent implementation of approved environmental management plan.

ii. **Sampling and the data collection plan:** This stage shall focus on conducting the planned surveys and collecting samples according to the established protocols. Further, samples shall be processed and analysed for generating data on various aspects of environment.

iii. **Data analysis and interpretation:** Collected samples and environmental data shall be analysed to understand their significance. This analysis will help interpret the collected information and its implications for the local environment.

iv. **Environmental management reporting:** The final step involves preparing reports that summarize the collected data, analysis of results, and its interpretations. These reports are crucial for supporting informed decision-making related to environmental management practices throughout the project lifecycle.

v. **Corrective measures:** Based on obtained data, necessary corrective measures shall be taken, if needed to minimize the impacts.

Considering the environmental implications of various actions involved in the proposed opencast project, a comprehensive environmental monitoring plan has been developed incorporating various mitigation measures for prevention/control of pollution. The following details the monitoring procedures designed to evaluate the success of these mitigation measures in the EMP:

6.2. STRUCTURE OF THE ENVIRONMENT MANAGEMENT CELL (EMC)

For effective monitoring of the EMP and other environmental protection measures, a committee will be formed at the project level. This committee shall constitute of the following members:

i. Project Proponent
ii. Environmental Engineer
iii. Mine Manager/Engineer
iv. Mine Safety Officer
v. Medical Officer
vi. Allied personnel assisting the above

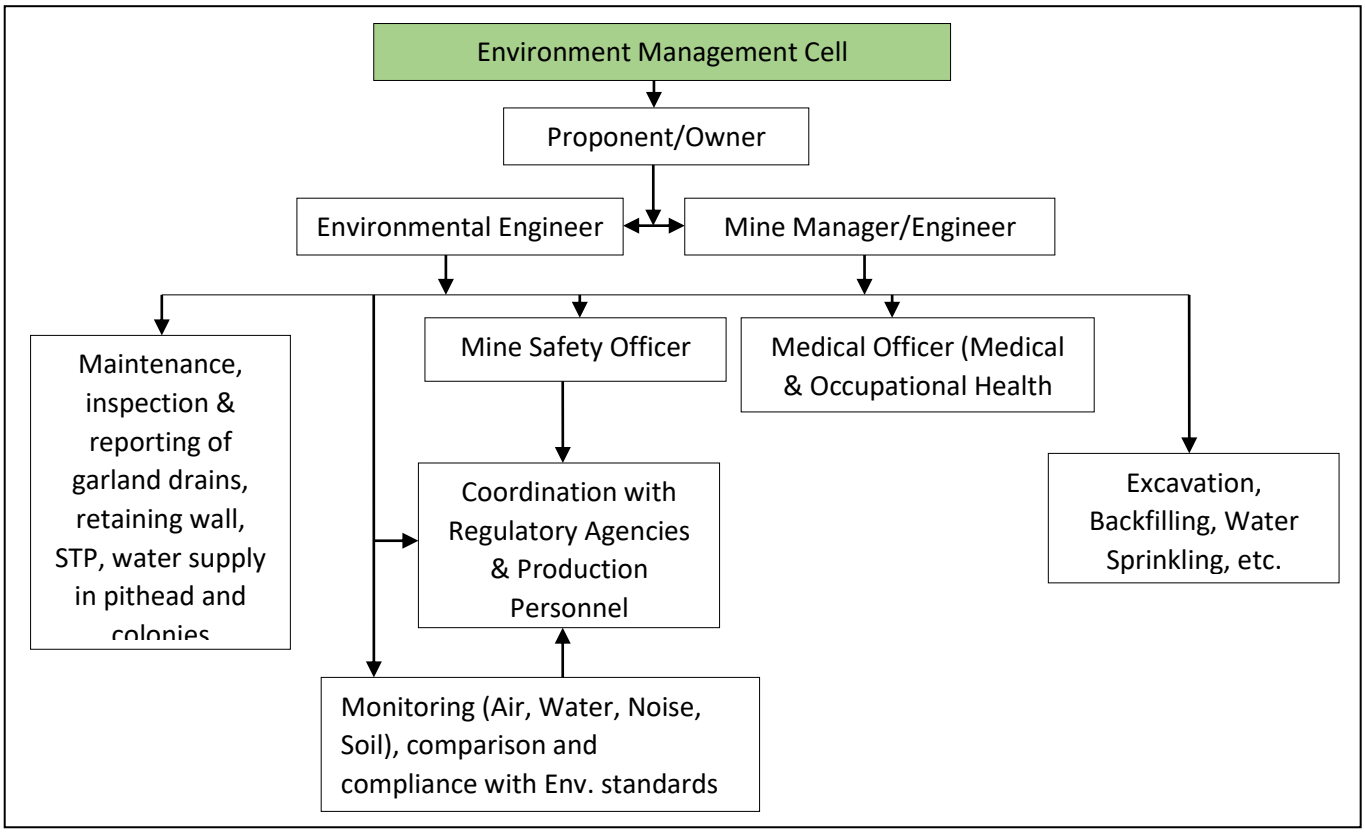


Fig: 6.1: Organizational set-up and basic functions of the Environment Management Cell (EMC)

6.3. METHODOLOGY OF THE MONITORING MECHANISM

6.3.1. Environmental Management and Monitoring

A two-tiered environmental monitoring system shall be established for Thanghunai Limestone Quarry project and its associated facilities. This system will track both project-level and area-level environmental impacts.

i. **Project Level:** Project authorities will monitor the effectiveness of various environmental protection measures such as dust suppression, effluent treatment and reuse, noise and vibration control, equipment maintenance, mine site cleanliness, greenbelt development and plantation activities, and compliance with the Environmental Management Plan (EMP) and Environmental Clearance conditions.

ii. **Area Level:** Dedicated authorised personnel as described in **Figure 6.1**, will oversee area-level protection measures, including planting and maintaining green belts on vacant land, proper functioning and maintenance of the ETP, and monitoring the overall environmental quality at the project site.

Coordination and Oversight: A senior executive such as the Mine Manager, Mine Safety Officer or the Environmental Engineer reporting directly to the Project Proponent/Management shall be responsible for ensuring collaboration between various departments working within the project and conducting regular monitoring of all environmental protection efforts. This executive shall be supported by an Environmental Engineer with expertise in pollution prevention and control specific to opencast mining operations in India.

6.4. POST-PROJECT MONITORING & EVALUATION PROGRAMME

6.4.1. Monitoring of Mining Parameters

Slope failure: Regular inspection (frequency and mechanism) will be carried out to examine slope stability, mine face and active working areas, etc. A team constituting of the Mine 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 material. The drains will also be checked for any damage in lining / stone

pitching, etc. The assigned Environmental Management Cell will inspect for such indications and submit such a report to the owner.

Blasting effect: Blasting is one of the most critical activities of mining operations. Because of presence of loose rock mass, rarely drilling and blasting is to be performed for loosening of the rock mass. Therefore, optimum drilling and blasting parameters will be developed to optimize the efficiency of blasting - keeping the associated hazards at a minimum.

6.4.2. Monitoring of Environmental Parameters

Air, water, soil, and noise monitoring will be conducted at the same locations where the samples were originally collected during the Environmental Impact Assessment (EIA) study.

To ensure the effectiveness of the environmental mitigation program, regular monitoring of crucial environmental parameters will be conducted. The specific location, schedule, duration, and parameters to be monitored are detailed in **Table 6.1**.

Table 6.1: Location, Monitoring Schedule and Parameters

Sl. No.	Description of Parameters	Location	Schedule and Duration of Monitoring
A	**Air Quality (PM_{10}, $PM_{2.5}$, SO_2, NO_2) monitoring**		
A-1	Six monitoring stations	One within and, five outside the project area covering upwind and downwind directions.	Monthly basis
B	**Quality of surface and ground water monitoring**		
B-1	Three or more surface water samples from the nearby water bodies will be regularly monitored as part of the project's environmental monitoring programme in consultation with the MSPCB.	Up-stream (Two locations) Down-stream (One locations)	Quarterly basis
B-2	Four groundwater samples will be regularly monitored as part of the project's environmental monitoring programme in consultation with the MSPCB.	One will be taken from near the active working area and three more from outside the project's core area	
C	**Ambient Noise Level monitoring**		
C-1	Six monitoring stations	One is on-site and, five within the study area covering the	Monthly basis.

		approach road connected with the main road.	
D	**Soil Quality monitoring**		
D-1	Soil samples will be collected from five locations.	Within the study area	Half-yearly basis.

6.4.3. Monitoring of Phase-Wise Reclamation Programme

A dedicated Environmental Management Cell (EMC) (as depicted in **Figure 6.1**) will conduct regular inspections to assess the progress of reclamation activities alongside mining operations. The Mine Manager will hold primary responsibility for ensuring the implementation of the approved reclamation program as outlined in the Environmental Management Plan (EMP).

6.4.4. Monitoring of Proactive Emergency Preparedness

The Mine Manager will lead efforts to identify and prepare for potential emergencies arising during opencast mining operations. An emergency response plan will be developed to address various scenarios, including:

i. **Inundation of the quarry:** Flooding due to unexpected water inflows.
ii. **Seismic Events:** Earthquakes and resulting landslides that could trigger slope instability or equipment damage.
iii. **Slope failures:** Landslides or collapses in pit walls.

By proactively identifying and planning for these potential emergencies, the Mine Manager shall ensure a swift and effective response to safeguard personnel, property, and the environment.

6.4.5. Occupational Health and Safety Monitoring

Full body health check-ups, complete with chest radiographs as per International Labour Standards guidelines on Occupational Health & Safety (ILO), shall be organised once in six-months through qualified medical officers for all work personnel in the mine.

Moreover, health camps shall also be organised in the neighbouring villages and others that fall within 10 km radius area from the project boundary to monitor the health of the nearby inhabitants after the start of mining operations.

6.4.6. Reporting Schedules of Monitored Data

Project-Level Environmental Committee: Monitoring Activities

To ensure successful implementation of the EMP and achieve the environmental goals of Thanghunai Limestone Quarry, the Environmental Management Cell (EMC) will focus on monitoring the following activities:

i. **Slope Stability:** Regular check for slope stability of mine working faces and dumps for taking necessary corrective steps.

ii. **Soil Erosion:** Regular monitoring of soil erosion will be done at dumps and other areas. Garland drains, check dams, plantation along dump slopes will be provided and maintained.

iii. **Garland Drains and Mine Sumps:** All drains including garland drains will be de-silted periodically during pre-monsoon season. Effectiveness of the drainage system will be regularly monitored.

iv. **Effects of Blasting Activities:** Blasting operations will be continuously monitored to minimize environmental impacts such as fly rock generation, ground vibrations, and dust production.

To summarize, the Environmental Monitoring Cell (EMC) will serve as the central hub for all environmental monitoring programs and data. This data will be compiled and submitted regularly to the relevant Meghalaya state regulatory agencies. Reports will be formatted for clarity and submitted on a biannual (six-monthly) basis.

