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TATA

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June 16, 2014

The Director (Non-Coal Mining),
Member Secretary, Expert Appraisal Committee
IA Division, Ministry of Environment & Forest,
New Delhi 110003

Sub: Tata Chemicals Limited- Application for Environmental Clearance of Limestone Mine Lease 16.21 Ha, Village- Aniali, Taluka- Ranavav, Dist- Porbandar

Ref: 1. MoEF ToR letter No. J-11015/308/2012-IA.II(M) dated 19.03.2013
2. MoEF letter No. Item No. J-11015/308/2012-IA.II (M) dated 25.04.2014

Dear Sir,

With reference to the above (Ref-2), we hereby submit revised EIA/EMP report (Annexure-1) with following information:

S. No.	Details required in revised EIA/EMP	Details incorporated in revised EIA
(i)	Mining plan and mining scheme has not been circulated to the Committee Members and that the Committee experienced difficulty to appraise the proposal of EC without mining plan;	Annexure XI of revised EIA
(ii)	there are Schedule-I species against which conservation plan on Biodiversity with funding provision has not been submitted;	Section 9.3.8.1 and Annexure IX of revised EIA
(iii)	cumulative impact of other mines within 10 km radius has not been reflected;	Section 4.4.5 of revised EIA
(iv)	details of impact due to transportation of limestone has not been provided;	Section 2.5.6 of revised EIA
(v)	Proponent reported in the Questionnaire that the mine is 'New Mine', however, it is an old working mine;	Updated Questionnaire S. No. 1 (d) of revised EIA
(vi)	analysis/testing report of water, air, soil, noise etc. are not enclosed with the EIA/EMP report;	Annexure XIV of revised EIA
(vii)	detailed Action plan with budgetary allocation on issues raised during the Public Hearing has not been submitted	Section 7.1 of revised EIA
(viii)	Geological profile, and the area falling under seismic zone have not been furnished	Section 3.2.2.3 of revised EIA

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S. No.	Details required in revised EIA/EMP	Details incorporated in revised EIA
(ix)	Details of occupational health status of the workers has not been furnished.	Section 9.3.9 of revised EIA

We request your good self to kindly consider the TCL request favourably and accord Environment Clearance.

Thanking You

R J Buch
General Manager (safety, Health & Environment)
Tata Chemicals Limited,
District Devbhumi Dwarka
Gujarat- 361345
Phone- 02892-665267, Mobile: 09227617010

Enclosures: Annexure1: Revised EIA/ EMP Report

FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT

&

ENVIRONMENT MANAGEMENT PLAN

FOR

ANIALI LIMESTONE MINE

(16.21 HA)

OF

M/S TATA CHEMICALS LIMITED,

AT SURVEY NO. 207/PART,

VILLAGE ANIALI, TALUKA -RANAVAV,

DISTRICT PORBANDAR, GUJARAT

PREPARED BY:

MANTEC CONSULTANTS PVT. LTD.

(QCI Accredited consultant at S. No. 96 as per List of Accredited Consultant Organizations/ Rev. 20/May 5, 2014)

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June, 2014

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	10	APPROVED MINING SCHEME DATED 21.10.2008

List of Annexures

ANNEXURE-XII	-	PUBLIC HEARING PROCEEDINGS
ANNEXURE-XIII	-	LATEST QCI ACCREDITATION STATUS OF MANTEC CONSULTANTS PVT. LTD.
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ANNEXURE-XV	-	FROM I – NOTICE OF OPENING, CLOSING OR CHANGE ETC.

CHAPTER 1:

INTRODUCTION

1 Introduction

1.1 Preamble

Environmental Impact Assessment (EIA) is the management tool to ensure the sustainable development and it is a process, used to identify the environmental, social and economic impacts of a project prior to decision-making. It is a decision making tool, which guides the decision makers in taking appropriate decisions for any project. EIA systematically examines both beneficial and adverse consequences of the project and ensures that these impacts are taken into account during the project designing. It also reduces conflicts by promoting community participation, information, decision makers, and helps in developing the base for environmentally sound project.

The Ministry of Environment and Forests, Govt. of India, through its EIA notification No.SO1533(E) of Sept. 14th 2006 and its subsequent amendments later under the Environment Protection Act, 1986, classified the projects under two categories – A (more than 50 ha) and B (≥5 ha but ≤50 ha). Category-A projects (including expansion and modernization of existing projects) require Environmental Clearance from Central Government (Ministry of Environment and Forests, Govt. of India, New Delhi) while category – B projects are considered by State Level Environmental Impact Assessment Authority (SEIAA), constituted by MoE&F, New Delhi. If in case, any category "B" project attracts the "general condition" given in the EIA notification, it shall be treated as category "A" and will be considered at MOEF, New Delhi.

The proposed project is categorized under category "B" Activity 1(a) (Open cast mining of minerals, mining lease area <50 hectare) as the lease area is 16.21 ha. However due to the presence of Barda Wildlife Sanctuary within 10 km radius of the mine lease area , the project is categorized as Category "A" and will be considered at MoEF, New Delhi.

In order to assess the likely impacts arising out of the project, the Environmental Impact Assessment (EIA) study is undertaken, which will be followed by preparation of a detailed Environmental Management Plan (EMP) to minimize those adverse impacts.

1.2 General information on Mining of Minerals

Geologically, Gujarat is a treasure trove of various mineral-bearing rocks ranging in age from Pre-Cambrian, Jurassic, Cretaceous, Tertiary and Quaternary Formations. Gujarat is

endowed with rich minerals like petroleum & natural gas, lignite, bauxite, limestone, bentonite, fire-clay, china-clay, fluorspar, marble, agate, chalk, gypsum and decorative &dimension stones with which, the State possesses a prominent place in mineral production in India. Mineral production has been a major factor in providing employment especially in backward areas, earning valuable royalty and foreign exchange. The existence of high-class infrastructure facilities and business environment, further add to the prospect of mineral development and mineral based industries in the state.

1.3 Environmental Clearance

As per the Gazette Notification dated 14th September, 2006 and its subsequent amendments later, the project is classified as Category "A" (as Barda Wildlife Sanctuary located within 10 Km radius of the Mine site.)

The Environmental Clearance process for the project will comprise of three stages. These stages in sequential order are:-

a. Scoping,
b. Public consultation &
c. Appraisal

Scoping of the EIA study (in the form of Terms of Reference) has already been carried out by MOEF, New Delhi after the presentation for obtaining Terms of Reference (TOR) before the Reconstituted Expert Appraisal Committee (Mining) on date 16-18 January 2013, The same was communicated vide MoEF letter no. J-11015/308/2012-IA.II (M) dated. 19.03.2013. This report has been prepared as per the scoping done by the MOEF and Terms of Reference (TOR) issued for the proposed project. Public hearing was conducted on 11-12-2013 under the supervision of Mr M. A. Gandhi (Collector & District Magistrate, Porbandar) & Mr B.L. Maru (Regional Officer, Gujarat State Pollution Control Board). This report is being submitted to MOEF for the purpose of final appraisal of the project for grant of Prior Environment Clearance. The report has been prepared using the following references:

1) Manual of Environmental Impact Assessment, Ministry of Environment and Forests, 2010
2) Form-1 as per EIA Notification, 14th September 2006 and its subsequent amendments
3) Approved Mining Plan.
4) Public hearing proceedings

5) In addition, other relevant standards for individual activities such as sampling and testing of environmental attributes have been followed.

1.4 Terms of Reference

The application for TOR of the "Limestone Mine" of M/s Tata Chemicals Ltd. Located in village-Aniali, Taluka- Ranavav, District-Porbandar, Gujarat was submitted on dated 12.07.2012 and the same was considered in the Meeting of Reconstituted Expert Appraisal Committee (EAC) of MoE&F held on 16-18 January 2013. The committee prescribed the TOR for EIA study of the proposed project vide letter no. J-11015/308/2012-IA.II (M) dated 19.03.2013 (Copy enclosed as **Annexure- I)**. The point-wise compliance of the TOR is as under:-

Table 1-1 : Point-wise compliance of prescribed ToR

S. No	TOR POINT	COMPLIANCE OF TOR
1.	Year-wise production details since 1994 onwards should be given clearly stating the highest production achieved in any one year prior to 1994. It may also be categorically informed whether there had been any increase in production after the EIA Notification, 1994 coming into force w.r.t. the highest production achieved prior to 1994.	• Limestone mine lease was granted vide grant order no MCR-1563/15740/-G-V- dated 12.06.1964 and same was executed on 31.10.1964. The First renewal was granted vide grant order no. MCR-1583(T-4) GOI-184-CHH dated 09.09.1986 and same was executed on 21.08.1987. Copies of lease deed and lease grant order are enclosed as **Annexure II.** • Mine lease was in operation during 1985-86 to 1993-94 with highest production of 55,065 tons during 1987-88. • Issues of mining quantity increase post the EC notification of 27th January 1994 are not applicable in view of the fact that the mine is idle after 1994. Notice of temporary closure dated 29-5-1994 Form I is enclosed as **Annexure XV**. • Present application is for starting mining operations. • This is the first EC application by TCL for the subject lease.
2.	A copy of the document in support of the fact that the proponent is the rightful lessee of the mine should be given.	Limestone mine lease was granted vide grant order no MCR-1563/15740/-G-V-dated 12.06.1964 and same was executed on 31.10.1964. The First renewal was granted vide grant order no. MCR-1583(T-4) GOI-184-

		CHH dated 09.09.1986 and same was executed on 21.08.1987. Copy of Lease deed and grant order stating that M/s Tata Chemicals Ltd. is the rightful lessee, has been attached as **Annexure- II**
3.	All documents including approved mine plan, EIA and public hearing should be compatible with one another in terms of the mine lease area, production levels, waste generation and its management and mining technology and should be in the name of the lessee.	All the documents including approved mining plan, EIA and public hearing are compatible with one another in terms of the Mine lease area (16.21 Ha), Production levels 0.093 Million MT (Ref- Section 1.8.3g) 0.088 (Ref- Section 1.8.3h), Waste generation (Nil) and its management and mining technology and are in the name of lessee (M/s Tata Chemicals Ltd). • The Approved Mining Plan is attached as **Annexure XI**. • Public Hearing Minutes of Meeting is attached vide **Annexure XII**.
4.	All corner coordinates of the mine lease area superimposed on High Resolution	All the corner coordinates of mine lease area has been marked/ superimposed on high resolution imagery. Copy is enclosed as **Annexure- III.**
5.	Imagery/Toposheet should be provided.	
6.	Does the company have a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.	M/s TATA Chemicals Ltd. has a well laid down policy for Safety Health and Environment and social accountability. The same has been detailed in **Chapter-9** (Section 9.2.1) of EIA report. Copy is enclosed as **Annexure- IV**.
7.	Does the Environment Policy prescribe for standard operating process/procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / conditions? If so, it may be detailed in the EIA.	M/s TATA Chemicals Ltd. conforms to the standard operating procedures for legal and quality system as per ISO 9001, ISO 14001 & OSHAS 18001. All these procedures are detailed in **Section 9.2** of **Chapter –9** in EIA report.
8.	What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the EC conditions. Details of this system may be given.	Company has well established Environmental Management System which is headed by General Manager- Safety, Health & Environment. Company has implemented online Legal Compliance management system with well-defined compliance owners. The system generates Email alerts for meeting compliances and has inbuilt escalation mechanism to keep the senior management informed on compliance updates. The Details

		of hierarchical system for environment management is detailed in **Chapter 9** of EIA Study Report **Section 9.2.3**.
9.	Does the company have a 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? This reporting mechanism should be detailed in the EIA report.	Company publishes Corporate Governance Report as part of Annual Financial Reporting. The corporate governance philosophy of the Company has been strengthened with the adoption of the Tata Code of Conduct, Tata Business Excellence Model, and Code of Corporate Disclosure Policies. The Company, through its Board and Committees, endeavours to strike and deliver the highest governing standards for the benefit of its stakeholders. Audit committee of Board of Directors ensures Company's compliance with the legal and regulatory requirements and the Tata Code of Conduct (TCoC).
10.	Issues relating to mine safety based on subsidence study should be detailed. The proposed safeguard measure in this regard should also be provided.	Mining will be carried out by opencast mechanized method as per Mining Plan approved by Indian Bureau of Mines. Subsidence is not envisaged. The Details are given in section **6.2.1.1.**
11.	The study area will comprise of 10 km zone around the mine lease from lease periphery and the data contained in the EIA such as waste generation etc. should be for the life of the mine / lease period.	The study area comprises of 10.0 km zone around the mine lease periphery as shown in the study area Map which is enclosed as **Annexure-V.** As per approved mining plan the mineral limestone is exposed on the surface and stratified. There is no overburden to handle. The mineable area is devoid of top soil; hence, no proposals are made for top soil management. The details of solid waste management are given in EIA Report **Section 2.5.7.**
12.	Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary and national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated.	A map delineating all the features such as Forests, Agricultural Land, Settlement, Wildlife Sanctuary etc. has been prepared and a copy of same has been enclosed as **Annexure – VI.** Land use classification of 10 Km radius study area around the mine site, is as given in **Table 3-1**.