Chapter 7 – ADDITIONAL STUDIES

7.1. INTRODUCTION

Additional Studies required for the proposed Thanghunai Limestone Quarry such as Risk Assessment (RA), Disaster Management Plan (DMP), Social Impact Assessment (SIA) in connection with opencast mining and related operations, dangers/ risks/ explosions/ accidents, etc. likely to arise, including onsite and offsite emergency plans to meet any potential disastrous situation are included in this chapter.

7.2. PUBLIC CONSULTATION

To ascertain the concern of affected persons who have a plausible stake in environmental impacts due to the project activity, public consultation will be done after submission of this draft EIA report to the concerned authority. In the Public Hearing process, the responses/opinions of the public, affected directly or indirectly shall be received by way of written correspondence & through verbal modes of communication. A datasheet format similar to the one given below will be used for questions asked/ comments/ suggestions from the public and the compliances against them. A copy of the final proceedings of the public consultation, the points raised by the public and commitments made in tabular form will also be incorporated as an Annexure in the Final EIA/EMP.

S. No.	Name & Address	Public Queries/ Comments/Suggestions	Response and Commitment/ Action Plan along with budgetary provision made by Project Proponent

7.3. RISK ASSESSMENT AND MANAGEMENT

Assessment of risks and their management is essential to guard against and mitigate the consequences of major accidents. The term, "major accident" means an unexpected and sudden occurrence of event from abnormal developments in course of one's industrial activity leading to a serious danger to personnel/public or the environment, whether immediate or delayed, inside or outside the installation involving one or more hazards.

Risk Assessment Process

The Risk Assessment Process shall involve measurement of risks to determine, prioritise and enable identification of the appropriate level of risk treatment.

Keeping in view the three basic principles i.e., **prevention, preparedness (both proactive and reactive) and mitigation** of effects through rescue, recovery, relief and rehabilitation; a comprehensive blue print of Risk Assessment and Management Plan will be prepared for the proposed Thanghunai Limestone Quarry incorporating the following:

i. Identification and assessment of risks

ii. Recommendation of measures to prevent damage to life and property against such risks

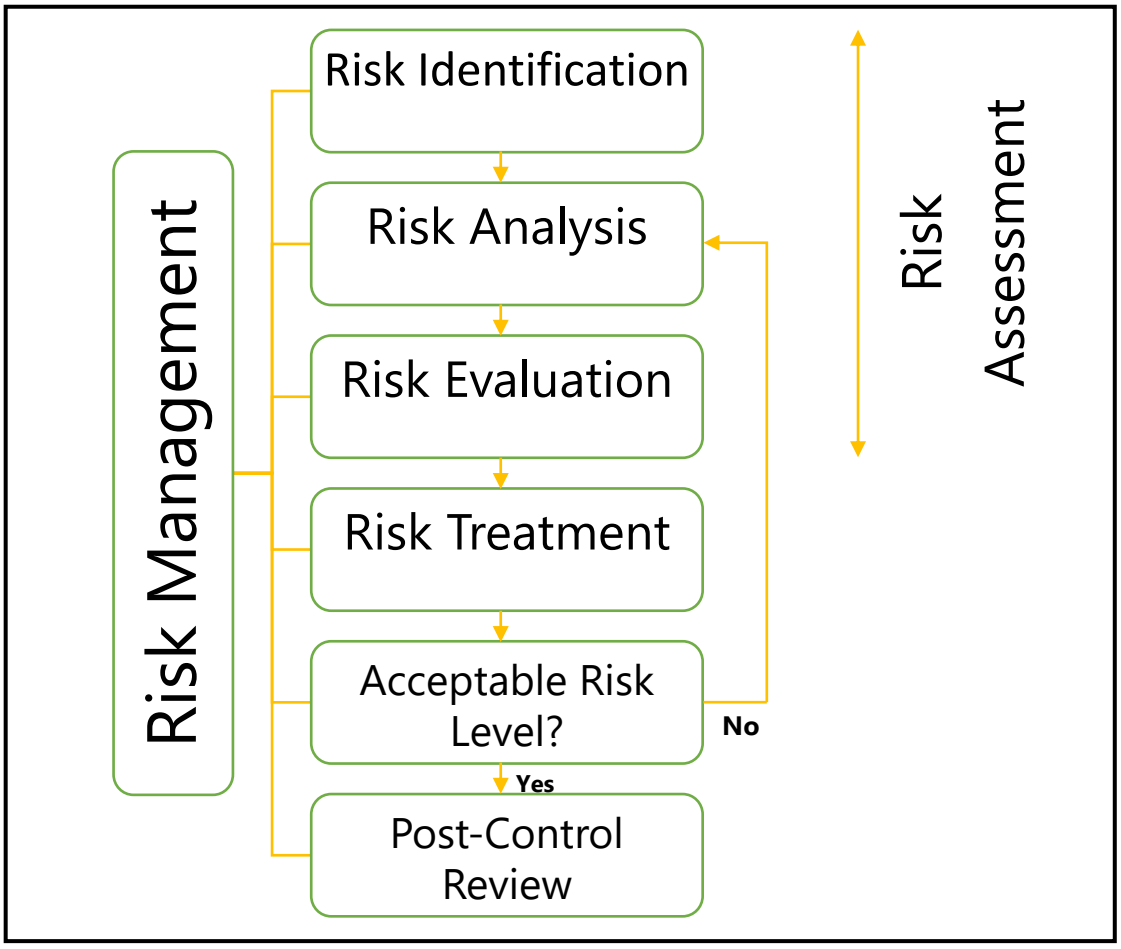


Fig 7.1: Brief summary of the Risk Management process to be implemented in the proposed Thanghunai Limestone Quarry

All statutory rules, regulations, applicable laws, etc. and statutory requirements related to govt. licenses, workers compensation, insurance, etc., including the Minimum Wage Acts for workers employed shall have to be adhered to. Rules, if any, imposed by local/State/Central authorities should also be complied by the lessor of HEMM/equipment, and the proponent will also have to supply various protective equipment such as safety helmets, shoes, etc. to the workmen.

Assessment of risks involved during mining operations and against them, the safety aspects and mitigation measures to combat such risks have been indicated below:

7.3.1. Safety Aspects for Operation of HEMMs/Equipment

Special precautions shall be taken while deploying workers in the mine. Before employing any personnel to the mine, proper vocational training shall be imparted and statutory provisions shall be implemented. For deployment of labourers, proponent/management shall fix terms and conditions. Some of the major aspects are as follows: -

7.3.1.1. For persons

i. No person shall be deployed unless he is trained at Mine Rescue and Mines Vocational Training (VT) Rules.
ii. Records in relevant forms shall be maintained.
iii. Records of Vocational Training Certificate and driving license of operators shall be kept by HEMM outsourcing agency/proponent and shall be made readily available for inspection by management.
iv. No person shall be employed unless person holds VTC certificate and the Mine Manager is informed. A record of it shall be maintained.
v. Adequate supervision shall be maintained by qualified competent persons.

7.3.1.2. For Machineries as recommended by the DGMS Circular (Tech.)

i. All the machineries to be deployed in mines should be checked before deployment by competent authority.
ii. Regular checking of machines deployed shall be carried out. No unfit machine shall be deployed before the defect is rectified.
iii. A proper record of repair and maintenance along with inspection done by management and defect pointed out shall be maintained and signed by authorized person.

iv. The trucks deployed shall be provided with audio-visual alarms, proper light for use at night and period when natural light is not sufficient. In addition, audio-visual alarms for reversing on trucks shall be provided.

7.3.1.3. Other Precautions for machines

i. RTO certificate along with photo copies of all vehicles shall be submitted to the Mine Manager.

ii. Daily welding, monitoring, inspection shall be done by the mechanic as directed by the management.

iii. Machine manufacturers should be asked to give risk analysis details in respect to machines deployed by outside agencies.

iv. Suitable type of the fire extinguishers shall be provided in every machine.

7.3.1.4. General

i. No person/vehicle shall be deployed at any place other than the authorized place.

ii. All workers should obey lawful instructions of the EMC.

iii. Risk Management Plan of tipper/payloader shall be made and implemented.

iv. All drivers shall obey systematic traffics rules as devised by the management.

v. Before deploying workers, they must be trained and briefed about safety aspects in opencast mines. However, during course of execution of the work, if any accident occurs whether major or minor, the matter shall have to be immediately informed to the EMC and the project proponent so that notices of accidents (**Section 23 of Mines Act 1952)** may be given and other necessary steps may be taken in accordance with the Mines Act 1952.

vi. The external agency shall operate transport system in such a way to minimize pollution in the mine.

7.3.2. Slope failure

During quarrying operations, it is necessary to adopt required mining parameters as per the approved Mining Plan to ensure the stability of benches, quarry walls and spoil dumps. It is also mandatory to examine systematically the fencing of mine workings, landslides and cracks between the benches. It is required to maintain well-graded and wide roads on benches,

keeping the width of working areas sufficient for spreading of blasted rock and movement of the mining and transport equipment. Statutory provisions, applicable for opencast working, should be strictly complied.

Slope failure in Mine Pit

The exposed ends of the OB/limestone will be left with a safe slope to avoid slope failure and collapse of benches. Similarly, at the end of mining operations, a safe terminal pit slope shall be provided to avoid failure.

All the working benches will be under the direct supervision of project level officials and all the necessary precautions – some of which are mentioned below, will be taken to make the workings safe.

i. Height & width of the benches, will depend upon the size of the equipment. In the mine pit and working area, the width and height of working benches shall be (6 x 6) meters.
ii. Bench Slope (working benches/active areas): = 70°.
iii. Overall final pit slope: 37° - 45°

Slope failure in the OB Dump

Total volume of waste which primarily consists of gritty soil to the tune of 6519 T only, will be removed and will be temporary stored the southern side of the applied area with suitable precautions to maintain its fertility and after exhaustion of the mineable reserve, the overburden dump soil will be used for progressively backfilling the exhausted quarry. Some quantities of the generated gritty soil would also be used for road maintenance and plantation activities. After exhaustion of the mineable reserve, the quarry will be reclaimed to the maximum extent possible.

It is suggested to level the dump, grade it properly and reverse slope to avoid water accumulation.

The following design criteria have been considered for waste dumps as per the approved Mining Plan:

i. OB in external dumps will be stacked in 3 m high and 3 m wide benches.
ii. OB in internal dumps will also be stacked in benches of height not exceeding 3 meters.

Width will vary between 3 m -5 m.

iii. A berm width of appropriate width will be provided for transport, etc.

iv. Dump slope for each deck to be at natural repose i.e., 37°.

v. Track dozers to be deployed for shaping and maintaining the dump's overall slope not exceeding 27° at any point with the horizontal.

vi. Height of the external dump will be variable at different spot levels and merged with the original profile of the undulating hilly terrain.

7.3.3. Mine Inundation due to heavy rains during the rainy season

The mine pit will receive water from three sources namely:

i. direct precipitation over the excavated area,

ii. surface run-off from the surrounding area and

iii. seepage from the strata.

A careful assessment will be made against dangers from mine flooding from surface water sources before the onset of the monsoon season in the region. During heavy rainstorms, there may be a situation when the mine may get flooded due to ingress of water from the higher ground through natural drainage which may cause serious loss of human life, equipment, etc. To guard against this eventuality, the following steps should be clearly laid down and implemented:

i. Garland drains need to be provided to drain away the surface rain water from coming into the mine.

ii. Where any mine or part thereof is so situated such that there may be danger of inrush of surface water into the mine, adequate protection against such inrush shall be provided and implemented.

iii. Provision and regular maintenance of garland drains around the mine to prevent ingress of precipitation, surface run-off.

iv. Provision of sufficient number of submersible pumps to pump out mine water during the critical rainfall period.

v. Every entrance into the mine shall be so designed, constructed and maintained that its

lowest point (which means the point at which a body of rising water on surface can enter the mine), shall not be less than 1.5 m above the highest flood level (HFL) at that point.

vi. During heavy rains, inspection of vulnerable points shall be carried out on a daily basis. In case of any danger, persons will be withdrawn to higher and safer places.

vii. Artificial nallahs or water inlet channels may be diverted or isolated by embankments, if so required.

Prevention of Flooding of Equipment Deployed at Bottom Horizons

During the monsoon season, mining activities in the lower-most bench may have to be stopped. The lowermost bench shall be kept intact and protruding around the seam to prevent direct contact with rainwater and prevent exposure of Limestone. This is to ensure that any possibility of chemical reaction with rainwater is avoided. The quarry shall then be dewatered before resumption of mining activities.

For ensuring safety of the mining equipment while working at the bottom horizons with no access to the surface profile, the following measures should be taken:

i. Drivage of initial trenches and mineral extraction on the bottom benches shall be done during the dry period of the year.

ii. Ramps should be made for quick shifting of mining equipment from the bottom to the top horizons, as the bottom horizons are more likely to be flooded during heavy rain spells in the monsoon season.

7.3.4. Electric Shocks

During ongoing mining operations, all statutory provisions of **the Indian Electricity Rules of 1956**, and **Indian Standards (IS) for installation and maintenance of electrical equipment**, etc. should be observed.

i. For protection from electric shocks to persons, from electrical equipment with voltage up to 1000 V, Earth Leakage Relays (ELR) should be provided which will automatically disconnect electrical circuits.

ii. Closed mobile substations and switchgears should be mechanically interlocked which exclude the possibility of opening the door when oil switch and air circuit breakers are

in operation.

iii. All metal parts of electrical equipment should be properly earthed to avoid failure of insulation.

iv. All High-Tension (HT) lines and cables if located within the blasting zones should be disconnected before the start of blasting operations.

7.3.5. Fire

In addition to statutory provisions, the measures for firefighting and prevention of fires are as follows:

i. Organization of a designated cell for systematic observations to examine and prevent fire.

ii. Storage of lubricants and cotton waste in enclosed fireproof containers at the working places.

iii. Fire alarm and firefighting systems should be provided at the proposed project site.

iv. Adequate number of fire extinguishers shall be provided at all the crucial points in the proposed project site.

7.3.6. Dust Suppression & Dilution of Exhaust Fumes

The necessary precautions, as per statutes should be implemented to suppress dust generation during mining operations. In general, the following measures should be adopted for dust suppression at all quarry working places, dumps, haul roads, and near other auxiliary operations:

i. Spraying with water on all the working faces & haul roads, by special spraying machines or water-sprinklers.

ii. While drilling holes, it is necessary to use dust extraction devices.

iii. Installation of local dust suppression and air conditioning devices in cabins of excavators and drilling rigs may be considered.

iv. Levelling of spoil dump surface.

To prevent the accumulation of harmful gases in the atmosphere from the different sections of quarry workings, it is recommended that:

i. Drilling & blasting operations should be timed while keeping in mind periods of minimum wind activity during the day.
ii. Dumpers may be provided with purifiers for exhaust gases.

7.3.7. Drilling & Blasting

Drilling and blasting in the quarry shall be done in compliance with the provisions of the **Mines Act of 1952**, and statutory provisions applicable for opencast working.

For proper blasting and minimising the adverse side effects due to blasting such as noise, ground vibration, back breaks, air blasts, fly rocks, etc. the following precautions have been suggested to avoid dangerous situations:

i. Optimal blast design parameters shall be implemented.
ii. A safety zone of 100 m beyond the quarry limit is envisaged and controlled blasting shall be done keeping this aspect in mind.
iii. Blasting shall always be done at a fixed time as governed by the local authorities such as the Village Headman/Sirdar.
iv. All necessary precautions should be taken while blasting.
v. Regular monitoring of vibration will be carried out and necessary precautions will be taken while blasting.
vi. Before blasting is done, 3 warning sirens shall be issued so that people can move over to safe places.
vii. Arrangements will be made to alert the people working for sudden inrush of water by accidental development of fractures connecting the working place to the water bodies/ ground aquifer.

7.3.8. Handling of Explosives

Adherence to relevant statutory safety provisions as stipulated by the DGMS, Chief Controller of Explosives and others shall be made.

7.3.9. Road Accidents

Sufficient arrangements for adequate light illumination of the mine roads including haul roads shall be undertaken. Properly planned and designed road crossings should be implemented to prevent vehicular accidents.

Further, haul roads have been planned in such a way that the HEMM traffic will be away from the passenger traffic. These are likely to prevent road accidents. All the dumpers would be fitted with audio visual alarms and arrangement of such automatic warning alarms while reversing should be made for preventing accidents.

7.3.10. Medical Preparedness

For guarding against accidental medical hazards, the following measures will be undertaken:

i. Emergency Ambulance service shall be kept ready on a 24x7 basis.
ii. Doctors and paramedical staff shall be kept ready during any emergency.
iii. First Aid Medical facilities will be ensured at the work place.
iv. Rotation of workers on shift basis, if necessary, exposed to noise and dust to reduce exposure time.

The district HQ of West Jaintia Hills, i.e., Jowai, already has existing medical facilities and community health centres (CHCs). They shall meet the medical emergencies arising out of any accident.

7.4. DISASTER MANAGEMENT PLAN

The disaster management plan, or DMP, is an action plan that should be followed in the event of an emergency or any perilous event, such as earthquake, flooding, fire, high wall failure, or dump failure. The DMP for the proposed Thanghunai Limestone Quarry will have 3 broad stages:

i. Information Stage
ii. Assessment Stage
iii. Action Stage

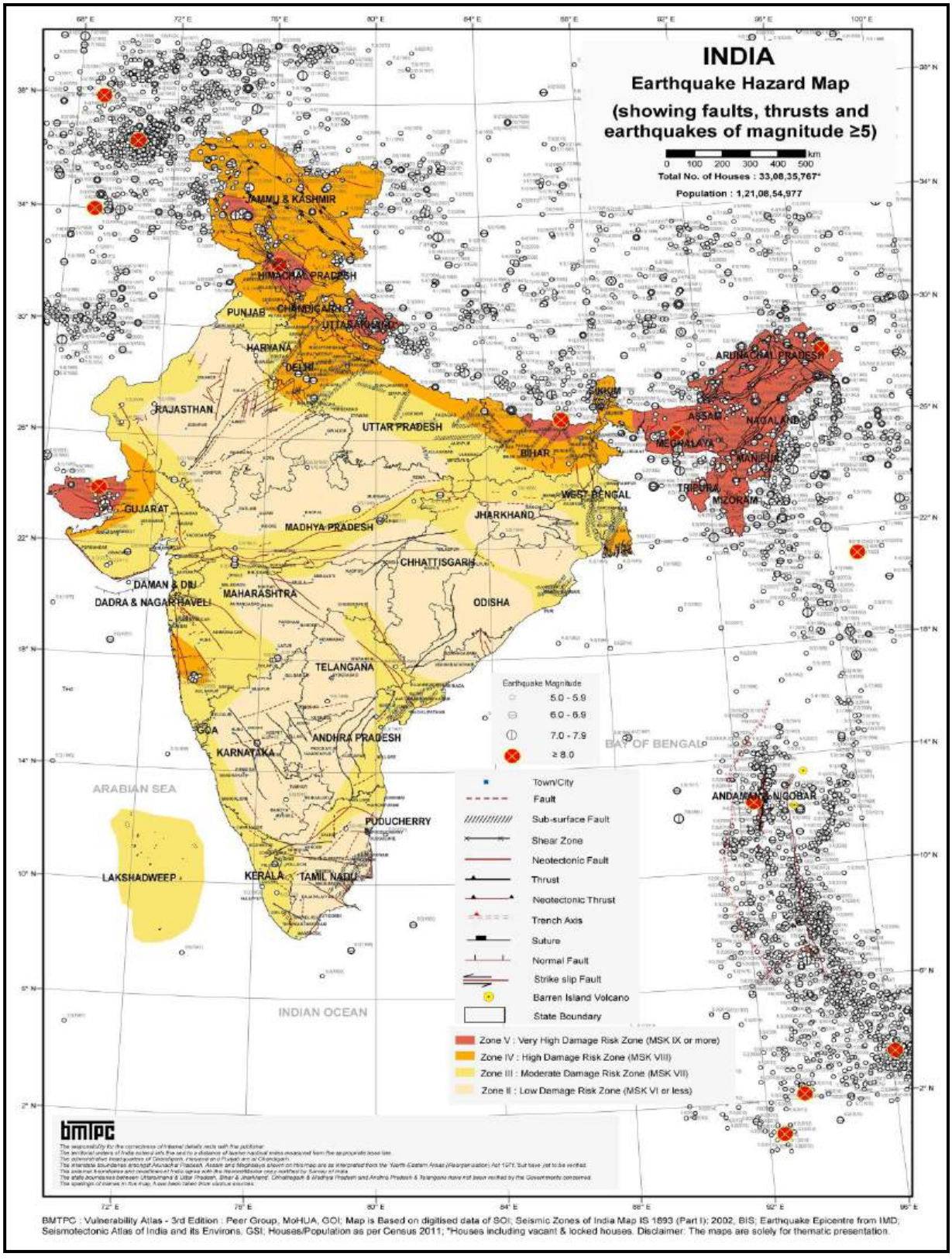


Fig 7.2: Earthquake Hazard Map of India *(Source: Building Materials & Technology Promotion Council (BMTPC). https://bmtpc.org/)*

7.4.1. Awareness, Evaluation and Execution

i. **Information Stage:** Information should be made available to all interested parties and stakeholders in a speedy, clear and concise manner. If a mine worker witnesses or learns of any dangerous situation, they have an obligation to notify the Manway Clerk (Attendance Clerk) or the closest authority, who will then notify the Manager or the senior most official in his absence.

ii. **Assessment Stage:** The Manway Clerk shall then promptly notify the Manager or the senior most mine official in his absence, notifying the rescue station, and gathering crucial information on the following 3 subjects:

a. Location of the incident,
b. Number of people involved, and
c. Nature of assistance needed.
d. Identity of the informant, and
e. Precise time

He should note the aforementioned details, including the identity of the informant and the precise time, and forward them to the management. He shouldn't leave the project site at any cost.

iii. **Action Stage:** The Manager is responsible for notifying the Proponent, or Highest Authority on the property to initiate the DMP. If the Manager is away from the project premises, he must also hurry to the location or mine and determine the seriousness of the matter by getting in touch with any possible witnesses or frontline supervisors via wireless sets. The project proponent and safety officer must be immediately notified. They should then notify the DGMS authorities, the local dispensary, the chief medical officer, the superintendent of police, acknowledged union delegates, local department heads, state disaster management authorities, etc. as necessary.