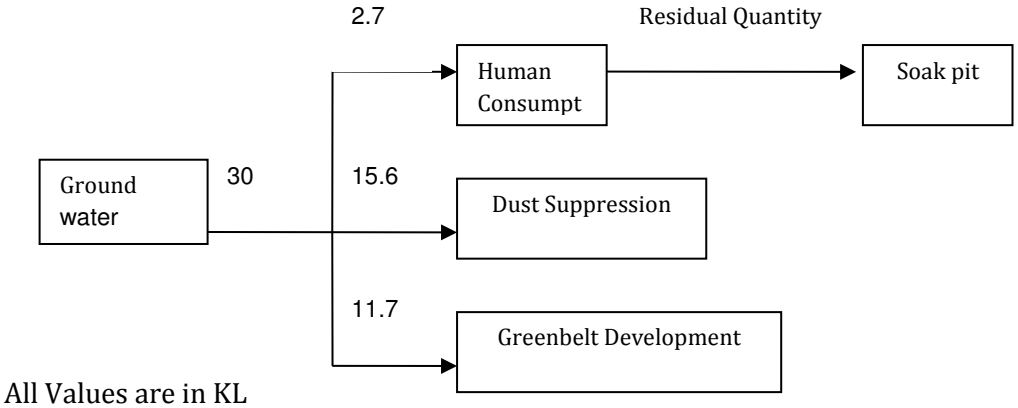
<table>
<tr><td></td><td></td><td>
<table>
<tr><th>S. No.</th><th>Land-use Class</th><th>Area (sq.km)</th><th>%</th></tr>
<tr><td>1</td><td>Agriculture land</td><td>186.28</td><td>59.29</td></tr>
<tr><td>2</td><td>Forest land</td><td>39.24</td><td>12.49</td></tr>
<tr><td>3</td><td>Settlement</td><td>34.87</td><td>11.10</td></tr>
<tr><td>4</td><td>Water Bodies</td><td>11.74</td><td>3.74</td></tr>
<tr><td>5</td><td>Waste land</td><td>17.85</td><td>5.68</td></tr>
<tr><td>6</td><td>Barda Wildlife Sanctuary</td><td>24.18</td><td>7.70</td></tr>
<tr><td colspan="2">Total area</td><td>314.16</td><td>100</td></tr>
</table>
</td></tr>
<tr><td>13.</td><td>Land use plan of the mine lease area should be prepared to encompass preoperational, operational and post operational phases and submitted.</td><td>As per Approved Mine plan Land use pattern for Pre-operational, Operational and Post-operational phases is given in Table 2-2 Section 2.2.2.
<table>
<tr><th>Particulars</th><th>Pre-operational phase – Area in Ha.</th><th>Operational Phase (after plan period) Area in Ha</th><th>Post Mining (Conceptual phase) at the end of Mine Life – Area in Ha.</th></tr>
<tr><td>Pits</td><td>9.544</td><td>13.08</td><td>13.13</td></tr>
<tr><td>Roads /</td><td>0.49</td><td>0.32</td><td>0</td></tr>
<tr><td>Plantation</td><td>0.02</td><td>0.52</td><td>0.86</td></tr>
<tr><td>Remaining Virgin area</td><td>6.156</td><td>2.29</td><td>2.22</td></tr>
<tr><td>Total area</td><td>16.21</td><td>16.21</td><td>16.21</td></tr>
</table>
</td></tr>
<tr><td>14.</td><td>Details of the land for OB dump outside the mine lease such as extent of land area, distance from mine lease, its land use, R&R issues, if any should be given.</td><td>As per approved mining plan the mineral limestone is exposed on the surface and stratified. There is no overburden to handle. The mineable area is devoid of top soil; hence, no proposals are made for top soil management. The details of solid waste management are given in EIA Report Section 2.5.7.</td></tr>
<tr><td>15.</td><td>High Resolution Satellite Imagery of the proposed area clearly showing the land use and other ecological features of the study area (core and buffer zone) should be furnished.</td><td>Land use map based on High resolution satellite imagery showing all the ecological features of the study area with their classification is enclosed as Annexure – VI.
Major ecological features cited from the land use are :
✓ Barda Wildlife Sanctuary at a distance of 3.92 Km towards NW.</td></tr>
</table>

		✓ Naliyadhar Reserved Forest is situated at a distance of 0.11 Km towards SW. ✓ Minsar River is flowing at a distance of 5.60 Km. ✓ Bileshwari River is at a distance of 4.86 Km.
16.	A Certificate from the Competent Authority in the State Forest Department should be provided, confirming the involvement of forest land, if any in the project area. In the event of any claim by the project proponent regarding the status of forests, the site may be inspected by the State Forest Department along with the Regional Office of the Ministry to ascertain the status of forests, based on which the Certificate in this regard as mentioned above be issued. In all such cases, it would be desirable for representative of the State Forest Department to assist the Expert Appraisal Committees.	As per Approved Mining Plan there is no Forest land involved in the mine lease area. Copy of Forest Dept. Map is enclosed as **Annexure - VII** showing mine lease area outside the forest boundary.
17.	Status of forestry clearance for the broken up area and virgin forestland involved in the project including deposition of Net Present Value (NPV) and compensatory afforestation (CA). A copy of the forestry clearance should also be furnished.	Proposed project site is existing limestone mine lease granted by State Government in 1964 vide. MCR- 1563/15740 –G-V, dated 12.06.1964. Limestone mining is proposed in existing mine lease only. As per a map authenticated by forest department **(Annexure VII)** there is no Forest land proposed to be involved within core zone and hence no such clearance from forest department is required.
18.	Implementation of status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 should be indicated.	Proposed project site is existing limestone mine lease granted by State Government. There is no habitation existing within core zone. As per the Socio-economic survey and census data no scheduled tribes and other Traditional Forest Dwellers as per the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 have been identified.
19.	Impact of the project on the wildlife in the surrounding and any other	Impact on the biological environment including wildlife and other protected areas has been

	protected area and accordingly detailed mitigative measures required should be worked out with cost implications and submitted.	thoroughly detailed in **Chapter 4** of EIA report. Mitigation measures have been proposed in Environment Management Plan (Section 9.3) which includes following: 1. Air Pollution Management &Control (Section 9.3.1) 2. Noise and Vibrations Mitigation (Section 9.3.2) 3. Control of Noise, Vibration and fly rock during blasting (Section 9.3.3) 4. Water Management & Pollution Control (Section 9.3.4) 5. Land Reclamation and waste management (Section 9.3.5) 6. Green belt development (Section 9.3.6) 7. Plan for reduction of Impact on Fauna (Section 9.3.8) 8. Wild life Conservation plan (Section 9.3.8.1) Wild Life Clearance Application (**Annexure-IX A**) and Wildlife conservation plan (**Annexure IX C)** are attached in EIA Report
20.	The vegetation in the RF/PF area with necessary details should be given.	The vegetation in the RF/PF area is given in Chapter-3 of EIA report and a detailed list of Flora is attached as **Annexure -VIII**
21.	A study shall be got done to ascertain the impact of the mining project on wildlife of the area including on the elephant population and details furnished.	No elephant population is sited during primary survey and also from secondary data available. Impact on the biological environment including wildlife in study areas has been thoroughly detailed in **Chapter 4** of EIA report. The conservation plan for Wild life at Barda Wild Life Sanctuary is detailed in **Section 9.3.8.1** at **Chapter 9**. The Copy of Wild Life Clearance Application and Wild life conservation plan is attached as **Annexure IX**.
22.	Location of National Parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, Tiger/Elephant Reserves (existing as well as proposed), if any, within 10 km of the mine lease should be clearly indicated supported by a location map duly authenticated by Chief Wildlife Warden. Necessary clearance, if any, as may be applicable to such projects due	TCL has applied for Wild life Clearance as per MoEF Guidelines dated 15.03.2011 vide their letter no. A/WG/0118/2012 dated 09.02.2012 Copy of same has been enclosed as **Annexure-IX A**. Location map has been authenticated by DCF. Porbandar. It is part of Wild life clearance application which is under process by forest department. Copy of authenticated map is attached as **Annexure- VII**

	to proximity of the ecologically sensitive areas as mentioned above should be obtained from the State Wildlife Department/Chief Wildlife Warden under the Wildlife (Protection) Act, 1972 and copy furnished.	
23.	A detailed biological study for the study area [core zone and buffer zone (10 km radius of the periphery of the mine lease)] shall be carried out. Details of flora and fauna, duly authenticated, separately for core and buffer zone should be furnished based on primary field survey clearly indicating the Schedule of the fauna present. In case of any scheduled-I fauna found in the study area, the necessary plan for their conservation should be prepared in consultation with State Forest and Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost.	Detailed biological study has been carried out in the study area and the same has been given in **Chapter-3 (section 3.6)** of EIA report under the sub-section Biological Environment. The details of flora and fauna presence in core zone and buffer zone indicating schedule of fauna present is given in **Section 3.6.5 of Chapter 3** in EIA Report. The Wild life conservation plan is described in Section **9.3.8.1 of Chapter 9** in EIA Report. • TCL expects to spend a very significant sum of money over the first five years of mines operation on afforestation of mined out areas • TCL is proposing to spend an additional sum of Rs 10 (Ten) lakhs (in consultation with local forest authorities) on wild life conservation in Barda Sanctuary.
24.	Impact, if any, of change of land use should be given.	Impact of land use change is given in **Chapter – 4, section 4.2** along with the mitigation measures.
25.	R&R plan / compensation details for the project affected people should be furnished. While preparing the R&R plan, the National Rehabilitation &Resettlement Policy should be kept in view. In respect of SCs / STs and other weaker sections, need based sample survey, family-wise, should be undertaken to assess their requirement and action programmes prepared accordingly integrating the sectorial programme of line departments of the	As per the Socio-Economic Survey, no R & R is envisaged; as there is no habitation within proposed mining area hence no displacement of people is envisaged from their respective areas due to proposed mining project. However, M/s TATA Chemicals Ltd. realizes its responsibility towards community and environment. Details of Community activities are provided in **Section 7.12 of Chapter-7**

<table>
<tr><td></td><td>State Government.</td><td></td></tr>
<tr><td>26.</td><td>One season (non-monsoon) primary baseline data on ambient air quality (PM_{10}, SO_2 and NO_X), water quality, noise level, soil and flora and fauna shall be collected and the AAQ data so collected presented date-wise in the EIA and EMP report. Site-specific meteorological data should also be collected. The location of the monitoring stations should be such as to represent whole of the study area and justified keeping in view the predominant downwind direction and location of sensitive receptors. There should be at least one monitoring station within 500 m of the mine lease in the pre-dominant downwind direction.</td><td>Primary baseline data has been generated for the pre-monsoon season for a period of Three months. The samples collected are analysed at NABL accredited laboratory and analysis results are given in Annexure XIV. The results of same have been incorporated in the tabular form in Chapter-3. Results and details of Monitoring is given at the following places in EIA Report:
<table>
<tr><th>S.No.</th><th>Particulars</th><th>Section No. of Report</th></tr>
<tr><td>i.</td><td>Land Environment</td><td>3.2</td></tr>
<tr><td>ii.</td><td>Water Environment</td><td>3.3</td></tr>
<tr><td>iii.</td><td>Air Environment</td><td>3.4</td></tr>
<tr><td>iv.</td><td>Noise Environment</td><td>3.5</td></tr>
<tr><td>v.</td><td>Soil Environment</td><td>3.2.3</td></tr>
<tr><td>vi.</td><td>Biological</td><td>3.6</td></tr>
<tr><td>vii.</td><td>Socio-Economic</td><td>3.7</td></tr>
</table></td></tr>
<tr><td>27.</td><td>The mineralogical composition of PM_{10} particularly for free silica should be given.</td><td>Mineralogical Composition of PM_{10} shows that silica content of PM_{10} is <0.1 µg/m^3.</td></tr>
<tr><td>28.</td><td>Air quality modeling should be carried out for prediction of impact of the project on the air quality of the area. It should also take into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input parameters used for modeling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any and the habitation. The wind roses showing pre-dominant wind direction may also be indicated on the map.</td><td>Prediction of impacts on air environment has been carried out employing mathematical model based on a steady state Gaussian plume dispersion model designed for area sources for short term. In the present case, Industrial Source Complex - dispersion model based on steady state Gaussian plume dispersion, designed for area sources for short term and developed by United States Environmental Protection Agency [USEPA] has been used for simulations from point sources.
Mining activities (Drilling, Mineral Excavation, Loading/Unloading and Haulage Emissions – Unpaved) have been analyzed systematically basing on USEPA-Emission Estimation Technique Manual, for Mining AP-42, to arrive at possible emissions to the atmosphere and estimated emissions are given in EIA Report Section 4.4.</td></tr>
<tr><td>29.</td><td>The water requirement for the project, its availability and source to be</td><td>30 KLD of ground water will be required. Detailed water balance is given Below:</td></tr>
</table>

	furnished. A detailed water balance should also be provided. Fresh water requirement for the project should be indicated.	
	 All Values are in KL	
30.	Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the project should be provided.	Approval from Central Ground Water Authority for abstraction of 30 KLD ground water has been taken vide letter no. **21-4 (860)/WCR/CGWA/2011-949** dated 27.07.2011 Copy of permission letter enclosed as **Annexure - X.**
31.	Details of water conservation measures proposed to be adopted in the project should be given.	The rain water collected in the pits after spell of rain will be used for plantation and dust suppression. At the end of life of mine, excavated area will be used as a rain water pit.
32.	Impact of the project on the water quality both surface and groundwater should be assessed and necessary safeguard measures, if any required should be provided.	The impact on water quality on both surface and ground water is negligible as Lime stone mining activity does not generate any waste water. The details of Anticipated Impacts on water environment are detailed in **Section 4.3.1** in EIA report.
33.	Based on actual monitored data, it may clearly be shown whether working will intersect groundwater. Necessary data and documentation in this regard may be provided. In case the working will intersect groundwater table, a detailed hydro geological study should be undertaken and report furnished. Necessary permission from Central	Limestone mining is proposed by opencast mechanized method. The ultimate pit limit of mining at conceptual stage will be 58.5 m RL (8.5 m BGL) in depth. Ground water level fluctuated from 47 m RL (20 m BGL) to 53 mR.L (14 m BGL) during pre-monsoon to post-monsoon respectively. Hence; mining will not intersect the Ground water table. It is detailed in section **2.5.1.1 of Chapter-2** with working depth, ground water table data.

<table>
<tr><td></td><td>Ground Water Authority for working below ground water and for pumping of ground water should also be obtained and copy furnished.</td><td></td></tr>
<tr><td>34.</td><td>Details of any stream, seasonal or otherwise, passing through lease area and modification / diversion proposed, if any and the impact of the same on the hydrology should be brought out.</td><td>No seasonal or permanent stream is passing through the mine lease area. The runoff from the mine follows the natural slope.</td></tr>
<tr><td>35.</td><td>Details of rainwater harvesting proposed, if any, in the project should be provided.</td><td>Mined out pits area 13.13 ha will be used to harvest rainwater progressively. Same will be used to recharge the ground water. The details of Rain water storage /Harvesting is given in EIA Report Section 2.10.2.</td></tr>
<tr><td>36.</td><td>Information on site elevation, working depth, groundwater table etc. should be provided both in AMSL and bgl. A schematic diagram may also be provided for the same.</td><td>
<table>
<tr><th rowspan="2">Particulars</th><th colspan="2">Level (m)</th></tr>
<tr><th>AMSL</th><th>BGL</th></tr>
<tr><td>General ground Level</td><td>67</td><td>-</td></tr>
<tr><td>Highest elevation</td><td>73</td><td>-</td></tr>
<tr><td>Lowest elevation</td><td>61</td><td>-</td></tr>
<tr><td>Water Table (Pre-monsoon)</td><td>47</td><td>20</td></tr>
<tr><td>Water Table (Post-Monsoon)</td><td>53</td><td>14</td></tr>
<tr><td>5th year working</td><td>62</td><td>5</td></tr>
<tr><td>Ultimate pit Limit</td><td>58.5</td><td>8.5</td></tr>
</table>
A schematic drawing of mine work development is given in EIA Report Figure 2-3 of Section 2.9.4.1.
</td></tr>
<tr><td>37.</td><td>Quantity of solid waste generation to be estimated and details for its disposal and management should be provided. The quantity, volumes and methodology planned for removal and utilization (preferably concurrently) of top soil should be indicated. Details of backfilling proposed, if any, should also be given. It may be clearly indicated that out of the total waste generated during the mine life, how much quantity would be backfilled and how much quantity would</td><td>As per approved mining plan the mineral limestone is exposed on the surface and stratified. There is no overburden to handle. The mineable area is devoid of top soil; hence, no proposals are made for top soil management. The details of solid waste management are given in EIA Report Section 2.5.7.</td></tr>
</table>

	be disposed off in the form of external dump (number of dumps, their height, terraces etc. to be brought out).	
38.	The reclamation plan, post mine land use and progressive greenbelt development plan shall be prepared in tabular form (prescribed format) and submitted.	The reclamation plan, post mine land use and progressive plantation development plan in tabular form is given in **Section 9.3.5** of **chapter- 9** (EMP).
39.	Impact on local transport infrastructure due to the project should be indicated.	This is a captive mine. Entire limestone production is proposed for the use in manufacturing of Soda-ash and Cement at their respective plant in Mithapur, District – Devbhumi Dwarka. Transportation of Limestone is proposed by trucks. Existing road network will be sufficient and able to handle the increased load.
40.	Projected increase in truck traffic as a result of the project in the present road network (including those outside the project area) should be worked out, indicating whether it is capable of handling the increased load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered.	Nearest highway is SH-27 & NH-8B with current vehicle plying capacity of 30-35 trucks/hr and 40 trucks/hr respectively. The predicted increase in traffic is 15 trucks/day or 1 truck/hr on basis of 12 hour operation, which is expected to have an insignificant impact on the existing capacity of roadways. • The proposed mining site is 2.23 km from Bordi village which is connected through a WBM Road. • From Village Bordi to SH-27 & NH-8B is connected through a well maintained tar road. • TCL will regularly maintain 2.23 km long WBM road connecting mine with Bordi Village Road.
41.	Details of the infrastructure facilities to be provided for the mine workers should be included in the EIA report.	Following infrastructure facilities shall be provided for the mine workers:- ✓ Mine Office; ✓ Rest Shelter; ✓ Blasting shelter; ✓ Drinking water facilities; ✓ Workshop & Stores; ✓ First-aid station; ✓ Sanitation facility However they will be improved further.