It is suggested that an emergency response team be formed, and that important staff members coordinate with one another. Three teams—a firefighting squad, a rescue team, and a support team—will make up the group. The Group will be led by the Mine Manager, who will also serve as the Exigency Coordinator. In his absence, the seniormost individual at the mine who is

available will serve as the Exigency Coordinator.

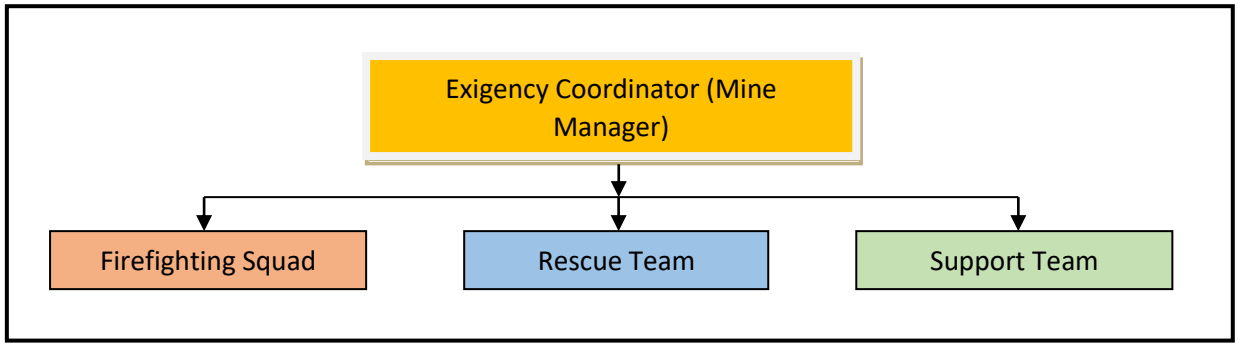


Figure 7.3: Organizational set-up of the Disaster Management Cell (DMC) for the proposed Thanghunai Limestone Quarry

Using the combined resources of the mines and outside services, the DMP seeks to accomplish the following goals:

i. Rescue and medical treatment of injured.
ii. Safeguard other people within the study area.
iii. Minimize damage to mine infrastructure, equipment, and the surrounding environment.
iv. Initially contain and ultimately bring the incidence under control.
v. Identify casualties, if any.
vi. Secure the safe rehabilitation of affected persons.

7.4.2. Training

Regular training programs, workshops and annual safety weeks shall be arranged for the workers and personnel regarding safety education & awareness in line with the Mine Rescue Rules, VT Rules, Mines Act of 1952 and other regulations.

7.4.3. Communication

The telephone numbers and addresses of adjoining mines, rescue stations, police stations, fire service stations, local hospitals/public and community health centres, electricity supply agencies and standing consultative committee members shall also be maintained for any emergency requirement. Supervisors will be provided with wireless/mobile phones to

communicate in case of any emergencies.

7.5. SOCIAL IMPACT ASSESSMENT

There will be spontaneous economic stimulus in the area with commencement of the opencast mine. Traders and private enterprises will grow in the area with this economic growth. Besides, the State Exchequer will derive financial revenues through levy of royalty, sales tax, etc. as applicable.

The following measures shall be additionally undertaken to drive the social growth in the mining area:

i. The project will provide skill-based training to the locals.

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

iii. Planning for social and physical infrastructure with the help of local authorities such as, driving education in nearby schools, organizing health awareness camps and medical camps, emphasis sanitation and personal well-being, plantation of trees etc.

iv. Proposed project will improve the quality of life of its employees and retention of skilled workers.

v. 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.

vi. The proposed project shall comply with existing principles and standards, thus setting the benchmark for other projects to follow as well.

7.6. REHABILITATION & RESETTLEMENT ACTION PLAN

The lease area comprises of 3.0 ha which is privately owned. There is no habitation within the mine lease area. Hence, no R&R is applicable for this project.

7.7. OCCUPATIONAL HEALTH STUDY

Mining activities may lead to respiratory disorders due to generation of dust, skin allergies, etc. in the mine workers and people living in the nearby areas. Additionally, elevated sound levels due to various activities may lead to partial hearing loss, vision impairment over the period of the mine's life.

A well-organized plan for routine medical examinations shall be carried out and an authorized organization, appointed by the project proponent shall carry out a comprehensive Occupational Health Study on a yearly basis. For all future purposes, all the collected data shall be biometrically identified and documented for each personnel.

A First-Aid/Occupational Health unit with basic medical facilities to monitor, control, prevent, and treat occupational health hazards as well as handle emergencies will be built close to the leasing area. **Table 7.1** lists the safety equipment (PPE) that should be made available to all workers within the mine.

Table7.1: List of Safety Equipment (PPE)

S. No.	Category	Equipment
1.	Face protection	Face Shield
2.	Eye protection	Different types of safety goggles used for different
3.	Ear protection	Ear plugs and ear muffs
4.	Feet and Leg Protection	Protective footwear such as safety rubber canvas boots, miner's safety boots with leather soles, rubber knee boots
5.	Working at height	Safety belts
6.	Head Protection	Safety helmets/hats
7.	Protection from Dust	Dust Masks and Respirators

The following measures should be carefully followed:

i. Workers will be informed and trained about occupational health hazards.
ii. Any worker's health related problems will be properly addressed.
iii. The personnel working in dust prone areas will be examined every year as per the **DGMS Circular No. 01** dated **21st January 2010**.
iv. Quick-Fix designed by the Occupational Safety and Health Administration's (OSHA)

ergonomic standards should be followed to reduce work-related musculoskeletal disorders (MSDs).

v. Lyophilized Polyvalent anti-snake venom serum should be always available at the mine site for potential snake bites.

To proactively reduce occupational hazards, the following measures should be implemented:

i. **Regular Air Quality Monitoring:** Every six months, high-risk workers from all mine activities should be monitored for exposure to Total Suspended Particulate Matter (TSPM). If necessary, an annual analysis of the dust's chemical composition should be conducted to assess levels of sulphates, lead, nickel, arsenic, and silicates.

ii. **Comprehensive Health Screenings:** All workers should undergo health check-ups every six months. These check-ups should include chest X-rays, lung function tests, ear, nose, and throat (ENT) examinations, eye exams, hearing tests, liver and kidney function tests, electrocardiograms (ECGs), and other relevant assessments.

iii. **Safe Drinking Water Monitoring:** The source of drinking water for both mine workers and nearby residents should be tested every six months to ensure it meets the safety standards outlined in **IS 10500: 2012**.

Chapter 8 – PROJECT BENEFITS

8.1. IMPROVEMENT IN PHYSICAL INFRASTRUCTURE

The project is proposed in the district of West Jaintia Hills, with the district headquarter: Jowai, lying at a distance of approximately 42 km by road from the mine lease area, where communications and other facilities are well established. The following physical infrastructure facilities shall be developed due to the proposed project:

i. Metalled Road Transport facilities
ii. Communication facilities
iii. Vehicles for public transportation
iv. Solar Power supply
v. Rain Water Harvesting facilities

8.2. IMPROVEMENT IN SOCIAL INFRASTRUCTURE

Resumption of mining activities in Thanghunai Limestone Quarry with safety rules, improved occupational health, and safety standards, the project will contribute greatly towards the socio-economic development of the state, both directly and indirectly by creating an economic flow which will significantly boost the state's GDP.

As per the Census of 2011, agriculture is the primary sector of employment for the local communities in this area. By re-commencing this project, direct employment will be generated for various operations in the mine. The total manpower that will be deployed during the operational phase shall be ≈ 37 people *(as described in the Approved Mining Plan of Thanghunai Limestone Quarry)*.

Apart from the direct employment, indirect employment shall also be generated in the form of material/mineral transportation, general conveyance of persons to the mine from their location by means of hired vehicles, small business establishments such as vehicle repair shops, eateries, garages and/or workshops, plantation areas, other recreational facilities, etc.

8.3. OTHER TANGIBLE BENEFITS

The proposed Thanghunai Limestone Mine is likely to have other tangible benefits such as:

i. Indirect employment opportunities to the people from the nearby communities in the form of various contractual works like temporary mine infrastructure development, transportation, sanitation, and supply of goods and services to the project and other community services.
ii. Market and small-medium business establishment facilities are projected to increase.
iii. Post-closure of the mine, cultural, recreational and aesthetic facilities shall improve.
iv. Improvement in public communication, transport, education, sustainable development and medical facilities.
v. Overall change in employment and income opportunities.
vi. Lastly, the State Government will benefit directly from the proposed project, through increased revenue from royalties, excise duties, and other taxes.

Chapter 9 – ENVIRONMENTAL COST BENEFIT ANALYSIS

The current proposal is for re-appraisal of Thanghunai Limestone Quarry by the SEAC/SEIAA of Meghalaya and for obtaining the Environmental Clearance for 148908 MTPA (Peak Limestone production) via opencast semi-mechanised method of mining over a mine lease area of 3.00 Ha located in Thanghunai, Nongtalang Elaka, Amlarem C&RD Block, West Jaintia Hills District in the state of Meghalaya. The scope of this EIA/EMP report has been specified via the Terms of Reference issued by SEIAA vide **File No. ML/SEAC/SEIAA/PP/WJH/18/2024** dated **03.07.2024** which does not require Environmental Cost Benefit Analysis.

Chapter 10 – ENVIRONMENT MANAGEMENT PLAN (EMP)

10.1. OBJECTIVE

The efficacy of an Environment Management Plan (EMP) is contingent upon the effectiveness of the organizational structure tasked with executing the program. It is imperative that environmental management be incorporated into the mine design process in order to preserve the area's ecological balance and prevent negative impacts.

The following objectives have been incorporated into the design of the EMP in order to mitigate the adverse environmental effects which will be caused due to mining:

i. Biological reclamation and rejuvenation of the mined-out areas and active points of the mine lease area to the maximum possible extent possible, in line with the economy of mining operations, the drainage pattern, geological stability, vegetation, etc.;
ii. Minimal disturbance to the water environment and existing ecological status of the area and conservation of the same;
iii. Efforts towards improvement of the air quality, water quality and the land during and post mining activities; and
iv. Establishment of an environment which is conducive to improve the socio-economic situation in the area.

10.2. ANTICIPATED POTENTIAL IMPACTS AND SUGGESTED MITIGATION MEASURES

Regular monitoring of environmental parameters is of immense importance to assess the status of the environment during project operation. With the knowledge of baseline conditions, the monitoring programme will serve as an indicator for any deterioration in environmental conditions due to operation of the project. Accordingly, suitable mitigative measures will be taken in time to safeguard the environment. Monitoring is important to determine the efficiency of control measures implemented.

The design of EMP for operational phase has been aimed to achieve

i. Adoption of practical environmental control measures and implementing them effectively;
ii. Implementation of monitoring program of the surrounding environment;

iii. Institutional arrangements to monitor effectively and take suitable corrective steps; and

iv. Implementation of schedule and reporting procedures.

10.2.1. Environment Management Measures

A summarised table for the anticipated impacts and details of suggested mitigation measures are furnished in **Table 10.1**.

Table 10.1: Probable Source and Mitigation Measures

Sources/Activities	Anticipated Impacts	Mitigation Measures
1. Soil Compaction and Settlement	The frequent movement of trucks on unpaved roads can result in soil compaction, reducing the infiltration rate and impeding the growth of deep-rooted plants.	• The project will utilize paved roads for vehicle movement. In areas where roads are partially paved, measures shall be taken to strengthen them, thereby minimizing the impact on soil quality. • The vehicles moving to and from the site will be regularly checked to prevent oil leakage. • There is no pollutant present in the mineral which may contaminate the site and/or surrounding soil and/or nearby water resources. • Within the mine lease area, haul roads will be aligned and developed in a stage-wise and progressive manner alignments shall be followed and developed, so as to use only these haul roads for the movement of HEMMs.
2. Air Pollution Control		
Drilling		• Wet drilling methods shall be implemented

	Fugitive dust generation - Particulate Matter and gaseous pollutants such as SO_2, NOx due to these activities	• Drilling operations shall be suspended during unfavourable environmental conditions (such as high velocity winds), which may lead to dissipation of dust • Emission from exhaust of compressors will be checked periodically to ascertain the engine efficiency. • Periodical monitoring through Respirable dust samplers shall be done to take corrective action
Blasting and fragmentation		• Blasting will be carried out using NONELs (non-electric detonators)-delay detonator relays and DGMS approved P1/P3/P5 type explosives as required. • Proper blast intervals shall be maintained and executed for proper free face creation during fragmentation • Proper blasthole designs shall be executed (burden and spacing shall be optimally decided by field trials based on the strength of the rocks) to achieve the best fragmentation within the desired Powder Factor • Blast faces and respective areas shall be water sprinkled before and after blasting
Movement of HEMMs (Heavy Earth Moving Machineries) on		• All haul roads & service roads shall be graded at regular intervals to maintain proper gradient as per statutes • Such roads shall be regularly sprayed

haul roads	Fugitive dust generation, particulate matter and gaseous pollutants such as SO_2, NOx, etc. due to these activities, effective photosynthesis of plants may be hampered due to a thin layer of dust settled on the leaves	with water at least thrice a day (or more) before the beginning of each shift • Plantation of wide leaved trees & tall grasses shall be done along all such roads
Overburden removal, storage and movement		• Completed areas and stable non-working areas of the dump shall be biologically reclaimed • Plantation will be carried out towards the outer periphery of the decks (of OB benches) to prevent dust dissipation • Water shall be regularly sprayed on all active areas, plantation areas, etc.
Mineral Handling and Transportation		• Provisions of mist spraying/water sprinkling arrangements shall be in place at all loading, transfer and receiving points of material in the mine. • The perimeters of commonly used haul roads and transportation routes to and from the working face/temporary stackyard shall be developed with plants to arrest fugitive dust. • A greenbelt will be developed in and around the temporary stackyard (if any) to arrest fugitive dust. • The width of linkage roads will be designed in a way that no truck shall intersect an unpaved road. • Limestone transport trucks will be

		optimally loaded and covered with tarpaulin sheets for preventing spillage and fugitive dust emissions. • Periodic air quality monitoring will be carried out to monitor the changes consequent upon mining activities as per the norms of the State Pollution Control Board. • To control emissions, regular preventive maintenance of vehicles will be carried out, and all transportation vehicles shall be required to carry a valid and periodically updated Pollution Under Control (PUC) certificate.
3. Noise Pollution/Vibrations Control		
Drilling and Blasting	Noise levels/vibrations will be high due to heavy earth moving machinery, vehicles and drilling & blasting. These adverse impacts may result in hearing loss and other related problems if mitigation through protective measures is not undertaken	• To protect the nearby areas from noise, a provision of a 7.5 meters wide safety barrier has been proposed as per regulations. This safety zone is proposed to be vegetated which will act as a buffer to absorb noise and dust. • Ambient noise monitoring will be conducted regularly at the designated noise monitoring stations that will monitor noise and vibrations created within the mine due to various mining operations. • Controlled blasting with muffling will be carried out along with proper stemming

		to keep vibrations and noise within the recommended CPCB levels. • Blastholes will be charged with explosives in a judicious manner as per requirement. During blasting, the Assistant Mine Manager will be supervising the whole operation. • To check vibration, values of peak particle velocity (PPV) will be maintained within the prescribed limit by DGMS
Due to HEMMs		• The operators engaged in stripping and Limestone winning equipment will be accommodated in cabins which are acoustically designed. Such a design shall also be present on all HEMMs that produce high noise levels such as dozers, hydraulic shovels, dumpers, etc. • Fitting of special silencers, and proper lubrication shall be ensured. Regular maintenance of noise generating machinery and transportation vehicles will be carried out. • Reducing the exposure time of workers to higher noise levels shall be practised. • Efforts shall be carried out to confine noise by isolation at source. • Provisions of protective devices like ear muffs/ear plugs will be kept for those workers that cannot be isolated from the

		source of noise.
4. Water Pollution Control		
Surface, and Excess Mine Water	Discharge of wash-off during rains away from the mine lease area, runoff from waste dumps	• Garland drains will be made around the quarry and OB dumps to intersect and collect run-off water into centralized siltation ponds and settling tanks of sufficient size. • Contour drains will be constructed along the slopes of the OB dumps, benches will be reverse sloped to arrest any wash-off along the slopes. • Retaining walls/toe walls shall be provided along the dip side of all benches, wherever necessary. • OB/Limestone benches will be kept free of any obstructions, sloped inbye and a proper gradient will be maintained to enable controlled flow of water thereby preventing slope failures, erosion, etc. • Mine water at the dip side sump at any point of operation shall be regularly pumped out and coursed through the garland drains into the siltation tanks, settling tanks and filtrations beds to be reutilised for different activities.
Washing of HEMMs and Mine Office	Contamination due to discharge of waste water from the mine office, oil spillage from washing of HEMMs and	• Effluent discharged by washing of HEMMs shall be constrained at a designated spot within the mine lease area and will be treated in an Effluent

	impact on surface water bodies through indiscrete disposal of liquid waste and suspended solids carried by rainwater.	Treatment Plant (ETP) containing an oil/grease trap and sedimentation tank. The treated water is to be stored and reutilised for washing of vehicles. • Conventional toilets will be provided for the workers. Sewage generated within the mining lease area will be treated by a combination of septic tank and soak pit arrangements.
Groundwater regime	Probability of Intersection with the local ground water table.	• Mining will be restricted above the local water table. • Mining activities will induce an increase in the infiltration rate within the excavated area thereby aiding ground water recharge during rainfall. • Since the mine lease area is over a small hillock-like terrain, it may be inferred that the ground water shall not be breached in any place over the excavation area. In any case, groundwater levels and groundwater quality shall be regularly monitored in existing open wells and borewells to study the ground water regime of the site.
5. Land Management		
Gritty Soil	Change in Land-Use pattern due to various aspects of mining, gritty soil removal and rehandling	• Gritty soil will be stacked at an earmarked place and completely utilised by the end of LoM for blanketing purposes and development of green

		cover.
Reclamation		• The mined-out void will be progressively backfilled with gritty soil to the extent possible, and reclaimed biologically by plantation and development of a pit lake. • Indigenous plant species that are resistant to tough environmental conditions and have a high APTI (Air Pollution Tolerance Index) – depending upon the availability of such seeds and/or saplings with the nearby Range Forest Offices/State Forest Department nurseries shall be utilized for reclamation purposes.
Greenbelt Development		• 0.56 Ha. (22.95%) of the mine lease area of 3 Ha. will be revegetated and ecologically reclaimed at the end of the Life of Mine.
6. Flora and Fauna	There are no endangered species in the study area.	• Although there are no endangered and/or vulnerable species within the mine lease area's vicinity, all attempts shall be made to conserve the natural ecology of the area. • The greenbelt around the periphery of the mine office, along roads will result in small sized fauna such as squirrels, reptiles and birds in finding a favourable habitat. • The roads leading to and from the mine

		shall have caution boards warning drivers to slow down for animal crossings, if any develop in the future. • The drivers shall be sensitized not to hit stray animals during transportation operations. • People from the neighbouring areas shall be sensitised about the variety of faunal species, their status of endangerment and behaviour through posters/seminars/workshops and discussions during social welfare activities.
7. Occupational Health and Safety (OHS)	Health hazards related to respiratory and hearing issues and other health hazards during working	• Dust masks, ear muffs and safety goggles shall be provided to all personnel as a primary protection measure against fugitive dust emissions due to various activities and noise generation. • Regular trainings shall be implemented by a competent authority/authorised mine personnel appointed by the proponent on various safe practices and working conduct as per existing rules and legislations. • Half-yearly health check-ups (lung function tests and audiometric/hearing tests) shall be held. • A mobile dispensary shall be set-up for the mine personnel and a site ready

		ambulance vehicle in cooperation with the nearest Public/Community Health Centre and/or hospital shall be kept ready within the mine premises.
8. Socio-economic condition	Currently, people in the nearby villages are only engaged in small scale businesses, agriculture, etc. After re-appraisal, Thanghunai Limestone Quarry will re-necessitate various jobs, thereby positively impacting the socioeconomic condition of the area.	• People living in the nearby areas will be made aware about the project and will be informed about the project details prior to its implementation. Initially, this shall be achieved during the process of Public Consultation. The mine would lead to various direct and indirect sources of income for the area's indigenous population.
9. Increased volume of vehicular traffic from the mine	Impact on air quality and noise due to increased vehicular movement resulting into impacts on habitation including flora and fauna falling along the mineral transportation route	• Improvement/development of metalled roads by strengthening and maintenance outside the ML area which shall be used for transportation of mineral and other raw materials. • Optimum weight shall be carried by the truck and overloading shall be prohibited so as to nullify any potential damage to roads due to spillage. • It shall be ensured that the transportation vehicles will undergo regular "Pollution Under Control (PUC)" check-ups and obtain and update valid PUC certificates. Moreover, periodic maintenance of the dumpers/trucks as

		per manufacturers' specifications for best fuel efficiency shall be ensured. • Depending on environmental and meteorological conditions, water spraying will be carried out at least 3-4 times a day – at loading and unloading points as well as on the haul roads; and covering of trucks with tarpaulin sheets will be ensured. • Efficient traffic management shall be ensured by facilitating the installation and usage of proper traffic signages throughout the mine and by regulating the speeds of the dumpers/trucks. Drivers will be trained to minimize the use of horns. • Width of the roads shall be so developed to tackle the increased traffic load from the mine. They shall be graded and maximum stretches of such roads shall be extensively landscaped with a variety of plants and trees.
10. **Solid Waste Generation (Top soil and Overburden (OB))**	Air pollution due to handling of OB and rejects, water pollution due to suspended solids in run-off and possible improper disposal of wastes.	**Top Soil Management:** • The total gritty soil generated during the life of the mine will at a designated place and progressively reused in reclamation process. • During the Plan Period and subsequently the LoM, some quantity of gritty soil will

		be removed and will be temporary stored the southern side of the applied area with suitable precautions to maintain its fertility and after exhaustion of the mineable reserve, the overburden dump soil will be used for progressively backfilling the exhausted quarry. Some quantities of the generated gritty soil would also be used for road maintenance and plantation activities. After exhaustion of the mineable reserve, the quarry will be reclaimed to the maximum extent possible. • Garland drains will be provided around the soil dump to arrest any soil from the dump from being carried away by the rain water. • The soil dump will be stabilised on non-working faces through plantation or geo-textiles to minimise gully formation. While the dumps exist, the following mitigation measures will be required to minimise erosion: • Retaining walls will be provided, wherever required, to support the benches or any loose material and also to arrest sliding of loose debris. • Garland drains along the retaining walls or along bench contours (leading to the

		settling/siltation tanks and filter beds) will be provided around the OB dump to arrest any particles from the dump area from being carried away by rains. • The silt and soil sludge from the settling tanks will be periodically removed and disposed in the OB dump area. • Any other generation of inorganic or non-biodegradable waste shall be minimised through the practise of the 3Rs of waste management. They shall be collected and handed over to local authorised bodies for disposal.
Environmental Monitoring	-	Statutory norms will be followed for the monitoring of significant environmental parameters such as ambient air quality, ground and surface water quality, soil quality, effluent discharge quality, noise and blast vibrations, phreatic surface and piezometric surface, and HEMM exhaust emissions. Corrective actions will be taken to mitigate environmental pollution.
Environmental Awareness	-	Environmental awareness programmes shall be carried out to improve awareness regarding various environmental and conservation policies and laws as a measure to safeguard the environment with the implementation of best practices.