<table>
<tr><td>42.</td><td>Conceptual post mining land use, Reclamation, and Rehabilitation of mined out area (with plans and with adequate number of sections) should be given in the EIA report.</td><td>A schematic diagram showing conceptual mine land use along with relevant cross-sections is attached as Plate No 8 of Annexure-XI.</td></tr>
<tr><td>43.</td><td>Phase-wise plan of greenbelt development, plantation and compensatory afforestation should be charted clearly indicating the area to be covered under plantation and the species to be planted. The details of plantation already done should be given.</td><td>Phase wise plan of green belt development and compensatory afforestation is given in EIA Report Table 4.13, Section 4.6.2.
<table>
<tr><th>Year</th><th>No. of Plants</th><th>Area (Ha)</th></tr>
<tr><td>1st</td><td>100</td><td>0.1</td></tr>
<tr><td>2nd</td><td>100</td><td>0.1</td></tr>
<tr><td>3rd</td><td>100</td><td>0.1</td></tr>
<tr><td>4th</td><td>100</td><td>0.1</td></tr>
<tr><td>5th</td><td>100</td><td>0.1</td></tr>
</table></td></tr>
<tr><td>44.</td><td>Occupational health impact of project should be anticipated and preventive measures initiated. Details in this regard should be provided. Details of pre-placement medical examination and periodical medical examination schedules should be incorporated in the EMP.</td><td>Occupational hazards involved in mines are related to dust pollution, noise pollution, blasting and injuries from equipment, and fall from high places. DGMS has given necessary guidelines for safety and surveillance against these occupational hazards. The hazard wise preventive measures are given in section 9.3.9 of chapter 9.
Initial & periodical examination will be conducted as prescribed in “FROM – O” for every employee as per rule 29B of Mines Rule – 1955. Details of tests are given in the form.
The medical examination required to carry out at the time of appointment of every employee and periodically ones in 5 year.
Provided that in case any dust related disease need to be confirmed, the pertaining tests may be conducted more frequently as the examining authority deems necessary.</td></tr>
<tr><td>45.</td><td>Public health implication of the project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocation.</td><td>As already indicated earlier, there is no habitation within the mining lease area. Mining activities will be away and will not progress closure to the nearest human habitation. However following remedial measures are proposed to be undertaken:
✓ Regular water sprays,
✓ Scheduled maintenance of machineries
✓ Covered transportation of vehicles
✓ Green belt / plantation as a green barrier will be carried out to protect the village habitation from</td></tr>
</table>

		the dust pollution ✓ Medical check-up / eye-camps will be organized for the villagers as a part of CSR activities. Allocation of funds towards public health has been indicated in the CSR activities **Section 7.12 of Chapter-7**. No site specific ailments have been detected so far affecting the health of persons/ public.
46.	Measures of socio economic significance and influence to the local community proposed to be provided by project proponent should be indicated. As far as possible, quantitative dimensions may be given with time frame for implementation.	1) The existing project will provide job opportunities to 179 employments directly employed for mining work earning wages as per the minimum wages act applicable for un-skilled, semi-skilled and highly skilled categories. 2) Training of employed workers to improve their skills for safe workings. 3) Free medical camp will be organized for the villagers. 4) Applicant will co-operate with the Govt. for the development of the area, nearby schools and basic amenities. Detailed action plan along with budgetary provisions have been provided in **Table 7.1** of **Chapter-7**.
47.	Detailed environmental management plan to mitigate the environmental impacts which, should inter-alia also include the impact due to change of land use, due to loss of agricultural land and grazing land, if any, occupational health impacts besides other impacts of the projects.	Chapter-9 of EIA report has been dedicated towards detailing of Environment Management Plan and covers all the major impacts and the respective mitigation measures taken towards them. A total of 13.13 ha area will be mined out at the end of lease period out of which 0.86 ha will be reclaimed by plantation, thus enhancing the aesthetic beauty of the landscape. The remaining mine pit will be converted into rain water reservoir.
48.	Public hearing points raised and commitment of the project proponent on the same along with time bound action plan to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project.	Public hearing has already been conducted and the details including points raised and other proceedings of the same are given in **Section 7.1 of Chapter-7** of the EIA/EMP report. Minutes of Public hearing meeting along with other relevant details like attendance etc. are also enclosed as **Annexure- XII**. Time bound action plan for the points raised during Public hearing along with budgetary provisions is enclosed in the **Table 7.1** of **Chapter-7**.
49.	Details of litigation pending against the project, if any, with	No litigation is pending against the applicant and the lease area in any court of law to the best of our

<table>
<tr><td></td><td>direction /order passed by any Court of Law against the project should be given.</td><td>knowledge.</td></tr>
<tr><td>50.</td><td>The cost of the project (capital cost and recurring cost) as well as the cost towards implementation of EMP should clearly be spelt out.</td><td><table><tr><th>Particulars</th><th>Capital Cost (Rs.)</th><th>Recurring Cost (Rs.)</th></tr><tr><td>Project Cost</td><td>39,00,000</td><td>-</td></tr><tr><td>EMP cost</td><td>1,50,000</td><td>4,35,000</td></tr></table></td></tr>
<tr><td colspan="3">Besides the above, the below mentioned general points should also be followed:-</td></tr>
<tr><td>a)</td><td>A note confirming compliance of the TOR, with cross referencing of the relevant sections / pages of the EIA report should be provided.</td><td>A Note is being provided in the tabular form. Refer Table 1-1.</td></tr>
<tr><td>b)</td><td>All documents may be properly referenced with index and continuous page numbering.</td><td>All documents have been properly referenced with index, page numbers and continuous page numbering.</td></tr>
<tr><td>c)</td><td>Where data are presented in the report especially in tables, the period in which the data were collected and the sources should be indicated.</td><td>All the tables containing monitoring and other baseline data have been properly references with the sources and the period of data generation.</td></tr>
<tr><td>d)</td><td>Where the documents provided are in a language other than English, an English translation should be provided.</td><td>For the Public consultation purpose Executive Summary has been provided in Local Language (i.e. Gujarati) along with its English translation. Also the public hearing proceedings have been enclosed in both the languages i.e. Hindi & English. All other documents have been provided in English.</td></tr>
<tr><td>e)</td><td>The Questionnaire for environmental appraisal of mining projects as prescribed by the Ministry shall also be filled and submitted.</td><td>The questionnaire for environmental appraisal of mining projects as devised earlier by the Ministry is enclosed as Appendix.</td></tr>
<tr><td>f)</td><td>Approved mine plan along with copy of the approval letter for the proposed capacity should also be submitted.</td><td>Copy of approval letter of Mining Plan along with approved mining plan is enclosed as Annexure –XI.</td></tr>
<tr><td>g)</td><td>While preparing the EIA report, the instructions for the proponents and instructions for the consultants issued by MoEF vide O.M. No. J-11013/41/2006-IA.II(I) dated 4th August, 2009,</td><td>All instructions mentioned in O.M. No. J-11013/41/2006- IA.II (I) dated 4th August, 2009 are being complied with M/s TATA Chemicals Ltd. Has hired Mantec Consultants Pvt. Ltd. For carrying out the EIA study for Aniali Limestone Mine (16.21 ha) and preparation of EIA/EMP report. Mantec Consultants</td></tr>
</table>

	which are available on the website of this Ministry should also be followed.	Pvt. Ltd. is a QCI Accredited consultant at S. No. 96 as per List of Accredited Consultant Organizations/ Rev. 20/May 5, 2014. Copy of latest accreditation attached as **Annexure-XIII.**
h)	Changes, if any made in the basic scope and project parameters (as submitted in Form-I and the F.R for securing the TOR) should be brought to the attention of MoEF with reasons for such changes and permission should be sought, as the TOR may also have to be altered. Post Public Hearing changes in structure and content of the draft EIA/EMP (other than modifications arising out of the P.H. process) will entail conducting the PH process again with the revised documentation.	There is no change made in the basic scope and project parameters.
The EIA report should also include :		
i.	Surface plan of the area indicating contours of main topographic features, drainage and mining area,	Surface plan has been enclosed as **Plate 3** of **Annexure-XI.**
ii.	Geological maps and sections and	Geological Plan along with cross section is attached as **Plate No 4A and 4 B** of **Annexure –XI.**
iii.	Sections of the mine pit and external dumps, if any, clearly showing the land features of the adjoining area.	Development Plan along with respective sections is attached as **Plate no 5A To 5 E** of **Annexure-XI.**

1.5 Post Environment Clearance Monitoring

The project management will submit a half yearly compliance report in respect of stipulated prior Environmental Clearance terms and conditions on 1st June and 1st December of each calendar year. The latest such compliance report will be displayed on the website of the concerned regulatory authority.

1.6 Generic Structure of Environment Impact Assessment Report

In terms of EIA Notification of the MoEF, New Delhi dated 14thSeptember 2006 and its subsequent amendments later, the generic structure of the EIA document is as under:-

Chapter No.	Title	Page No.
1.	Introduction	1-1
2.	Project Description	2-1
3.	Description of Environment	3-1
4.	Anticipated Environment Impact & Mitigation Measures	4-1
5.	Analysis of Alternatives	5-1
6.	Environment Monitoring Programme	6-1
7.	Additional Studies	7-1
8.	Project Benefits	8-1
9.	Environment Management Plan	9-1
10.	Summary & Conclusion	10-1
11.	Disclosure Of Consultants	11-1

1.7 Identification of Project Proponent

Tata Chemicals Limited (TCL) was founded in 1939 and has operated a Soda ash plant at the Mithapur site since 1943. The site is located close to the Arabian Sea as well as the Gulf of Kutch on the western coast of Gujarat. The industrial township of Mithapur is situated 20 km north of Dwarka and 9 km south of the port of Okha on State Highway 25-A. Western Railway's broad gauge line from Mumbai to Okha, passes through Mithapur. The chemical complex uses solar evaporated salt from its captive salt works (located 12 to 43 km away) and the sea water from Arabian Sea 3 km away from the factory site. The other inputs are:

- Coal (as boiler fuel from various domestic mines as well as imported through Okha port) Pet coke from Petroleum Refinery located near Jamnagar
- Coke (as Kiln fuel from imported sources as well as coking plants located nearby
- As and when required Lignite is used as a fuel for the boilers. This is transported by road from Panandhro about 530 km away in Kutch district.

The complex consists of various plants manufacturing Soda ash (1,091,000 TPA) and Sodium Bicarbonate (150,000 TPA- various grades), Caustic Soda (50% lye 36,000 TPA) – Liquid Chlorine (18,000 TPA) – Hydrochloric acid (33% 64,800 TPA), Bromine (2,400 TPA), Vacuum Evaporated Salt (800,000 TPA) and Clinker (825,000 TPA) / Cement (787,000 TPA). A 85 MW power plant burning Pet coke/Coal and Lignite is located within the complex to supply steam at various pressures and power to all units. Fly ash from the boilers is used to

manufacture cement. Seawater pumping stations for the supply and disposal of spent seawater are built at various locations. Water treatment supply and drainage systems are also built. A Fabrication machining shop and foundry are located in the complex to supply castings, pipes and other cast/machined parts to the units within the complex. Material handling facilities for handling the Limestone, Coal, Petcoke, Coke, Lignite, and Salt as well as packing plants to pack the finished products are part of the complex. Offices and product storage godowns and a store for all parts, tools, packing material, chemicals, lubricants etc., Laboratories other maintenance shops are also located within premises. A telephone system is installed and operated by the company for its internal use at the factory and the township.

As part of its backward integration plans, TCL has been mining limestone, a basic raw material for its soda ash plant, since more than 45 years, in Jamnagar and Jamnagar district of Gujarat, located ~ 130- 150 km, South-Southeast of the Mithapur Facility. Historically, Adityana Village of Ranavav Taluka (now in part of the newly formed Jamnagar District, consisting of territories lying in the undivided Junagadh District), besides Kutiyana & Jamnagar Taluka and Bhanvad Taluka of Jamnagar District has been the centre of mining activities.

TCL, (including its mining operation) is certified to ISO 9001:2000, ISO 14001:2004 and OHSAS 18001:2007.

1.8 Brief Description of the Project

1.8.1 Project Nature, Size & Location

The mining lease of Limestone mine is categorized as Government waste land. State Government has granted the Lease for mining of Limestone. The production rate of the mine will be 0.088 Million Tons Per Annum (MTPA) as per Mining plan approved by IBM. The estimated project cost will be Rs. 0.39 Cr. Mining will be carried out by opencast mechanized method.