10.2.2. EMP – Implementation Framework

The responsibility for mitigating the different environmental impacts due to various activities as discussed in **Table 10.1** and implementation of the different corrective mechanisms shall be carried out by the mine personnel and owner as detailed in **Table 10.2**.

Table 10.2: Impact Management and Implementation Framework

S. No.	Particulars of Impact Areas	Responsibility	Frequency of Monitoring
1	Soil Compaction and Settlement	Mine Manager	As required
2	Air Pollution Control	Mine Manager	Twice a week
3	Noise Pollution/Vibrations Control	Safety Officer	Once a month
4	Water Pollution Control	Environmental Engineer	Quarterly
5	Land Management	Mine Manager and Environmental Engineer	–
6	Flora and Fauna	Environmental Engineer	Half-Yearly
7	Occupational Health and Safety (OHS)	Medical/Occupational Health Officer	Half-Yearly
8	Socio-economic Condition	Project Proponent	Yearly
9	Increased volume of vehicular traffic	Mine Manager	Regularly as and when required
10	Solid waste generation	Safety Officer	Half-Yearly
11	Environmental Monitoring	Safety Officer	Half-Yearly
12	Environmental Awareness	Project Proponent	Yearly

The Environment Management Cell (EMC) will be constituted by the PP, shall be structured with a core group dedicated to environmental management, comprising of expert members. The supporting group shall include members from allied disciplines and areas of activities, including top management personnel. This organisational set-up of the EMC has been shown as **Figure 10.1** below.

The Project Proponent of this opencast project shall be responsible for implementation of the approved EMP and various conditions of EC, FC and CTE/CTO. An Environmental Engineer shall assist the Project Proponent in ensuring the compliance of conditions. The Environment Department of the

project shall monitor the compliance of environmental norms in all the areas of Thanghunai Limestone Mine.

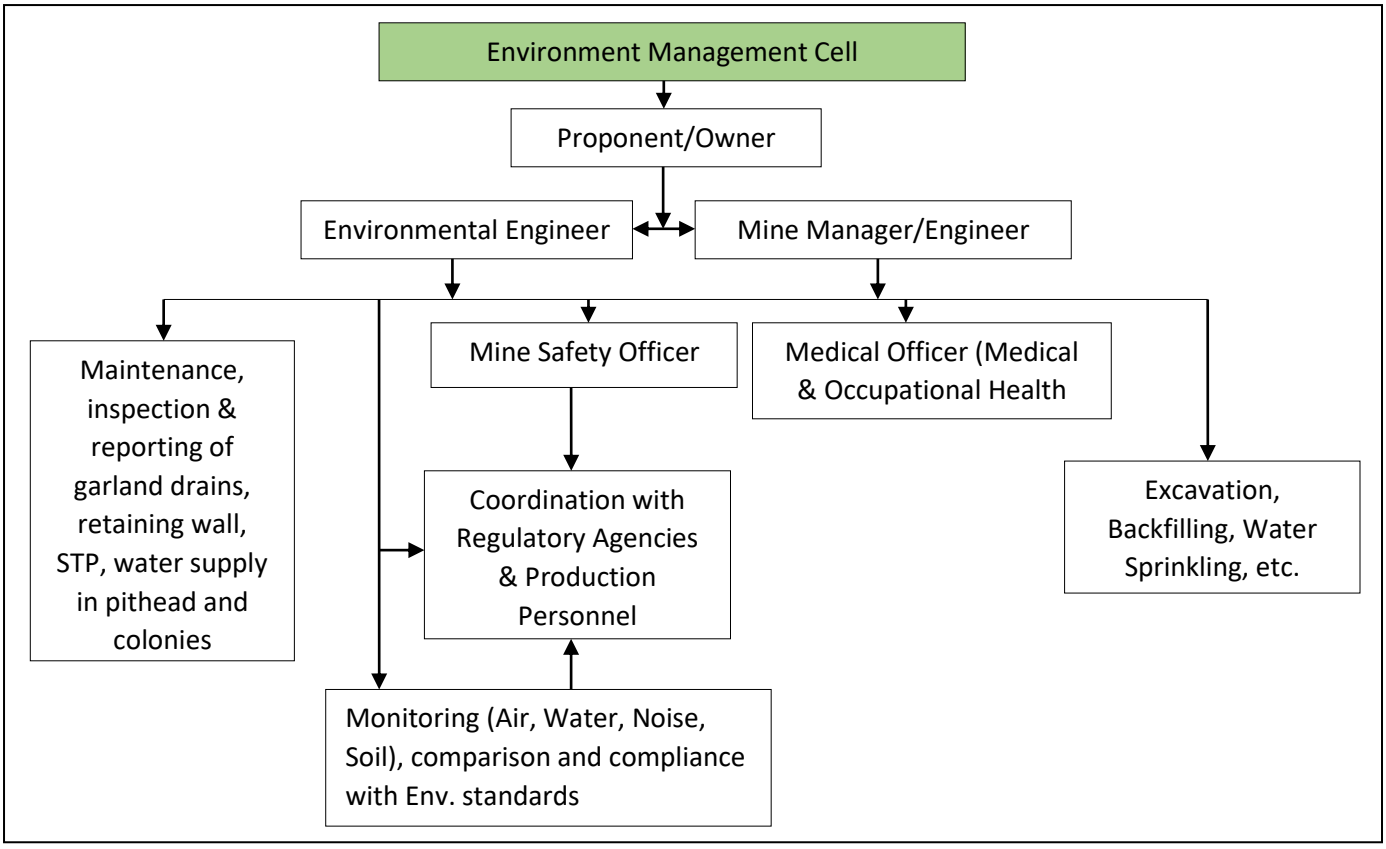


Fig 10.1: Organizational Set-up and basic functions of the Environment Management Cell (EMC)

10.2.3. System of reporting non-compliances/violations of environmental norms

The EMC shall monitor the implementation of environmental norms/conditions and inform about any deviations to the Owner. The Project owner will then take suitable corrective measures in co-ordination with the state environment departments, forest department, State Pollution Control Board of Meghalaya and the Integrated Regional Office (IRO) of the MOEF&CC.

10.2.4. Estimation of Capital and Recurring Expenditure towards Environmental Protection

Capital and ongoing expenses will be incurred in the process of putting the recommended environmental protection measures into practice. Since the execution of protective measures would be ongoing throughout the mine's life, capital investment shall not be necessary all at once. It

would be executed in a phased manner. Every year, there would be a regular requirement for the recurring expenditure, which has been furnished in **Table 10.3**.

The total funds earmarked for the environmental protection and monitoring measures as described in in this Environment Management Plan (recurring for LoM) with the proposed production capacity for this mine is **₹ 6.00 L/year** and, with an allocated Capital Cost of **₹ 5.00 L**.

Table 10.3: Estimated EMP Cost

S. No.	Particulars	Capital Cost (in Lakhs)	Total Recurring Cost (in Lakhs)
1	Pollution monitoring – Air, Water, Noise and Soil	0	1.50
2	Water requirements (Drinking and domestic, plantation, and dust suppression, etc.)	0	1.20
3	PPE and First-Aid facilities	1.50	0.30
3	Green Belt development (Tree guards, plantation and its maintenance, etc.)	1.50	1.00
4	Construction and maintenance of approach road into metalled road approx. (250m) which will be used for mineral transportation till main road, settling tanks, garland drain, and the retaining wall	3.00	1.00
5	Septic Tank construction and maintenance	2.00	0.60
6	Implementation of rainwater storage and harvesting structures and its maintenance	1.00	0.40
Total		**9.00**	**6.00**

10.3. CORPORATE SOCIAL RESPONSIBILITY (CSR)

The proposed Thanghunai Limestone Quarry over an area of 3.0 Ha. is privately owned by the applicant Shri Plenty K Pyngrope. The estimated project cost is around ₹25 Lakhs. The project proponent will bear 5% of the total estimated Project Cost (approx. ₹25 L) as mentioned in the pre-feasibility report, which comes to ₹1.25 L to be spent under Corporate Social Responsibility (CSR) plan annually to mitigate impacts due to this mining project and concerns raised during public consultation. A tentative breakup is given in **Table 10.4**.

Table 10.4: Estimated CSR Budget

S. No.	Particulars	Expenditure (in ₹ Lakhs)
1	Organization of quarterly (every 3 months) health check-up camps for the mine workers and villagers of the nearby villages of Nongtalang, Amjajer Roko, and others	0.65
2	Tree plantation drive for avenue plantation works on both sides of the roads and in community areas in the nearby village areas	0.6
Total		**1.25**

10.4. PLAN OF COMPLIANCES OF REGULATORY REQUIREMENTS

It is inadequate to merely implement and oversee the approved and suggested EMP. Part and parcel of the procedure also includes keeping accurate records and informing the relevant regulatory authorities regarding various compliances.

Details of the monitored data and half-yearly compliance reports will be submitted to the Regional Office of the MoEF&CC and the State Environment Impact Assessment Authority of Meghalaya (SEIAA Meghalaya) on a bi-annual basis. All concerned departments shall be informed about the commencement of mining operations at the proposed project location after the grant of Consent to Operate (CTO) and shall be regularly consulted during the mine's operational stage.

Chapter 11 – SUMMARY AND CONCLUSION

11.1. INTRODUCTION

The applicant for Thanghunai Limestone Quarry - Smt. Plenty K Pyngrope, has obtained the Letter of Intent vide No. **JH/PKP/ML/LS/2018-19/959/B/920**, dated **16/01/2024** over an area of **3.0 ha** at Thanghunai, Nongtalang, West Jaintia Hills, Meghalaya (**Refer Annexure 7**).

The Divisional Forest Officer, Jaintia Hills Territorial Division, Jowai issued letter vide No. **JH/PKP/ML/LS/2018-19/959/B/826** dated **22/12/2023** stating that the proposed project falls under a non-forest land category (**Refer Annexure 6**).

The Modified Mining Plan with Progressive Mine Closure Plan of Thanghunai Limestone Quarry was approved by the Divisional Mining Officer, Directorate of Mineral Resources, Meghalaya, Jowai vide letter No. **DMO-J/78/MM/Mining Plan/2022-23/20** dated **31/01/2024** (**Refer Annex 8**).

The project proponent has also obtained a cluster certificate from the Divisional Mining Officer, West Jaintia Hills, Jowai vide letter No. **DMO-J/78/MM/Mining Plan/2022-23/21** dated **31/01/2024** (**Refer Annexure 9**). As per the cluster certificate, seven limestone projects or mines with a total area of 21.86 ha are lying within 500 m from the periphery of this mining lease area.

State Environment Impact Assessment Authority (SEIAA) of Meghalaya recommended the Terms of Reference ToR for the preparation of the EIA/EMP report and subsequently issued ToR vide File No. **ML/SEAC/SEIAA/PP/WJH/18/2024** dated **3rd July 2024** to Thanghunai Limestone Quarry (**Refer Appendix 1**).

The bounding latitudes of the project area are 25°13'03.48"N to 25°13'12.18"N and bounding longitudes are 92°04'43.48"E to 92°04'50.27"E with a maximum elevation of 719 mRL and minimum elevation of 709 mRL. The area falls in the Survey of India Topo Sheet No. 83C/4 (Restricted). The lease area forms a part of the individual owned land taken on lease.

The estimated total balance mineable reserve within the leasehold area is approximately 1621598 Tonnes. Targeted peak production would be 148908 TPA. A few important details of the approved Modified Mining Plan with Progressive Mine Closure Plan are depicted in the **Table 11.1** below:

Table 11.1: Brief details of the project as per the approved Modified Mining Plan with Progressive Mine Closure Plan of Thanghunai Limestone Quarry

Aspect	Value	Aspect	Value
Allotted Mine Lease Area (Ha.)	3.0	**Plan Period (Years)**	5
Total Mineral Reserve (Tonnes)	1621598	**Total Production (T)**	16,21,598
Life of Mine (Years)	12	**Total Working Days/Year**	300
Manpower	37	**Mining Method**	Opencast, Semi-mechanised

11.1.1. Mining Method

- Opencast semi-mechanized mining will be carried out in the area as the deposit is massive and compact in nature.
- Jack hammer drill machine will be deployed for drilling of shot holes ranging from 39 mm to 34 mm diameter. Breaking of limestone at the required site will be done manually.
- For blasting of holes with burden and spacing of 0.8 m x 1.0 m in a staggered grid pattern would be adopted.
- Muffle blasting will be adopted as a precautionary measure to control fly rocks. Excavation and handling of gritty soil will be done by excavator if necessary.
- The benching system 6m x 6m will be practiced in the area in order to comply with the provisions of Metalliferous Mines Regulations, 1961. Bench slope angle for stabilization of the benches will be maintained at 45°.

11.1.2. Raw Materials Required

Inputs	Approx. quantity required (KLD)
High Speed Diesel Water Requirement	
Diesel	~0.1
Water Requirement	
Water for Drinking and Domestic Purposes	~2.0 Water requirement for drinking & domestic per person is 50 L/day. Therefore, requirement is 37x50 = 1850 L/day (~2 KLD)
Dust Suppression	3.0
Greenbelt Development/Plantation	3.0
Cleaning of HEMMs, and other machinery	2.0
Total	**10.0**

11.2. DESCRIPTION OF ENVIRONMENT

The baseline data has been collected from December 2023 to February 2024. The details area given below:

Micro-Meteorological Parameters

Temperature: Temperature of the area varied from 8.4°C to 28.1°C.

Relative Humidity: Relative Humidity of the area varied from 23.7% to 100%.

Wind Speed: Maximum win speed was 40.7 Km/hr with average wind speed was 5.65 Km/hr. Calm wind was 12.73%.

Ambient Air Quality (AAQ) Results

Samples were collected from 6 sampling locations during the baseline data collection period. The results are given below:

Particulate Matter (PM_{10})

The results of PM_{10} of all the locations are showing variations from 48.7µg/m^3 in the Pamtbuh

Village to 68.0 µg/m^3 at the project site. Hence, the results are within the limits of the National Ambient Air Quality Standards (NAAQS).

Particulate Matter ($PM_{2.5}$)

The results of $PM_{2.5}$ of all locations are showing variations from 23.5µg/m^3 in the Pamtbuh Village to 41.0 µg/m^3 at the project site. However, the results are within the limits of the National Ambient Air Quality Standards (NAAQS).

Gaseous Pollutants

The results of SO_2 concentration at all locations are showing variations from 6.4µg/m^3 in the Nongtalang College (Permanent Campus) to 14.9 µg/m^3 at the project site. However, the results are within the limits of the National Ambient Air Quality Standards (NAAQS).

The results of NO_2 concentration at all locations are showing variations from 13.2µg/m^3 in the Nongtalang College (Permanent Campus) to 20.8 µg/m^3 in the project site. However, the results are within the limits of the National Ambient Air Quality Standards (NAAQS).

Ambient Noise Level (ANL) Results

Samples were collected from 6 sampling locations during the baseline data collection period. The results are given below:

The ambient noise level at day time varied from 43.5 dB (A) at Pamtbuh village to 63.1 dB(A) at the project site which is within the standard limits of an Industrial area of 75 dB(A). The night time noise result varied from 37.9 dB(A) at Pamtbuh village to 52.6 dB(A) at the project site which is within the standard limits of an Industrial area of 70 dB(A).

Water Quality Results

The samples were collected from 4 ground water locations and 3 surface water locations (2 water sources). The results are given below:

Groundwater Results

All results comply with the standard drinking water standards of India, i.e., IS: 10500:2012.

Surface Water Results

The surface water quality results of the upstream and downstream water sampling locations of Wah Umngot and a sampling location of Wah Amkshar are within the IS standard 2296:1992 and prescribed CPCB Water Quality Criteria Class-C.

Soil Quality Results

Samples were collected from 5 sampling locations during the baseline data collection period. The results are given below:

pH ranging from 6.34 to 6.82 in the study area. Bulk density of the study area ranges between 1.34 gm/cm^3 S3 (Amtapoh) to 1.56 gm/cm^3 at S1 (Project Site). Electrical conductivity of the soil samples is found to be average and ranges from 340 µmhos/cm to 371 µmhos/cm. Organic carbon of the soil samples varies from 1.42% in S2 (Nongtalang) to 1.70% in S5 (Pantbuh). Nitrogen content in the surface soil of the study area varies between 24.8 mg/100g at S4 (Amlarem) to 28.7 mg/100g at S3 (Amtapoh). Available Phosphorus ranges between 0.80 mg/100g at S2 (Nongtalang) to 8.3 mg/100g at S5 (Pantbuh). Potassium content in the study area ranges between 0.53 mg/100g at S1 (Project Site) to 7.0 mg/100g at S2 (Nongtalang).

Based on the provided data, it can be inferred that the soil in the study area has moderate fertility, indicated by sufficient levels of phosphorus and Organic Carbon for plant growth and foliage development.

Ecological Studies

Flora: The flora found in the whole of the study area are representative of mainly Deciduous/Semi-Deciduous Forest and Scrub Forest. The complete list of Flora in the Study area has been given in Chapter 3.

Fauna: During study, various types of fishes, amphibians, reptiles, avifauna and mammals along with invertebrates were recorded. A list of the faunal diversity of the study area is given in Chapter 3.

Demography and Socio-economic Study Results

The study area encompasses 66 villages within the buffer zone. The study was conducted using a combination of primary surveys and secondary data sourced from the Census of India 2011. Summarized details are given below:

Population

The study area has a total population of 28902 residing in 5211 households. On average, each

household consists of 5.55 members. The gender ratio in the study area was 1009 in 2011.

Social Structure

In the study area, the Scheduled Tribes (ST) population accounts for 89.56% of the total population, while the Scheduled Caste (SC) make up 1.54% of the total population.

Literacy

Within the study area, the overall literacy rate is 59.39% of the total population. Among the literate population, male literacy stands at 49.25%, while female literacy is recorded at 50.75%.

The project will provide direct employment opportunities for 37 individuals, with a focus on hiring local residents in addition to fulfilling any necessary statutory employment requirements.

11.3. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

This section summarizes the pollution potential of the proposed project, possible impacts on the surrounding environment during its operational phases and the environment management plan proposed for prevention and control of pollution.

11.3.1. Impacts due to Air Pollution and their Mitigation Measures

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, water sprinkling and mist spraying via APCEs shall be done and workers will be given protective gears such as Personal Dust Samplers, full PPE which shall include protective goggles, dust masks, gloves, safety helmets, and safety shoes.

11.3.2. Impacts due to Noise Pollution and their Mitigation Measures

Due to mining operations such as machinery, drilling and blasting for mine development, excavation, transportation and sizing of limestone, it is anticipated that noise levels will increase. Proposed mitigation measures include maintenance of blasting parameters such as burden, spacing, charge per delay, sub-grade drilling, etc. Controlled blasting techniques such as pre-split blast, use of NONEL, etc. will be followed to minimize noise and generation.

Further, engines of HEMM and other mine machinery and transport vehicles shall be properly maintained to reduce noise generation. Provision of incorporating silencers into the dumpers and other vehicles shall be suggested to control noise propagation. Acoustic enclosures shall be

provided in the DG sets. All the workers will be provided with personal PPE such as ear plugs and ear muffs for noise attenuation.

The greenbelt development around the ML area shall also act as a noise barrier.

11.3.3. Impacts due to Water Pollution and their Mitigation Measures

The main sources of water pollution are mine discharge and surface run-off containing suspended solids. The mine discharge water will be passed through settling ponds for removal of suspended solids.

About 10 KLD water is required for various requirements of the mine like dust suppression (3 KLD), HEMM washing at workshop (2 KLD), plantation (3 KLD) and drinking and domestic consumption (2 KLD).

As the system involved is a closed circuit, there is no scope for process wastewater generation. Hence, there will be no wastewater discharge outside the mine premises and no contamination of surface and/or groundwater bodies is anticipated. To augment the artificial recharge of groundwater, a detailed Rainwater Harvesting and Artificial Recharge of Groundwater Plan is included as **Annexure 12** to this report.

11.3.4. Impacts due to Solid Waste Generation and their Mitigation Measures

The entire product of limestone will be used as building materials for construction activities. During the project's life, 6519 Tonnes of gritty soil will be removed which will be stacked in a specific stack yard and will be used for haul road dressing and plantation. Moreover, to prevent erosion during rainy as well as windy season, the stack yard will be planted with small varieties of plantation and grasses to prevent such erosion.