The mine is situated near in survey No. 207/part, Village- Aniali, Taluka- Ranavav of Porbandar District (Gujarat). The geographical location of the lease area are given in **Table 1-2**:-

Table 1-2 : Geographic Co-ordinates of Mine Site[1]

Pillar No	Latitude	Longitude
1	21⁰ 42' 20.15"	69⁰49'38.56"
2	21⁰ 42' 17.62"	69⁰49'31.80"
3	21⁰ 42' 23.13"	69⁰49'29.44"
4	21⁰ 42' 21.73"	69⁰49'25.69"
5	21⁰ 42' 19.84"	69⁰49'26.50"
6	21⁰ 42' 18.43"	69⁰49'22.72"
7	21⁰ 42' 27.06"	69⁰49'19.01"
8	21⁰ 42' 35.11"	69⁰49'40.53"
9	21⁰ 42' 32.82"	69⁰49'41.52"
10	21⁰ 42' 30.11"	69⁰49'34.29"

1.8.2 Project Importance

Limestone Mining is a very important economic activity in Saurashtra region of Gujarat. Chemical Grade Limestone is mainly found in this region, is essential for Soda Ash Manufacturing. This region practically supplies limestone for all Soda Ash production of India. The Soda Ash based limestone mining industry contributes significantly to the State Gross Domestic Product and provides direct employment to about 7500 labourers. Additional jobs are created by way of transportation and related jobs, ancillary to mining. Subject mine lease aims to augment the limestone supply to TCL, Mithapur.

The products of TCL's Mithapur plant, especially soda ash, are a vital input for a number of basic industries such as glass, pulp and paper, chemicals and detergents, besides others. Consequently, this project aims at keeping many of the key industries within the country well supplied with an essential raw material. Cement, another product of TCL, also dependent on limestone inputs, is a key input to the infrastructure development of India.

1.8.3 Regulatory Compliance

a. The original lease deed was granted vide grant order no mcr-1563/15740/-G-V-dated 12.06.1964 and same was executed on 31.10.1964 for a period of 20 years.
b. The First renewal was executed on 21.07.1987 vide letter MCR-1583(T-4) GOI-184-CHH dated 09.09.1986 for 20 years. Copy of lease deed and lease grant order is enclosed as **Annexure II.**

[1] Reference : Page No 9 and 10 of Annexure XI.

c. The TCL has applied for 2nd renewal vide letter No A/WG/2558/ 2003 dated 21.10.2003 for 20 years and the lease renewal is pending with the Gujarat Govt.

d. Mine Lease was in operation during 1985-86 to 1993-94 with highest production of 55,065 tons during 1987-88.

e. Mine is Idle (not in operation) since 1994-95. No mining carried out after EIA Notification 1994.

f. Application for wildlife clearance has been applied vide letter no. A/WG/0118/2012 dated 09.02.2012. Copy of Application is attached as **Annexure - IX A**.

g. Approved Scheme of Mining with progressive mine closure plan by Indian Bureau of Mines vide letter No. 682(23) MS 473/2008-MCCM (N) UDP; dated 21.10.2008. **Annexure-XI-10.**

h. Approved Mining plan along with progressive mine closure plan by Indian Bureau of Mines vide letter No. 682(23) MP 473/2008-MCCM (N) UDP; dated 01.04.2014. Copy of approved Mining Plan is enclosed as **Annexure-XI.**

i. Mining related information has been updated in EIA Report as per latest approved Mining Plan approved by IBM letter no 682(23)MP473/2008 – MCCM (N) UDP dated 01-04-2014.

j. TCL has applied for fresh Environmental Clearance to MoEF First Time for Aniali 16.21 Ha. Lease.

k. Form I – Notice of Opening, Closing or Changing dated 29-5-1994 is attached as **Annexure XV.**

1.8.4 Environmental Setting of the Project in Study Area (10 Km)

Table 1-3 : Environmental Setting of the project in study area (10 Km)

Particulars	Details
Location	Aniali Limestone Mining Lease
Village	Aniali
Taluka	Ranavav
District	Porbandar
State	Gujarat
Latitude	As per **Table 1-2.**
Longitude	
Total Mine Lease area	16.21Hectare
Elevation	73 – 61 M.RL[2]
Land use of the lease area	Govt. Waste land – 16.21Ha [3]

[2] Reference : Page No 16 of Annexure XI.

[3] Reference : Page No 59 of Annexure XI.

Nearest Habitation	Bordi Village
Nearest Highway	SH-27 & NH – 8B
Nearest Railway station	Sakhpur
Nearest Airport	Porbandar
Nearest educational institutions	Ranavav
Nearest Medical facilities	Ranavav
Nearest place of worship	Ranavav
Nearest communication & post-office	Ranavav
Tourist places	None
Archaeological Features	None
Defence installation	None
Reserved/ Protected Forests	Nearest reserve forest is Naliyadhar reserve forest which is located at 0.11 km in South west direction
Protected Area	Barda wildlife sanctuary (Notified by Government of Gujarat) is located at 3.92 km from site in north west direction.
Water bodies	Minsar River (Distance 5.60 KM) Bileshwari River (Distance 4.86 KM)
Other Industries	Limestone Mine leases of Tata Chemicals and other leases belongs to different owners
Seismic Zone	Seismic Zone –III
Water Demand & Supply	30 KLD from Ground water source

CHAPTER 2:
PROJECT DESCRIPTION

2 PROJECT DESCRIPTION

2.1 General

The proposed project is for opencast mining of limestone by mechanized means. The project will include of mining, sizing, screening, and transportation of limestone to TCL's Chemical Complex and Cement Plant at Mithapur.

The Project aims to augment supply of limestone to TCL's Mithapur plant, as part of TCL's business requirements of maintaining adequate availability of soda ash for its customers. The mine lease area falls in survey no. 207/p of the village Aniali, Taluka- Ranavav, Dist- Porbandar. It is located at about 2.23 km to the South of Rana Bordi village. From village Boardi the mine lease is approached by motorable road.

2.2 Brief Description of the Project

The proposed project is for limestone production from 0.088 MTPA (Million Tonne Per Annum) by open cast mechanized method. The lease area is 16.21 ha which comprises totally of Govt. waste land. The mineable reserves are 0.444 Million Tonnes. The expected life of the mine is 6 years. Limestone produced will be transported to the Mithapur chemical complex by road.

Table 2-1: Project Profile

Project	Aniali Limestone Mine
Name of Lease/ Area	Tata Chemicals Ltd / 16.21 Ha.
Survey No.	207/P
Village/ Taluka	Aniali / Ranavav
District/ State	Porbandar / Gujarat
Mining Method	Mechanized Open Cast Mining Method, Drilling and Blasting will also be carried out.
Proposed Area to be mined out/ Ultimate Depth of Mining	Area Proposed – 13.13 Ha.[4] Ultimate working depth – 8.5 m[5]
Planned Production (year 01 to 05)	0.088 Million MT / Year
Water Requirement	30 KLD
Plantation Details	500 saplings in five years on commissioning of mining operations.

[4] Reference : Page No 75 of Annexure XI.

[5] Reference : Plate No 8 – Conceptual Plan of Annexure XI.

2.2.1 Location Details

The mine is situated near in survey No. 207/part, village Aniali, Taluka- Ranavav of Porbandar District (Gujarat). It is located at about 2.23 km to the South of Bordi village. Aniali mine lease site is approached by motorable road. Location of the mine lease area is given in **Plate 1 of Annexure IX**. The geographical location of the lease area is given in **Table 1-2.**

2.2.2 Leasehold Area

As per the approved mining plan lease area is a government wasteland and part of Survey No. 207/P, which falls under the revenue limit of Aniali village. There is no reserve forest or protected forestland within the lease area. There is no village or hutment within the lease area. Existing land use pattern is given in **Table 2-2.**

Table 2-2 : Present land use pattern of the lease area

Particulars	Aniali16.21 Ha Mine (Area in Ha)		
	Preoperational phase[6]	Operational Phase (after mining plan period)[7]	Post Mining (Conceptual phase) at the end of Mine Life[8]
Pits	9.544	13.08	13.13*
Roads / Building	0.49	0.32	0
Plantation	0.02	0.52	0.86
Remaining Virgin area	6.156	2.29	2.22
Total area	**16.21**	**16.21**	**16.21**

* 3.51 Ha remaining mine out and 9.62 Ha reclaimed.

2.2.2.1 Existing Land Use, General Topography & Breakup of the Lease Area.

As per the IBM approved mining plan, the proposed lime stone mine is designated as Government Waste land where no forest land is involved. The lease area occupies the almost plain with no drainage pattern. The general elevation within the lease area varies from around 73 m to high of around 61 m showing relief around 12 m with general ground. The existing land use and break-up of the lease area is given in **Table 2-2.**

[6] Reference : Page No 68 of Annexure XI.

[7] Reference : Page No 68 of Annexure XI.

[8] Reference : Page No 75 of Annexure XI.

2.2.2.2 Geography, Topography & Physiography[9]

The limestone at lease area is outcropping ridge with moderate height. The lease area under reference is a wasteland of Aniali village revenue area which is rocky covered and part of area is covered with soil. The highest and lowest elevation in the lease area is 73m AMSL to 61m AMSL having an elevation difference of 12 m with general ground. There is no prominent water course available within and near lease area but during rainy season the rain water flows from SE to NW direction and meets nearby small nallas.

2.3 Geology

2.3.1 Regional Geology

Geological study of the study area and further deep into Barda hills region reveals the following Stratigraphic sequence of this region. The regional stratigraphic sequence is given in **Table 2-3.**

Table 2-3 : Regional Stratigraphic Sequence

Age	Formation	Rock type
Recent (Holocene)	Alluvium/Recent Limestone	Alluvial Soil, Black-brown soil, coastal Limestone
Early Holocene to late Pleistocene	Miliolite formation	Arenaceous limestone and calcareous sandstone
Pliocene	Dwarka beds	Gypsiferous clay and sandy foraminifer limestone
Miocene	Gaj beds	Clay and calcareous clay
<<<<<<<<<<<<<<<<<<<<<<Unconformity>>>>>>>>>>>>>>>>>>>>>>>>>>>>		
Paleocene to upper Cretaceous	Deccan trap	Basalt and its derivatives including the intermediate and acidic rock types like dacites, granophyre etc

The rocks of the Miliolite Formation along the coast have the appearance of dirty, white, friable, ooliticcalcarinite. Further inland but still along the coastal plains, these are somewhat purer, well consolidated, white oolitic limestone. The rocks occur in beds, which show a gentle seaward dip of 5° to 14°. The rocks are extensively cross-laminated showing dune type current bedding. Alternating coarse and fine-grained lamination is common. They occur at various levels, in the coastal plains, along the foothills and high up in their glens. The name

[9] Reference: Page No 16 and 64 of Annexure XI.

"miliolite" has been derived from the Miliolidae, belonging to the, common foraminifera present in profusion in the rock. Composition-wise, the rocks are extremely variable ranging from near pure limestone devoid of sand to calcareous sandstone and clays limestone. The rock formations originated as beach sediments formed in agitated, warm and very shallow waters. They were subsequently cemented by calcspar precipitated from sea water saturated with $CaCO_3$. The warm, shallow, circulating waters were favourable living areas for marine organisms which have left their in shells and fecal pellets. The occurrence of the Pleistocene beach limestone all over Tertiary coastal plains fringing the Deccan Trap plateau and deep in the interior of the Deccan Trap country at high elevations tends to lead to the conclusion that during Pleistocene at high elevations the sea level stood much higher than at present. This may be true in respect of the coastal plain and the foothill regions. But the occurrence of the Miliolite rock in the interior areas also point to an Aeolian origin indicating that from the fragmented beach sediments might have been deposited in the valleys of the hills, which acted as natural wind barrier and the sea need not have transgressed to such great heights in order to form the thinner layers of the Miliolite rocks at such higher altitudes.

2.3.2 Local Geology[10]

Almost 70 % of the lease area has been subject to mining activity removing the upper part of the limestone formation by shallow pitting. The depth of pits is limited to the extent of chemical grade after which the downward progress has been ceased. The prime area now available for mining of chemical grade is in the mining block – 2, which has been demarcated in Geological Plan. The mined out area is now entirely covered by lower layers of the limestone formation followed downwards by a thin layer of clay resting unconformity over basement granophyre. The local stratigraphic sequence is presented in **Table 2-4.**

Table 2-4 : Local Stratigraphic Sequence[11]

Age	Formation	Rock type
Recent	Soil (0.05 m Max)	Dark grey to brownish, thin impersistent layer of top soil
Pleistocene	Miliolite Formation – 11 m (max)	Coarse to Medium to Fine grained, light grey to greyish white limestone with occasional bands of impure limestone and calcareous clay.

[10] Reference: Page No 13 of Annexure XI.

[11] Reference : Table 3.2 Page No 14 of Annexure XI.

Miocene	Gaj Beds (Impersistent)	Clay and Calcareous clay
----------	Unconformity	----------
Pilocene to Upper Cretaceous	Deccan Trap	Granophyre

2.3.2.1 Limestone [12]

The greater part of the limestone has already been mined. The maximum thickness of the remaining limestone horizon is about 11 meters along parts of the peripheral area outside the worked out pits. In the worked out area the thickness varies from two to nearly ten meters at places.

The Geological plan is presented in **Plate No 4 A and Plate No 4 B of Annexure XI.**

2.4 Mineral Reserves

2.4.1 Mineral Exploration

As per Approved mining plan the area is irregular rectangle in shape bounded by 10 no's boundary pillars as marked on **Plate No 3 of Annexure XI**. The eastern and western side are adjoined with the lease boundary of TCL. A no of spot levels have been marked on quarry floor and along the bench tops. Only in the small unbroken area within the lease contouring has been done at 1m interval. All other available surface features have been plotted on the map so prepared on scale of 1:1000. The topographic map so prepared is presented as **Surface Plan- Plate No 3** of **Annexure XI.**

2.4.2 Quality of Reserves

Different manufacturers have developed their own specifications suiting to their process parameters and looking to the availability of limestone. TCL has prescribed a marginally liberal chemical specification as presented in besides the physical requirement of the lump size being between 50 mm & 100 mm. Presented in **Table 2-5**.

Table 2-5 : Quality of reserves

S.No	Grade	Characteristics
1.	Chemical Grade	Total carbonate ≥ 92 % & SiO2< 4 %
2.	Marginal Grade	Total carbonate ≥ 92 % & SiO2> 4 % and < 5 %
3.	Inferior Grade	Total carbonate < 92 % & SiO2> 5 %

[12] Reference : Page No 14 of Annexure XI.

The management specified the soda ash and cement grade limestone requirement as under:

- CaCO3 + MgCO3: ≥ 92 %
- SiO2: < 4 %
- Size: 50 mm to 100 mm

Limestone with the same total carbonate but with 4 % or more of SiO2 but not exceeding 5% is considered to be marginal quality but still acceptable for the manufacture of soda ash. For the purpose of cement making the following broad chemical specification for limestone may be accepted:

- CaO: ≥ 44%
- MgO:≤ 3.5%

2.4.3 Estimation of Reserves

The category and grade wise updated recoverable reserves as per approved Mining Plan are as given under **Table 2-6.**

Table 2-6 : Estimated reserves[13]

Category	UNFC Code	Quantity in Million Metric Tons
Total Mineral Resources (A+B)		1.0176
A. Mineral Reserve		
1. Proved Mineral Reserves	111	0.4439
2. Probable Mineral Reserves	121 & 122	-
B. Remaining Resource		
1. Feasibility Mineral Resource	211	0.0598
2. Pre-Feasibility Mineral Resource	221 & 222	-
3. Measured Mineral Resource	331	0.5139
4. Indicated Mineral Resource	332	-
5. Inferred Mineral Resource	333	-
6. Inferred Mineral Resource	334	-

2.4.4 Proposed Rate of Production and Expected Life of Mine

The proposed rate of production for the next five years as per the approved mine plan is given as under:

[13] Reference : Page No 24 of Annexure XI.