11.3.5. Impacts on Land and their Mitigation Measures

The Land Use pattern in the lease area may change as a result of different phases of mining operations. Land reclamation shall be done along with ongoing mining operations in order to minimise the negative consequences. After the end of mining operations, a total area of 0.56 Ha. of land within the safety barrier of the ML area shall be developed into a dense greenbelt area, and the remaining backfilled areas will be revegetated by plantation activities. Any remaining mine void shall be converted into a water body – which may act as a potential source of surface water and recharge for ground water in the future for the neighbouring communities (Sengupta,

2015).

11.3.6. Impacts on Ecology and Biodiversity

As the mining activity is restricted to the core zone, no significant impact on the surrounding ecology of the area is anticipated. With development of greenbelt around the mine, aesthetics of the area shall be improved

11.3.7. Impact on the Socio-economic Environment

The project will enhance direct and indirect employment in the area. Therefore, overall economic development is likely to improve after the commencement of the project.

11.4. ENVIRONMENTAL MONITORING PROGRAMME

A systematic environmental monitoring programme will be implemented within the mining lease area and a 10 km radius study area. A comprehensive network for monitoring has been developed, considering factors such as pollution sources from mining operations, wind direction, drainage pattern, topography, and the biological environment. Sampling locations have been identified accordingly to ensure comprehensive coverage and accurate assessment of environmental parameters. The Environment Monitoring Cell (EMC) will be responsible for successful implementation of the monitoring program.

11.5. ADDITIONAL STUDIES

Risk Assessment & Disaster Management Plan: Mining will be carried out by semi-mechanized opencast mining, with mining equipment as Jack Hammers, Hydraulic Excavator, Air Compressor, Rock Breaker, tippers etc involving drilling and blasting. Mining will be done under strict supervision hence the rate of operational risks is minimal.

Rehabilitation and Resettlement: There is no human habitation at the project site. So, there will be no rehabilitation and resettlement issue.

11.6. PROJECT BENEFITS

The mining project has a substantial positive impact on the socio-economic environment, supporting the overall development of the area. It contributes significantly to economic growth by generating direct employment for 37 individuals and creating numerous indirect employment opportunities for the local community.

11.7. ENVIRONMENT MANAGEMENT PLAN

An EMP is a site-specific plan developed to ensure that the project is implemented in an environmentally sustainable manner. An effective EMP should ensure the application of best practice environment management to a project. Hence, to ensure effective environmental protection measures throughout and after the commissioning of the proposed mining project, the preparation of an Environmental Management Plan (EMP) is necessary. The EMP serves as a comprehensive framework for formulating, implementing, and monitoring environmental safeguards.

By the end of the lease period, green belt development programme will be carried out over an area of 0.56 ha. Native species will be considered for the plantation purpose.

The following objectives have been incorporated into the design of the EMP in order to mitigate the adverse environmental effects which will be caused due to mining:

- Biological reclamation and rejuvenation of the mined-out areas and active points of the mine lease area to the maximum possible extent possible, in line with the economy of mining operations, the drainage pattern, geological stability, vegetation, etc.;
- Minimal disturbance to the water environment and existing ecological status of the area and conservation of the same;
- Efforts towards improvement of the air quality, water quality and the land during and post mining activities; and
- Establishment of an environment which is conducive to improve the socioeconomic situation in the area.

11.7.1. Estimated Cost of the Project

The project cost is **₹25.0 Lakhs** and the EMP capital cost is **₹9.0 Lakhs** and annual recurring cost is about **₹6.0 Lakhs**. Budget towards Corporate Environment Responsibility (CER) will be **₹1.25 lakhs**.

11.8. CONCLUSION

From the detailed analysis of the environmental impacts and the mitigation measures proposed in the EMP, it is anticipated that no significant deterioration in the eco-system is likely to occur due to this limestone mine. On the other hand, the project is likely to have several benefits like improvement in indirect employment generation and economic growth of the area, by way of improvements in the infrastructure facilities and better socio-economic conditions.

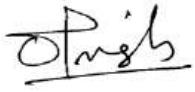
Chapter 12 – DISCLOSURE OF CONSULTANTS ENGAGED

12.1. DECLARATION BY EXPERTS CONTRIBUTING TO THE PREPARATION OF EIA-EMP OF THANGHUNAI LIMESTONE QUARRY

12.1.1. Declaration by the EIA Co-Ordinator

I, hereby declare that I was involved in the capacity of an EIA Coordinator for developing and preparing the EIA-EMP Report of Thanghunai Limestone Quarry for a Mine Lease area of 3.00 Ha. located in Thanghunai, Nongtalang Elaka, Amlarem C&RD Block, West Jaintia Hills District of Meghalaya.

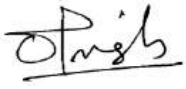
***Name*: Dr. Om Prakash Singh** (NABET Approved Category-A EIA Coordinator)

***Signature*:** 

***Period of Involvement*:** December 2023 - Ongoing

***Contact Information*:** N6/2, 150 S, Indira Nagar Colony, Chitaipur, Varanasi- 221005, Uttar Pradesh

12.1.2. Declaration By the Functional Area Experts (FAEs)

S. No.	Name of the Expert	Functional Areas	Involvement	Period	Signature
1	Dr. Om Prakash Singh	AP Category A	Involved in identifying monitoring locations, interpretation of results, identifying impacts and suggesting mitigation measures.	December 2023 - Ongoing	
		WP Category A	Involved in identifying monitoring locations, interpretation of results, identifying impacts and suggesting mitigation measures.		
		AQ Category A	Involved in meteorological studies,		

			identifying air pollution sources, Suggesting mitigation measures.		
2	Jadab Chandra Dutta	GEO Category A	Involved in interpreting the geology of the project area and identifying impacts. Suggesting mitigation measures.	December 2023 - Ongoing	
3	Rajnarayan Biswas	HW Category A	Involved in quantifying hazardous waste, identifying impacts and suggesting mitigation measures.	December 2023 - Ongoing	
		NV Category A	Involved in identifying monitoring locations, interpretation of results, identifying impacts and suggesting mitigation measures for adverse impacts due to noise.		
		RH Category A	Risk assessment, preparation of risk and disaster management plan.		
4	Amlanjyoti Kar	HG Category A	Involved in identifying the drainage pattern and potential impacts to the surface/groundwater regime of the area. Suggesting mitigation measures.	December 2023 - Ongoing	
5	Asok Kanti Sanyal	EB Category A	Involved in flora & fauna studies by species identification. Identifying impacts and suggesting mitigation measures.	December 2023 - Ongoing	
6	Mita Chakrabarty	SE Category A	Involved in socio-economic studies, data analysis and interpretation, identifying impacts and potential socio-economic change due to the project.	December 2023 - Ongoing	
7	Saumendra Narayan Halder	LU Category A	Processing satellite imageries for land use classification. Identifying	December 2023 - Ongoing	

			impacts and suggesting mitigation measures.		
		SC Category A	Characterisation of soil, assessment of pollutant impacts on soil and suggesting mitigation measures		
8	Rajendra Kumar Kalita	HG Category A	Involved in identifying the drainage pattern and potential impacts to the surface/groundwater regime of the area. Suggesting mitigation measures.	December 2023 - Ongoing	R. Kalita

12.1.3. Declaration by the Head of the Accredited Consultant Organisation

I hereby confirm that the EIA/EMP for Thanghunai Limestone Quarry was prepared by the aforementioned experts. The EIA Coordinator (EC) has reviewed the report. The consultant organization assumes full responsibility for any misleading information. It is certified that no unethical practices or plagiarism were involved in carrying out this work. External data or text has not been used without proper acknowledgment.

Signature: Soumi Chakraborty

***Name (authorized signatory)*: Soumi Chakraborty**

***Designation*:** Managing Director

***Date*:** 26/07/2024

12.2. EIA-CONSULTANT ORGANISATION NABET ACCREDITATION CERTIFICATE

QUALITY COUNCIL® OF INDIA
QCI Creating an Ecosystem for Quality

NABET

National Accreditation Board for Education and Training

NABET

Certificate of Accreditation

Novomine India Private Limited

4th Floor, Building No. 65, Opp- The Children's Hospital,
Pohkseh, Shillong, East Khasi Hills, Meghalaya- 793006

*The organization is accredited as **Category-A** under the QCI-NABET Scheme for Accreditation of EIA Consultant Organizations, Version 3: for preparing EIA-EMP reports in the following Sectors –*

S. No	Sector Description	Sectors (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 IA AC minutes dated September 22, 2023, posted on the QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance with the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/23/3025 dated November 10, 2023. The accreditation needs to be renewed before the expiry date by Novomine India Private Limited, Meghalaya following the due process of assessment.

Sr. Director, NABET
Date: November 10, 2023

Certificate No.
NABET/EIA/2326/IA 0124

Valid up to
August 3, 2026

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

12.3. NABL CERTIFICATE OF EXTERNAL LABORATORY

National Accreditation Board for Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

N. D. INTERNATIONAL

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

17, JNAN GOSWAMI SARANI, 107B, BLOCK-F, NEW ALIPORE, KOLKATA, WEST BENGAL, INDIA

in the field of

TESTING

Certificate Number: TC-5910

Issue Date: 07/06/2022 Valid Until: 06/06/2024

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Identity : N. D. INTERNATIONAL

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

Gmail **N D INTERNATIONAL <ndinternational@gmail.com>**

Fw: Extension of the accreditation for One month i.e. 06.08.24

Sutapa (ND International) <sutapa@ndinternational.org> Thu, Jul 4, 2024 at 5:19 PM
To: "Debasis De (ND International)" <debasis@ndinternational.org>
Cc: ND International <ndinternational@gmail.com>

Extension letter from NABL

From: Ajay Sharma <ajay@nabl.qcin.org>
Sent: Thursday, July 4, 2024 3:32 PM
To: Sutapa (ND International) <sutapa@ndinternational.org>
Subject: Re: Extension of the accreditation for One month i.e. 06.08.24

Dear Madam,

Greetings!

The validity of the accreditation of your laboratory is further extended for the existing scope of accreditation up to 06.08.24 or till the decision on renewal of accreditation, whichever is earlier.

You may continue to issue test reports with the NABL symbol for the existing scope and the personnel for report review and authorize the results.

The extension of accreditation validity is subject to continued compliance of NABL norms during the accreditation period.

Being an accredited laboratory of NABL, you must fulfill all the Terms and Conditions laid down in NABL document NABL-131. You are requested to follow NABL-133 for using the NABL symbol.

Thanks & Regards

डॉ. अजय कुमार शर्मा
(Dr. Ajay Kumar Sharma)
उप निदेशक (Dy. Director)
राष्ट्रीय परीक्षण और अंशशोधन प्रयोगशाला प्रत्यायन बोर्ड
National Accreditation Board for Testing and Calibration Laboratories
भारतीय गुणवत्ता परिषद I Quality Council of India
"NABL House", Plot No. 45, Sector 44,
Gurgaon - 122002, Haryana
Tel. no.: 91-124-4679793

From: Ajay Sharma
Sent: 07 June 2024 17:09
To: sutapa@ndinternational.org <sutapa@ndinternational.org>
Subject: Extension of the accreditation for One month i.e. 06.07.24