Table 2-7 : Proposed rate of production in Million Metric Tons per Annum[14]

Year / Production Million Tons	First Year	Second Year	Third Year	Fourth Year	Fifth Year
Chemical & Inferior grade Total Production (ROM)	**0.087**	**0.087**	**0.088**	**0.087**	**0.084**

Table 2-8 : Estimation of Mine life[15]

S.No	Particulars	Details
1..	Net Mineable Reserves	0.444 million tones
2.	Mineral to be mined during mining plan period	0.361 million tones
3.	Remaining reserves at the end of plan period	0.083 million tones
4.	Rate of production per year	0.077million tones
5.	Life of mine at the end of plan period	1 Years
6.	Total life of mine	6 years

2.5 Details of Mining Process

2.5.1 Conceptual Mining Plan

The lease area has been fully explored and reserves have been established. The mining plan has been conceived on the basis that the chemical grade limestone deposit, proved within the lease area, would be fully extracted. The chemical grade limestone would be sized at sizing plot or alternately in the event of Labourer shortage, a mobile sizer & screening equipment will be deployed at Aniali 21.04 Ha Mine lease for sizing and screening of limestone.

The output in the required size range of +50 to –100mm would be dispatched to the Soda-ash plant at Mithapur and also under sized –50mm also dispatched regularly to Cement Plant at Mithapur.

[14] Reference : Page No 26 of Annexure XI.

[15] Reference : Page No 24, Section 24 of Annexure XI.

2.5.1.1 Ultimate Pit Limit[16]

It is anticipated that true potentiality of the area in depth can be assessed at end of first five years. In absence of true potentiality of area, determination of ultimate pit limit shall be apparent and it likely to be revised at the end of fifth year on basis of outcome of exploratory work as proposed above. On the above techno-economic as well as environmental consideration, the conceptual mining plan has been drawn keeping 45^0 ultimate pit slope angle. The anticipated size of excavation for the five years period is given in **Plate 8** of **Annexure XI**.

The details of working depth, water table during pre-monsoon and post monsoon are given in **Table 2-9.**

Table 2-9 : Details of Working Levels

Particulars	Level (m)	
	AMSL	BGL
General ground Level	67	-
Highest elevation[17]	73	-
Lowest elevation[18]	61	-
Water Table (Pre-monsoon)	47	20
Water Table (Post-Monsoon)	53	14
5th year working[19]	62	5
Ultimate pit Limit[20]	58.5	8.5

2.5.2 Method of Mining

2.5.2.1 Primary Mining:

Primary mining is done by conventional drilling & blasting (using explosives) as per the guidelines of Directorate General of Mines Safety, Dhanbad as well as Indian Bureau of Mines, Udaipur.

Blasted material (ROM) is loaded into tippers and shifted to a nearby sizing yard outside the leasehold area where sizing of limestone is done manually using contract labourers.

[16] Reference : Page No 33 of Annexure XI.

[17] Reference : Page No 16 of Annexure XI.

[18] Reference : Page No 16 of Annexure XI.

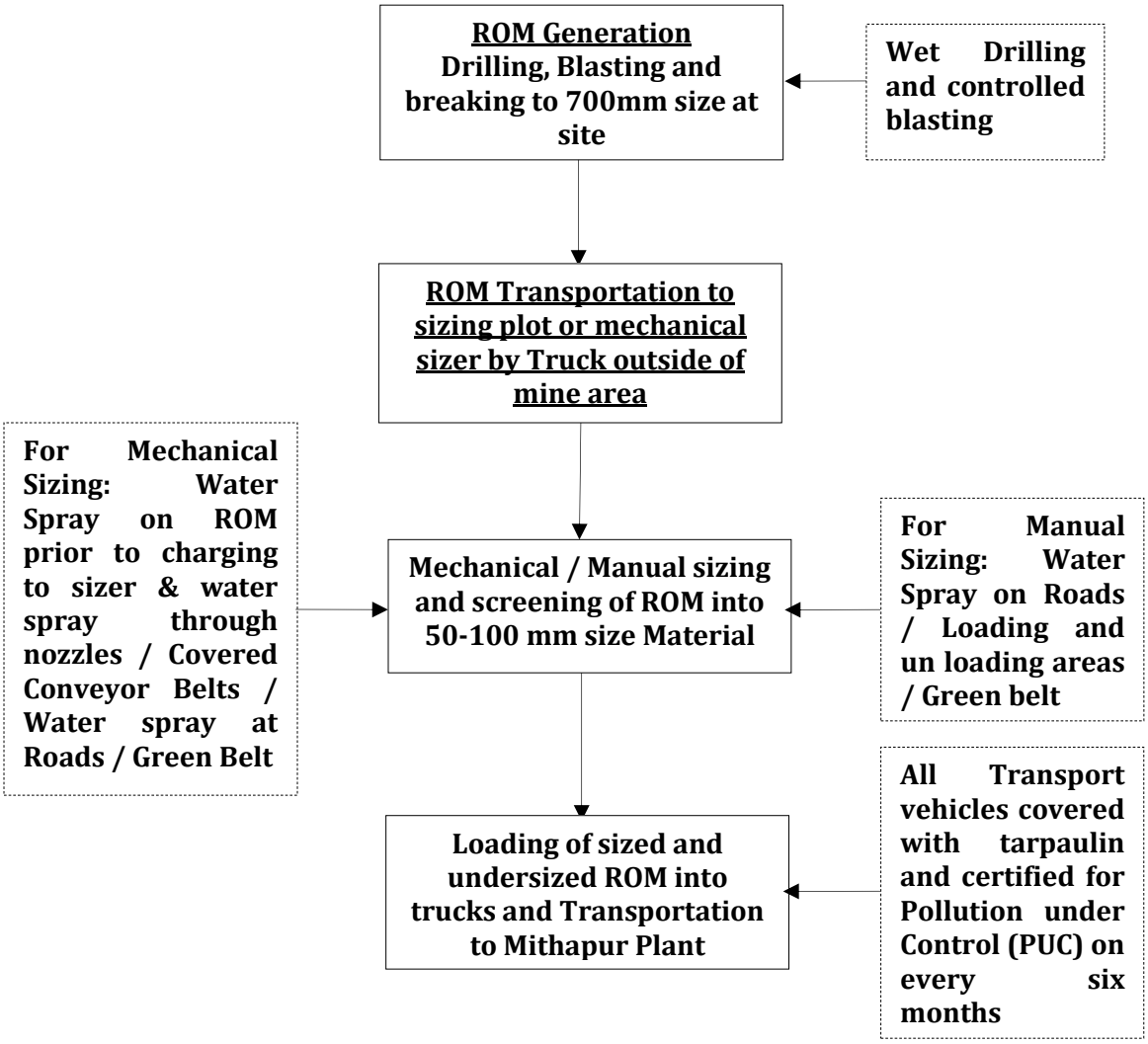
[19] Reference : Page No 30 of Annexure XI.

[20] Reference : Plate No 8 – Conceptual Plan and Sections of Annexure XI.

Alternately in the event of Labourer shortage, a mobile sizer & screening equipment will be deployed at Aniali 21.04 Ha Mine lease for sizing and screening of limestone.

Method of mining along with the pollution control measures have been provided in **Figure 2-1**

Figure 2-1 : Mining process flow diagram with pollution control measures



2.5.3 Drilling & Blasting

2.5.3.1 Pattern

Blasting is proposed to be done using explosive Ammonium Nitrate – Fuel Oil (ANFO) as the column charge and cap sensitive explosive (normally slurry/ emulsion explosives) as the booster charge. The ratio of column charge to the booster charge is 75:25. For drilling

blast holes, wet drilling process will be adopted as to suppress dust emissions at the source of generation.

2.5.3.2 Blast Hole Design

Of the various firing patterns in vogue, the multi row staggered gird V pattern is proposed to be adopted sequencing with short delay detonator.

2.5.3.3 Types of Explosives & Their Optimum Use

The explosives will be used for the blasting are enlisted in **Table 2-10.**

Table 2-10 : Types of Explosives & their Optimum Use

Type of blasts	Booster Charge (Cap sensitive)	Column charge	DTH & TLD in combination with sock tubes non electric initiation system
Primary	Kelvex – 600 (83 mm dia), Solar Prime	Ammonium nitrate fuel oil mixture (ANFO)	Down the hole delay Detonators (DTH) & Trunk Line Delay Detonators (TLD) fitted with shock tube based non-electric initiation system will be used for primary blasting.

2.5.3.4 Storage of Explosives

Explosives are stored in purpose built structures called 'magazines'. TCL has 2 magazines for storage of explosives. The main storage area ('main magazine') is located near the Ranavav Railway Station. The 'service magazine' is located near the Adityana Site Office. These magazines cater to the explosives requirements of all mines operated by TCL.

2.5.3.5 Transport of Explosives

Transportation of explosives will be done by an "explosive van" (a TATA-407 Mini Van). The total capacity of storing explosives in this van is 2585 kg.

2.5.3.6 Frequency of Blasting

The blasting activity is proposed to be carried out during day time (Lunch Break).The frequency of blasting will be 3 to 4 days in a week.

2.5.3.7 Powder Factor

Blasting is proposed to be done using explosive Ammonium Nitrate – Fuel Oil (ANFO) as the column charge and cap sensitive explosive (normally slurry explosives) as the booster charge.

The ratio of column charge to the booster charge is 75:25. For drilling blast holes, wet drilling process will be adopted as to suppress dust emissions at the source of generation. Considering the nature of the limestone deposit, the blast hole parameters proposed are shown in **Table 2-11.**

Table 2-11 : Blast hole parameters[21]

S.No	Parameter	Dimension
1.	Mineral Max	290 Tons
2.	Depth	4.0m
3.	Depth of hole including sub grade	4.1 m
4.	Burden	1.5 m
5.	Spacing	2.0 m
6.	Volume blasted per hole	12.0 Cum
7.	Tons blaster per Hole	25.2 Tons
8.	Powder factor Tons /Kg of Explosive	6
9.	Explosives Per Hole	4.2 Kg
10.	Explosives / Day	50 Kg
11.	Booster Charge 25 %	12.5 Kg / Day
12.	ANFO @ 75 %	37.5 Kg / Day

2.5.4 Sizing:

Boulders are broken into sized Limestone manually employing contractual Labourers. However in case of labour shortage/ crisis, sizing will be done in a Mobile Sizer & screening unit at Aniali 21.04 Ha Lease.

2.5.5 Mineral beneficiation:

Except manual/ mechanized sizing and sorting of the Limestone, no other processing is proposed for the ROM Limestone at the mines.

2.5.6 Transportation:

This is a captive mine. Entire limestone production is proposed for the use in manufacturing of Soda-ash and Cement at their respective plant in Mithapur, District –Devbhumi Dwarka. Transportation of Limestone is proposed by trucks. Existing road network will be sufficient and able to handle the increased load. Nearest highway is SH-27 & NH-8B with current vehicle

[21] Reference : Page No 38 of Annexure XI.

plying capacity of 30-35 trucks/hr and 40 trucks/hr respectively. The predicted increase in traffic is 15 trucks/day or 1 truck/hr on basis of 12 hour operation, which is expected to have an insignificant impact on the existing capacity of roadways.

2.5.7 Solid waste management[22]

As per approved mining plan the mineral limestone is exposed on the surface and stratified. There is no overburden to handle. The mineable area is devoid of top soil, hence, no proposals are made for top soil management but efforts shall be made to recover even thin layer of soil (incidental soil), it shall be scrapped in separate slice and kept preserved for utilisation in plantation work. There is no sub grade mineral to be separated hence no proposal for disposal of waste in mining plan are provided.

2.5.8 Proposed Mechanization

The heavy earth moving machinery at present available at Adityana mining lease is given in **Table 2-12**. This machinery will be shifted to Aniali group of mining leases.

Table 2-12 : Mining Machinery Details

S. No.	Machinery	Quantity
1.	Wagon drill	1
2.	Compressor	1
3.	Front End Loader	1
4.	Excavator	2
5.	Tippers	7

2.5.8.1 Details of Machinery:

Drilling Equipment

The details of machinery required for drilling operation is given in **Table 2-13**.

Table 2-13 : Machinery Required for Drilling Operations[23]

S. No	Type	No.	Diameter of Holes	Size Capacity	Motive Power	HP
1	Wagon Driller	1	110 mm	20 M/Hr	Air Pressure	---
2	Air Compressor	1		450 Cfm	Diesel	125

Excavator and Loading Equipment

[22] Reference : Section 7.0, Page No 41 of Annexure XI.

[23] Reference : Page No 37 of Annexure XI.

Details of machinery required for excavation and loading are given in **Table 2-14.**

Table 2-14 : Machinery required for Excavation and Loading

S. No	Type	No.	Bucket Capacity in m^3	Motive Power	HP
1	Back Hoe Hydraulic Excavator	1	1.54 Cum	Diesel	110

Haulage Equipment

Details of machinery required for transportation of ROM are given in **Table 2-15**:

Table 2-15 : Machinery required for Haulage

S. No	Type	No	Sizing Capacity(Tones)	Motive Power	HP
1	Tipper	3	10	Diesel	110

2.6 Employment Potential

The local labours shall be engaged for sizing of limestone and loading and handling of mineral in mining area, besides, watch and ward and plantation activity with proper maintenance. On assumption that one man on and average can size 1.5 tonnes of material per man day. The total manpower required for material handling and loading works out to 150. Beside this, TCL Shall engage skilled and managerial staff to meet the statutory requirement under MMR 1961 and MCDR 1988. At present, the mine is not functional. The following skilled / unskilled and semi-skilled workers besides managerial and administrative staff shall been employed at the time of re-opening of mine.

Table 2-16 : Manpower Details[24]

S. No.	Designation	Number
Managerial and Supervisorial Personnel		
1.	Mine Manager (As per MMR – 1961)	1
2.	Mining Engineer (as per MCDR 1988)	1
3.	Mining Geologist	1
4.	Mining Mate/Supervisor	1
5.	Driller Cum Blaster	1
Skilled		
6.	Excavator Operator	2
7.	Tipper Operator	6

[24] Reference : Page No 44 of Annexure XI.

8.	Drill m/c Operator	2
9.	Driver Explosive Van	1
10.	Driver Water Tanker	1
11.	Driver Jeep	1
Semiskilled		
12.	Helpers	8
13.	Clerk cum Store Keeper	1
Un Skilled		
14.	Un Skilled	2
15.	Others – for manual sizing	150
	Total	**179**

2.7 Site Facility

2.7.1 Mines Office

Mine office and rest room will be provided at a Centre area of all Aniali leases. Specifically the following facilities will be provided to mine workers at the mines' office and in conformance with the Mines Rules, 1952:

- Canteen cum Rest room
- Toilet
- First Aid

2.7.2 Rest Shelter

Rest shelters along with first-aid station, complying with relevant provisions of Mines Rules will be provided at mine.

2.7.3 Blasting Shelter

A portable blasting shelter will be provided for the mine employees to take shelter during blasting operations. Blasting operations will be usually carried out during lunch hours.

2.8 Utilities Required

2.8.1 Power Supply

The mine will work in day shift only, so lighting arrangement will not be required.

2.8.2 Workshop and Stores

Infrastructure for repair and maintenance is already available at the Adityana mine site; hence no major additional facilities will be required to be installed.

2.8.3 Fuel Detail

High Speed Diesel (HSD) is used for running equipments and vehicles at the mining site. Daily consumption of HSD is estimated to be about 0.08 MT/Day for running mining machineries.

2.9 Water & wastewater management

2.9.1 Water Supply & Sanitation

The Aniali mine plans to abstract water from nearby privately owner dug well located near Aniali mine lease area.

2.9.2 Water Source & Requirement

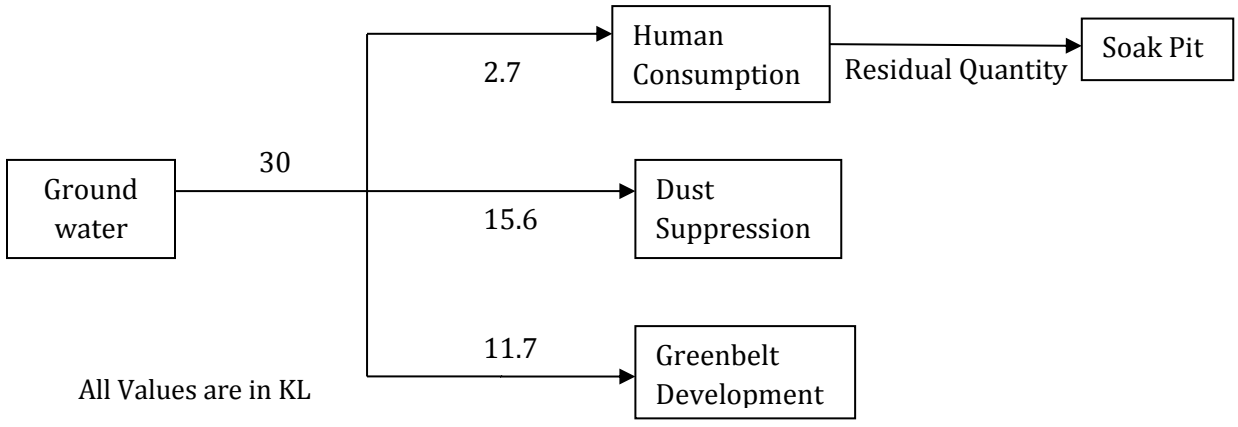
The projected water requirements for the mine site are likely to be in the range of 30kld. The major areas of water consumption are dust suppression (15.6 KLD), for domestic purposes (2.7 KLD) and green belt development (11.7 KLD). Most of the water consumption proposed will be for dust suppression. It is to be noted that due to mechanical nature of mining in this lease the water requirement for the dust suppression will be optimal.

Several water conservation methods will be adopted by way of

- Harvesting rain water in mined out pits.
- Using truck mounted sprinkler system.
- Development of drip irrigation system for watering plants.

The detailed water balance is shown below
Figure 2-2.

Figure 2-2 : Water Balance Diagram (KLD)



2.9.3 Waste water generation & disposal

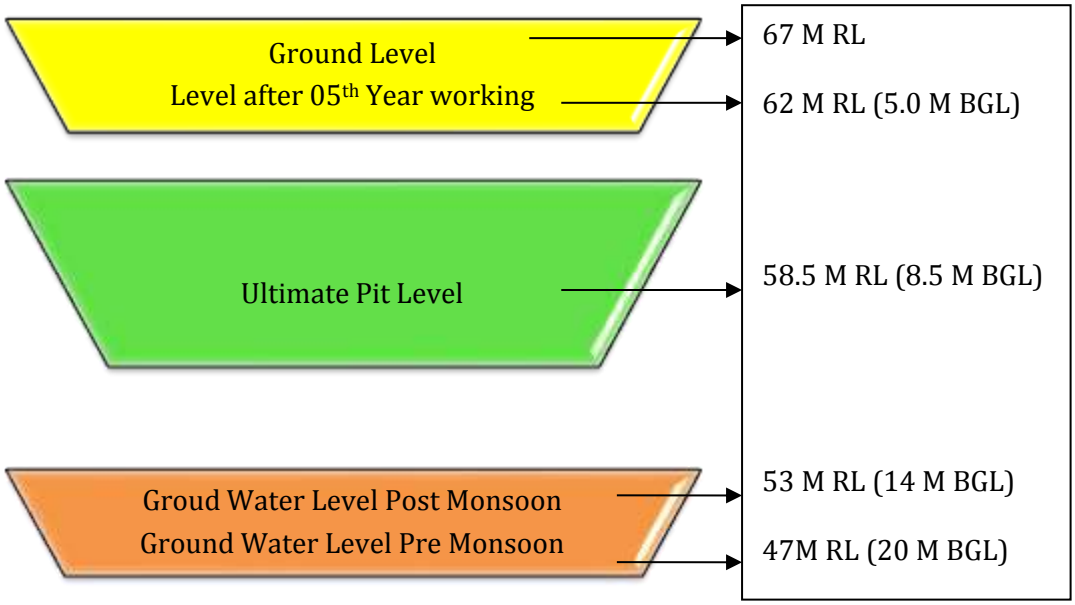
There will be no wastewater generation from limestone mining activities; however, marginal quantities of domestic wastewater will be generated, which will be disposed in soak pits.

2.9.4 Mine Drainage

2.9.4.1 Ground water

The lime stone deposit is an elevated, above the ground and hence mining excavation will not go deeper down the ground level, will never touch the ground water table. The details of site levels and ground water table are given as below **Figure 2-3**.

Figure 2-3 : Working level through the mine life



Hence, The Proposed Mining will not intersect ground water. The detailed quality of ground water in study area and impacts has been given in EIA Report Chapter 3.

2.9.4.2 STORM WATER

The lease area is slightly sloppy hence no collection of surface water at site is envisaged during pre-operational stage. After commissioning of mining activities the rain water will get collected in the mined out pits and as a common practice is used for dust suppression and greenbelt development. After completion of mining activities, the site will cater 1,116,050 KL water storage in the region will create positive environment.

2.10 POST MINING LAND USE

2.10.1 A forestation Programme up to the end of Conceptual Plan

The proposed mining to be carried out with opencast mining method and rest of area will be developed as green belt for creation of aesthetic environment suitable to local conditions. At the end of mining lease total 0.86 Ha area will be developed as green belt. The selection of species to be planted will be done with criteria like local, speedy growing & fruit bearing in nature.

2.10.2 Rain Water storage/ Harvesting

The mine will be worked as opencast mechanised method and mining operations will generate rainwater storage pits at the end of mining. The total estimated area of pits will be 13.13 Hectare with maximum depth of 8.5 meters. The shallow pit will cater water storage of 1,116,050 KL of water at site for green belt development and dust suppression.

CHAPTER 3: DESCRIPTION OF ENVIRONMENT

3 DESCRIPTION OF ENVIRONMENT

3.1 Introduction

This chapter presents a regional background to the baseline data at the very onset, which will help in better appreciation of micro-level field data, generated on several environmental and ecological attributes of the study area. The baseline status of the project environment is described section wise for better understanding of the broad spectrum conditions. The baseline environment quality represents the background environmental scenario of various environmental components such as Land, Water, Air, Noise, Biological and Socio-economic status of the study area. Field monitoring studies to evaluate the base line status of the project site were carried out covering March, April & May 2013 with CPCB guidelines. Environmental data has been collected with reference to proposed mine for:-

a) Land
b) Water
c) Air
d) Noise
e) Biological
f) Socio-economic status

3.1.1 Study Area

Study area of Limestone Mine for baseline study covers the total area covering a 10 Km radius from the mine lease periphery. Further the study area has been divided into two zones namely “Core Zone” and “Buffer Zone”. Core zone comprises of the mine lease area within the mine lease boundary while the area around the mine lease periphery covering 10 Km radius area constitutes the Buffer Zone. Map showing study area of the proposed project has been attached as **Annexure-V.**

3.1.1.1 Geographical location of the study area

The study area comprises of 10 Km radius area around Limestone Mine of 16.21 ha at Village- Aniali, Tehsil - Ranavav, Dist. -Porbandar (Gujarat) and the total geographical area of study area is ≈314.16 Sq. Km.

3.1.2 Methodology adopted for Baseline Study

The methodology for conducting the baseline environmental survey considered the guide-lines given in the EIA Manual of the MoEF. Baseline information with respect to Land, Water, Air, Noise, Biological and Socio-economic quality status in the study area were collected by conducting primary sampling / field studies during summer season March 2013 to May 2013. The characteristics of baseline status of study area with respect to the parameters are discussed.

3.2 Land Environment

Since the mining is carried out by opencast mining method, studies on land environment of eco-system play an imperative role in identifying susceptible issues and taking appropriate action to uphold ecological equilibrium in the region. The main objective of this section is to provide a baseline status of the study area covering 10km radius around the proposed mine site so that temporal changes due to the mining activities on the surroundings can be assessed in future.

3.2.1 Methodology

Land use / Land cover map preparation, Base map creation; Geometric and Radiometric correction of satellite image has been processed using ERDAS Imagine 9.2 Software.

The methodology used for present LU/LC of study area is shown in **Figure 3-1** and is detailed below:

Methodology adopted for thematic data extraction from the satellite imageries:

ERDAS image processing software and ARC/GIS Software were used for the project. Erdas 9.2 Image Processing Software was used for digital processing of the spatial data. Digital image processing techniques were applied for the mapping of the land use/land cover classes of the provided area from the satellite data. The methodology applied comes under following steps:

Image Extraction:

Satellite imageries of was obtained and a sub set for the Area of Interest was created through ERDAS image processing software.

Geo-Rectification:

Geometric correction includes correction for geometric distortions due to sensor, earth geometry variations and conversion of the data to real world coordinates (e.g. Latitude and Longitude) on the Earth's surface. The satellite imagery was geometrically rectified with reference to the geo-referenced Toposheet and vector data.

Image Enhancement:

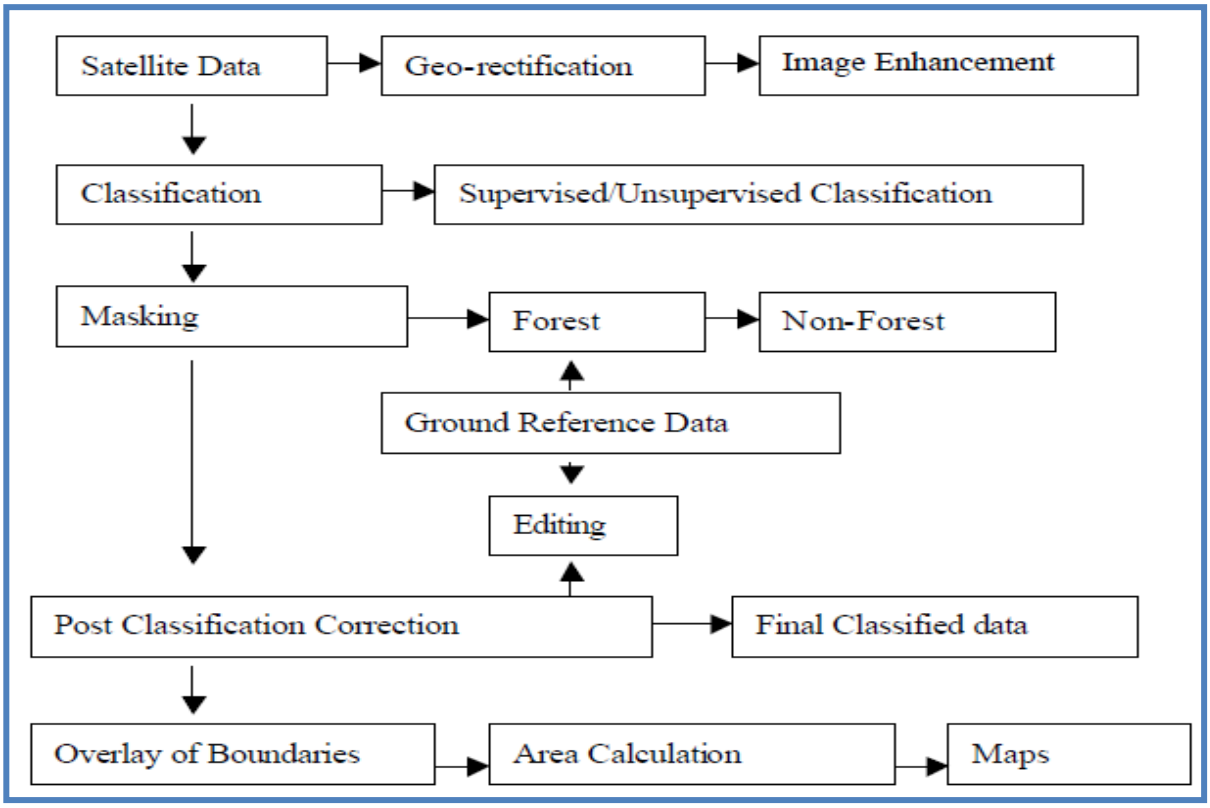
Image enhancement is one of the important image processing functions primarily done to improve the appearance of the imagery to assist in visual interpretation and analysis. Various options of image enhancement techniques were tried out to get the best image for visual interpretation. Histogram equalized stretch enhancement techniques was applied to the imagery of the study area for better interpretation of different features in the satellite imagery.

Classification:

Satellites images are composed of array of grid, each grid have a numeric value that is known as digital number. Smallest unit of this grid is known as a pixel that captures reflectance of ground features represented in terms of Digital number, which represent a specific land features. Using image classification technique, the satellite data is converted into thematic information map based on the user's knowledge about the ground area.

Hybrid technique has been used i.e. visual interpretation and digital image processing for identification of different land use and vegetation cover classes based on spectral signature of geographic feature. Spectral signature represents various land use classes. Image interpretation keys are developed based on image characteristics like colour, tone, size, shape, texture, pattern, shadow, association etc. which enables interpretation of satellite images for ground feature. Training sites are then assigned based on their spectral signature and interpretation elements. Land use/Land cover Map has been broadly classified into five classes namely Agriculture, Forest Land, Built up area, Water Bodies and waste land and all other land uses have been categorized in others class. Using image classification algorithm land use map is then generated.

Figure 3-1 : Methodology use for land use classification and mapping



3.2.2 Land Use/ Land Cover

The existing land use pattern of the study area based on the latest satellite imagery is given in **Table 3-1** as follows and is shown in **Annexure VI.**

Table 3-1 : Land use pattern of the study area

Sr. No.	Land-use Class	Area (sq.km)	% Land Cover
1	Agriculture land	186.28	59.29
2	Forest land	39.24	12.49
3	Settlement	34.87	11.10
4	Water Bodies	11.74	3.74
5	Waste land	17.85	5.68
6	Barda Wildlife Sanctuary	24.18	7.70
Total area		**314.16**	**100**

3.2.2.1 Description of land use

The study area is prominently covered by agricultural land (59.29 %). The drainage & water bodies are covering 3.74 % while built-up area covers 11.10 % of the study area. Forest Area along with vegetation and land with semi-arid vegetation covers 12.49 % of the study area. 5.68 % of land is occupied by the waste barren land and the mine area is also covered in that share. Apart from all the above mentioned classes 7.70 % land is covered by Barda Wild Life Sanctuary. The wheat and maize are main crops of the study area and opium cultivation was also reported in the study area. The above land use analysis indicates that a healthy distribution exists in the area.

3.2.2.2 Physiography

The Aniali Limestone mine area has almost flat topography gradually sloping towards eastern direction. The highest contour level is 73m AMSL on W and lowest is 59m AMSL on E side. There is no permanent water body or any perennial stream located within lease area.

3.2.2.3 Seismicity of the area

The Bureau of Indian Standards is the official agency for publishing seismic zone maps and codes in India. As per latest Seismic Zone Map (Published by BIS in 2002), the country divided in to four seismic zones. Zone II is the least vulnerable and Zone V is most vulnerable. As per Seismic Zones details given in **Figure 3-2**, the Proposed Mining location and study area falls under Zone – III. Which is classified as moderate risk zone as per Gujarat State Disaster Management Authority.

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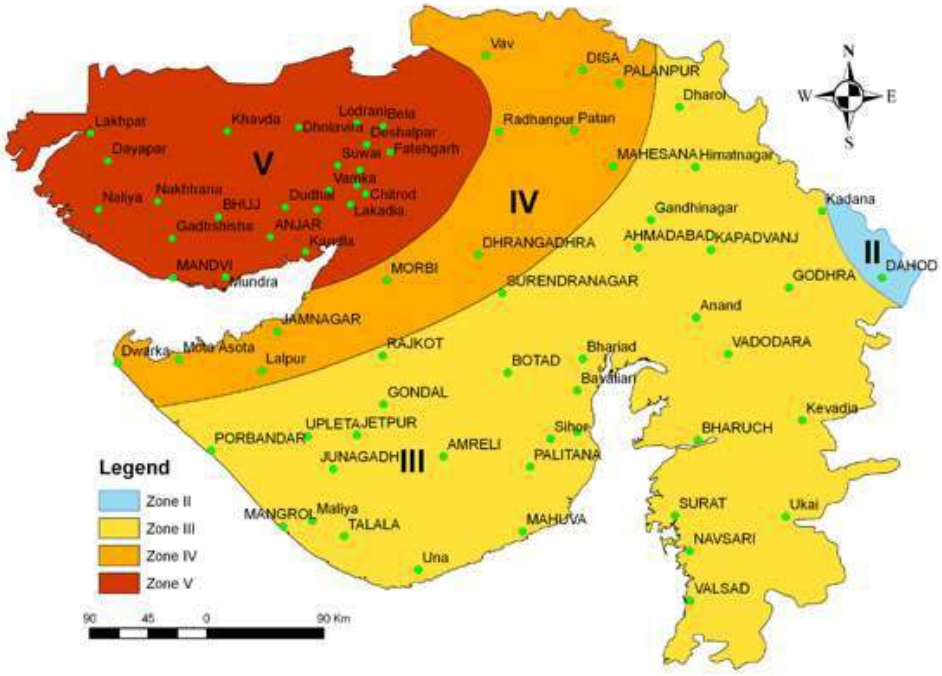
Figure 3-2 : Seismic Zone Map of Gujarat



(Source: Institute of Seismological Research, Govt. of Gujarat)

3.2.2.4 Major Environmental Features in the Study Area

No major eco-system / biosphere reserves have been identified within the periphery of the project study area. Details of the important features along with other sensitive ecological locations in the study area are provided in **Table 3-2.**

Table 3-2 : Important Features and Sensitive Ecological Locations in the Study Area

S.No	Sensitive Ecological Features	Name	Distance (in.km.)
1.	National Park/Wildlife Sanctuary	Barda wildlife sanctuary	3.92
2.	Reserved forest	Naliyadhar Reserved Forest	0.11
3.	Tiger Reserve/Elephant Reserve / Turtle Nesting Ground	None	---
4.	Core Zone of Biosphere Reserve	None	---
5.	Habitat for migratory birds	None	---
6.	Lakes/Reservoir/Dams	None	---
7.	Stream/Rivers	Minsar River	5.60
		Bileshwari	4.86
8.	Estuary/Sea	Arabian sea	23.53
9.	Mangroves	None	---
10.	Mountains/Hills	none	---

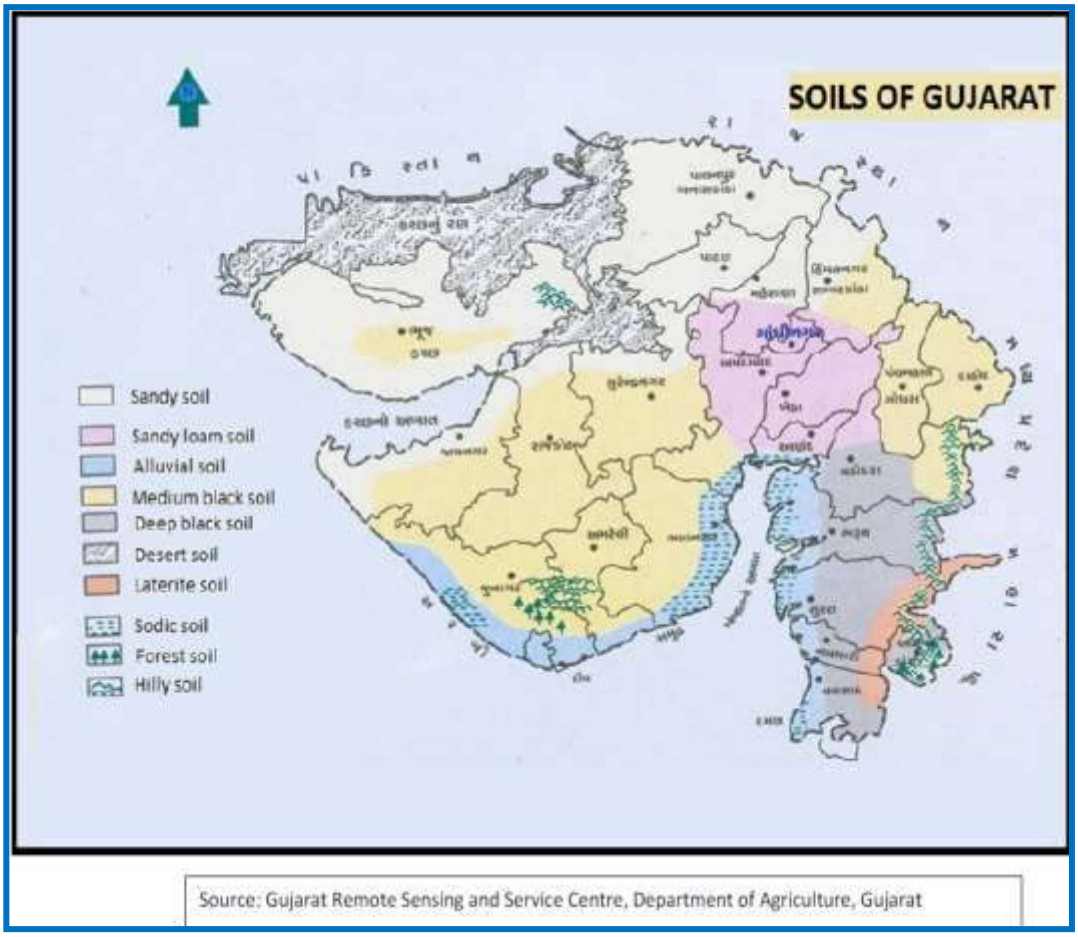
11.	Notified Archaeological sites	none	---
12.	Industries/Thermal Power Plants	Saurashtra Cement	10.06
13.	Defence Installation	Coast guard	23.53
14.	Other mines	Aniali (12.27 Ha)	0
		Aniali(21.04Ha)	0
		Aniali (15.99Ha)	3.35
		Aniali (6.07Ha)	4.27
15.	Airport	Porbandar	18.10
16.	Railway Lines	Porbandar Ahmedabad	2.14
17.	National/ State Highway	NH 8-B	5.23
		SH-27	4.06

3.2.3 Soil Characteristics

Soil may be defined as a thin layer of earth's crust, which serves as a natural medium for the growth of plants. The soil characteristics include both physical and chemical details. The soil survey was carried out to assess the soil characteristics of the area. For studying soil quality of the region 5 samples were collected to assess the existing soil conditions in and around the area. The study area has medium black soil as shown in **Figure 3-3.**

The soil of the Porbandar district is conspicuous by their deficiency in quality and depth. Porbandar district falls under south Saurashtra Agro climatic zone. The soil of this zone is medium black and silty loam with calcareous in nature. The soil on the sea shore is saline and sandy. The upper layer of the soil is thin and shallow in depth.

Figure 3-3 : Soil classification map of Gujarat



3.2.3.1 Methodology of baseline data generation

Soil samples have been taken from 5 sites within the study area. Distance and direction of soil sampling station from the mine site have been given in **Figure 3-3** & same is shown in **Figure 3-4**.

Figure 3-4 : Environmental Monitoring Location Map.

Table 3-3 : Details of Soil monitoring locations

S.No.	Location code	Distance (Km)	Location Name	Direction
1.	S1	0.5	Near Mine site	N
2.	S2	2	Village Dolatgadh	E
3.	S3	3	Village Aniali	SE
4.	S4	3	Village Bordi	N
5.	S5	2	Near Naliadhar RF	S

The sample was collected by driving an auger into the soil up to the depth of 90 cm. The present study on the soil quality establishes the baseline characteristics and identifies the

incremental concentrations if any, due to the proposed project. The objective of the sampling is:-

- To determine the baseline soil characteristics of the study area;
- To determine the impact of proposed activity on soil characteristics and;
- To determine the impact on soil more importantly agriculture production point of view.

The soil sample is collected from three different depths viz. 30cm, 60cm and 90cm. The sample was then packed in polythene plastic bags and sealed. The sample from three different depths is homogenized and is then analyzed. Main test methodologies used for analysis of Soil are given in **Table 3-4** :

Table 3-4 : Methodologies used for Soil Analysis

Sampling Parameters	Sample collection and Frequency	Sample Analysis		Methodology
		Analytical Equipment	Sensitivity / Detection Limit	
Texture	Manual sample collection using hammer and container tube for collecting undisturbed top soil and will be collected once in season	As per	As per	IS: 2720 Part 4
Water holding capacity		As per HMSO, UK	As per HMSO, UK	HMSO, UK
Porosity		As per IS: 2720	As per IS: 2720	IS: 2720 Part VII
Permeability		Falling Head Method		IS: 2720 Part XVII
Moisture		Electronic Balance	0.001 mg	IS: 2720 Part 2
Particle size distribution		As per IS: 2720	As per IS: 2720	IS: 2720 part 4
Cation Exchange Capacity		As per IS: 2720	As per IS: 2720	IS: 2720 part 24
Electrical Conductivity		As per IS: 14767-2000	As per IS: 14767-2000	IS: 14767-2000
pH		pH Meter		4500 H+B
Calcium		EDTA Titration	-	3500 Ca B
Magnesium		EDTA Titration	-	3500 Mg B
Sodium (Na)		Flame Photometer	100 µg/l	3500 Na B
Potassium		Flame Photometer	100 µg/l	3500 K B

3.2.3.2 Baseline data status

The results of soil analysis are given below in **Table 3-5** collected from five different locations.

Table 3-5 : Soil Quality Analysis results (March to May 2013)

S. No.	Parameters	Units	Location				
			S1	S2	S3	S4	S5
1	pH	-	7.40	8.02	7.52	7.92	7.82
2	Bulk Density	gm /cm^3	1.62	1.47	1.39	1.43	1.54
3	Conductivity	Micro mhos/cm	281.35	582.08	234.87	787.17	566.76
4	Moisture	%	23.1	24.03	19.76	23.51	22.76
5	WHC	-	33.1	35.18	35.2	33.46	35.69
6	Texture	-	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
7	Sand	%	72	74	74	74	72
8	Clay	%	8	8	8	6	8
9	Silt	%	20	18	18	20	20
10	Sodium	mg/100gm	0.8	1.1	1.0	1.2	1.3
11	Potassium	mg/100gm	0.3	0.4	0.3	0.4	0.3
12	CEC	meq/100gm	12.36	12.39	8.40	10.48	10.45
13	Nitrogen	mg/100gm	4.40	2.09	3.01	3.02	2.10
14	Phosphorous	mg/100gm	60.50	42.49	40.15	52.39	48.39
15	Organic Matter	%	2.85	2.60	2.23	3.38	2.63
16	Ca	meq /100gm	3.13	6.03	6.05	5.43	5.69
17	Mg	meq /100gm	5.67	3.09	2.76	4.09	3.39
18	SAR	-	3.49	2.48	1.20	2.36	5.20

The samples collected are analysed at NABL accredited laboratory and analysis results are given in **Annexure XIV.** Monitoring data shows that the texture of soil at all locations is sandy loam. The monitoring sites have sand ranging from 72% to 74 %. Silt content varies from 18% to 20 % while clay varies from 6 % to 8 %.

- The data shows that value of pH ranges from 7.4 near mine site to 8.02 at Village Dolatgadh.
- The conductivity ranging from 234.87 to 787.17 Micro mhos/cm at village Aniali and Bordi respectively.
- Soil has Water holding capacity in the range of 33.1 to 35.69.
- Nitrogen, Phosphorous &Potassium (NPK) level of soil ranges from 2.09, 40.15 & 0.3 mg/100gm to 4.4, 60.50 & 0.4 mg/100gm respectively.

3.3 Water Environment

The general ground water table depth of study area falls between 47 to 53 m RL from the surface during pre-monsoon and post-monsoon periods.

3.3.1 Water consumption & Sources

The projected water requirements for the mine site are likely to be in the range of 30kld. The major areas of water consumption are dust suppression (15.6 KLD), for domestic purposes (2.7 KLD) and green belt development (11.7 KLD). Most of the water consumption proposed will be for dust suppression. It is to be noted that due to mechanical nature of mining in this lease the water requirement for the dust suppression will be optimal.

Several water conservation methods will be adopted by way of

- Harvesting rain water in mined out pits.
- Using truck mounted sprinkler system.
- Development of drip irrigation system for watering plants

3.3.2 Methodology of Baseline data generation

The assessment of present status of water quality within the study area was conducted by collecting water from ground water sources and surface water sources during the period of March'13 to May'13. The sampling locations were identified on the basis of their importance. Three ground water samples and two surface water samples were collected during the monitoring period. The locations of sampling stations for ground water and surface water are shown in **Figure 3-4** and details are given in **Table 3-6.**

Table 3-6 : Location of water monitoring station

S.No.	Type of sample	Location code	Location Name	Distance (km)	Direction
1.	Ground water	GW1	Village Aniali	3	SE
2.	Ground water	GW2	Village Bordi	3	N
3.	Ground water	GW3	Village Dolatgadh	2	E
4.	Surface water	SW1	Village Valotra	6	E
5.	Surface water	SW2	Khambhada Reservoir	6.5	NW

Water samples were collected from all the sampling locations and analysed for relevant physical, chemical and bacteriological parameters. Collection and analysis of the samples was carried out as per established standard methods and procedures, prescribed by CPCB,

relevant IS Codes and Standard Methods of Examination of Water. This report presents data for the month of April, 2013.

Analyses of the parameters like temperature; pH, dissolved oxygen and alkalinity were carried out at the sampling stations immediately after collection of samples with the help of Field Analysis Kits. For analysis of other parameters, the samples were preserved and brought to laboratory at Noida. The metallic constituents like arsenic, mercury, lead, cadmium, chromium, copper, zinc, selenium, iron and manganese were analysed with Atomic Absorption Spectroscope.

3.3.3 Ground water

The groundwater table in this region fluctuates between 47 to 53 m RL from the surface during pre-monsoon to post-monsoon seasons.

3.3.3.1 Ground water potential

Mining lease is located in Ranavav Taluka. Groundwater potential data of Ranavav Taluka is presented in **Table 3-7.**

Table 3-7 : Groundwater potential of the Ranavav Taluka

S. No	Particulars	Units	Details
1.	Gross groundwater recharge	MCM/ year	66.14
2.	Recharge due to rainfall	MCM/ year	62.83
3.	Recharge due to artificial recharge measures	MCM/year	42.06
4.	Proposed industrial draft	MCM/ year	2.09
5.	Draft due to evaporation losses	MCM/year	44.15
6.	Surplus reserves	MCM/ year	18.68
7.	Level of groundwater development	(%)	70.26

3.3.3.2 Ground water quality

The ground water analysis data for the monitoring period i.e. March to May' 2013 is presented in

Table 3-8 respectively. The physico-chemical characteristics of Ground water are analysed with the drinking water standards, prescribed in IS: 10500 (Test Characteristics for Drinking Water).

Table 3-8 : Ground water quality Analysis results for March to May'2013

S. No.	Parameters	Unit	IS 10500 Standard Limits for drinking water		Ground water Quality		
			Desirable limit	Permissible limit	GW 1	GW2	GW 3
1.	Colour	Hazen	5	15	< 5	< 5	< 5
2.	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3.	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4.	Turbidity	NTU	1	5	<5	<5	<5
5.	pH	-	6.5 – 8.5	6.5 – 8.5	7.65	7.54	7.78
6.	Temperature	^{0}C	NS	NS	31	31	31
7.	Conductivity	µmhos /cm	NS	NS	1352	3256	1427
8.	Alkalinity as CaCO3	mg/l	200	600	210	141	186
9.	Total Dissolved Solids	mg/l	500	2000	1286.9	2246	472
10.	Total Hardness as CaCO3	mg/l	200	600	402	1126	406
11.	Calcium as CaCO3	mg/l	75	200	326	840	261
12.	Magnesium as CaCO3	mg/l	30	100	76	286	145
13.	Chloride as Cl	mg/l	250	1000	465	1077	559
14.	Phosphate as PO4	mg/l	NS	NS	0.07	0.1	0.07
15.	Nitrate asNO3	mg/l	45	45	0.5	0.09	0.01
16.	Oil and Grease	mg/l	NS	NS	BDL	BDL	BDL
17.	Sulphate as SO4	mg/l	200	400	65.3	166	154.6
18.	Sodium as Na	mg/l	NS	NS	31	35	25
19.	Potassium as K	mg/l	NS	NS	2	3	3
20.	COD	mg/l	NS	NS	<4	<4	<4
21.	BOD	mg/l	NS	NS	<2	<2	<2
22.	Total coliform	MPN/ 100ml	Absent	Absent	Absent	Absent	Absent
23.	Faecal Coliform	MPN/ 100 ml	Absent	Absent	Absent	Absent	Absent

***NS: Not Specified**

The value of pH ranges from 7.54 to 7.78, indicating that water is alkaline in the study area. Maximum Conductivity observed is 3256 µmhos/cm at Bordi village, whereas minimum conductivity was observed at Aniali Village as 1352 µmhos/cm. Total hardness of ground water ranges from 402 to 1126 mg/l. Observed values of Chloride vary from 465 mg/l at Aniali village to 1077 mg/l at Bordi village. The ground water quality is in general poor (brackish to saline) at deeper levels at mostly all locations.

3.3.4 Surface Water

The samples of surface water have been collected from two surface water bodies and analysed for parameters prescribed as per IS 10500.

3.3.4.1 Existing drainage pattern

No prominent water course or nallas occur in the lease area. The general slope of the lease area is SE to NW. During rainy season the surface runoff follows the natural contour and flows in the same direction. Two seasonal rivers namely Minsar & Bileshwari are present in the study area.

3.3.4.2 Surface water quality

The surface water analysis data for the monitoring period i.e. March to May' 2013 is presented in **Table 3-9**. The physico-chemical characteristics of Surface water are found within the limits, prescribed by CPCB. The surface water quality is in general poor (brackish to saline) at mostly all locations.

Table 3-9 : Surface water analysis results (March to May 2013)

S.No.	Parameters	Unit	Desirable limit	Surface Water Quality	
				SW 1	SW2
1.	Colour	Hazen	5	<5	<5
2.	Odour	-	Agreeable	Agreeable	Agreeable
3.	Taste	-	Agreeable	Agreeable	Agreeable
4.	Turbidity	NTU	1	<5	<5
5.	pH	-	6.5 – 8.5	7.98	7.86
6.	Temperature	^{0}C	-	25	21
7.	Salinity	-	-	306	125
8.	Conductivity	µmhos/cm	-	596	540
9.	Total Dissolved Solids	mg/l	500	764	685
10.	COD	mg/l	-	24	22
11.	BOD	mg/l	-	9	8
12.	Magnesium as CaCO3	mg/l	30	29.16	12.6
13.	Chloride as Cl	mg/l	250	170	153
14.	Phosphate as PO4	mg/l	-	0.206	0.385
15.	Nitrate as NO3	mg/l	45	42.43	35.69
16.	Dissolved Oxygen	mg/l	-	4.4	4.6
17.	Sulphate as SO4	mg/l	200	39.45	64
18.	Potassium as K	mg/l	-	4	5
19.	Iron as Fe	mg/l	0.3	0.023	0.002
20.	Copper as Cu	mg/l	0.05	0.496	0.02
21.	Zinc as Zn	mg/l	5	BDL	BDL
22.	Total Coliform	MPN/100 ml	Absent	2	<2

3.4 Air Environment

3.4.1 Meteorology

The meteorological data helps for appropriate interpretation of the baseline status of the study area as well as for input into prediction models to evaluate air quality dispersion. Chronological data on meteorological parameters also plays an important role in identifying the general meteorological regime of the region.

The climate in the region shows broadly four seasonal variations, namely :

- Winter: December – February
- Summer: March – Mid June
- Monsoon: Mid June – September
- Post-monsoon: October - November

Information presented in subsequent paragraphs is from the Indian Meteorological Department (IMD), Long Term Climatological Tables, 1961-1990, Porbandar (A) given in **Table 3-10**. These tables give useful information about a region's weather, since they are collected over a period of 30 years.

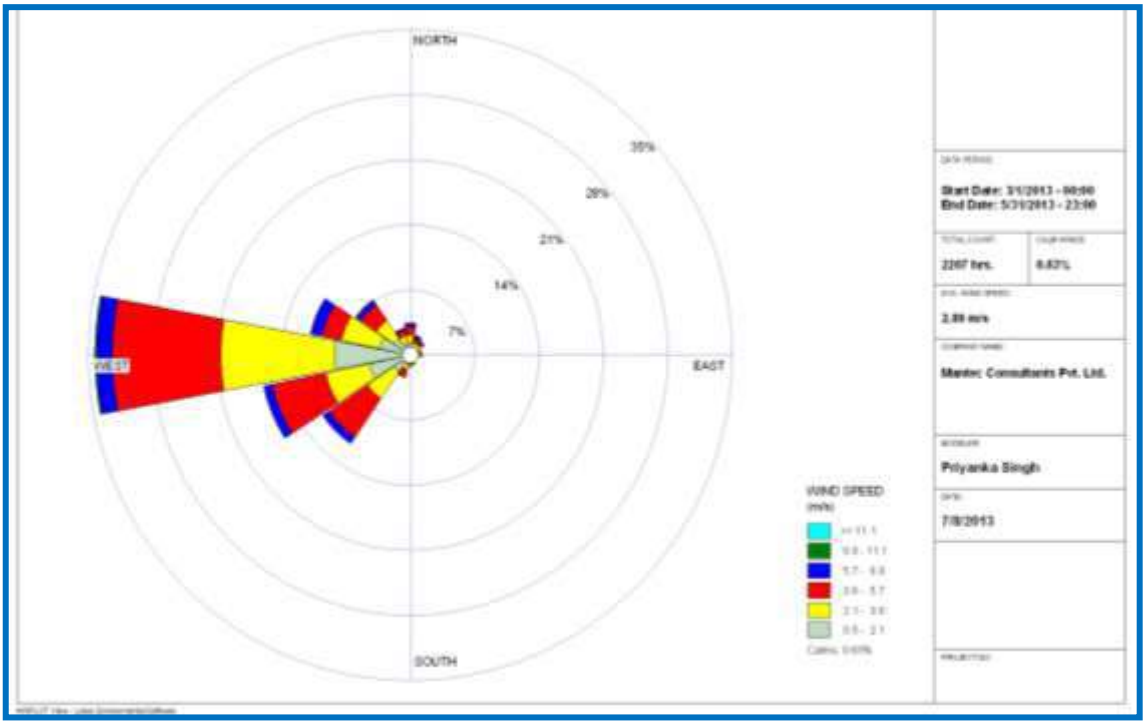
3.4.2 Site Specific Meteorology

Site specific meteorology during the study period was recorded by an automated weather station. Wind profile of the area is shown in the form of windrose diagram given in **Figure 3-5.** Site specific meteorological data of the study area reveals that predominantly wind is blowing from the west direction accounting approximately 34% of the total wind followed by SW and SSW contributing 16% to 11% respectively. Calm winds are only 0.63% of the total value. Average wind speed during the study period is 2.89 m/s.

Table 3-10 : Climatological data of Porbandar

MONTHS		AIR TEMPERATURE										HUMIDITY		CLOUD AMOUNT		RAINFALL						
		MEAN						EXTREMES														
		Dry Bulb	Wet Bulb	Daily Max	Daily Min	Highest in the Month	Lowest in the Month	Highest	Date and Year	Lowest	Date and Year	Relative Humidity	Vapour Pressure	All Clouds	Low Clouds	Monthly Total	No. of Rainy Days	Total Wettest Month with Year	Total Driest Month With Year	Heaviest Fall in 24 Hours	Date and Year	Mean Wind Speed
		°C	°C	°C	°C	°C	°C	°C		°C		%	hPa	Oktas of sky		mm		mm	mm	mm		Kmph
JANUARY	I	16.6	12.4	28.8	13.9	32.6	9.1	35.4	17	4.7	22	60	11.2	1.0	0.1	0.9	0.2	7.2	0.0	7.2	31	11.6
	II	26.3	18.1						1965		1962	42	14.2	0.9	0.1			1961			1961	
FEBRUARY	I	18.4	14.6	30.0	15.4	35.0	10.8	38.4	11	7.5	07	65	13.7	1.0	0.2	1.7	0.2	18.1	0.0	12.0	05	12.4
	II	27.3	19.4						1985		1974	46	16.4	0.7	0.2			1990			1961	
MARCH	I	22.6	19.0	32.4	19.0	38.1	14.1	41.4	27	8.7	02	70	19.1	1.3	0.4	2.3	0.1	68.6	0.0	28.2	27	13.5
	II	29.3	21.8						1973		1972	51	20.2	0.9	0.1			1967			1967	
APRIL	I	26.3	23.3	33.2	22.3	39.6	18.4	44.0	26	15.4	26	77	26.3	1.7	0.9	0.2	0.0	6.1	0.0	5.9	15	13.7
	II	30.4	24.4						1979		1985	60	25.8	1.0	0.3			1983			1983	
MAY	I	28.8	25.8	33.0	25.8	37.5	21.9	45.5	03	19.2	02	78	30.9	2.1	1.9	1.7	0.1	22.9	0.0	22.9	08	15.4
	II	31.0	26.6						1966		1979	70	31.4	1.5	1.3			1982			1982	
JUNE	I	29.5	26.8	32.6	27.6	34.6	24.37	38.3	30	22.7	13	80	32.9	4.0	2.8	140.7	4.0	1128.9	0.0	416.0	21	18.6
	II	30.8	27.3						1987		1964	75	33.4	4.1	2.8			1983			1983	
JULY	I	28.3	26.1	31.0	26.7	33.0	24.0	35.2	03	18.7	09	83	32.1	6.0	3.4	222.4	8.3	610.8	13.1	252.6	16	18.5
	II	29.3	26.5						1961		1973	79	32.1	5.8	3.6			1962	1986		1969	
AUGUST	I	27.2	25.4	30.0	25.7	31.8	24.0	34.1	17	22.2	07	85	30.9	6.1	3.3	140.4	6.6	565.5	0.3	320.7	07	16.1
	II	28.4	25.7						1987		1968	80	30.9	5.7	3.3			1979	1972		1968	
SEPTEMBER	I	27.1	24.9	31.0	24.7	34.4	22.2	40.3	30	19.2	26	82	29.6	3.7	2.1	63.6	3.0	554.4	0.0	511.4	04	12.2
	II	29.1	25.3						1966		1972	73	29.3	3.4	2.2			1977			1977	
OCTOBER	I	26.2	22.7	34.2	22.2	38.4	18.3	41.2	15	15.3	30	74	25.0	1.3	0.5	20.3	0.8	351.6	0.0	99.9	22	10.4
	II	31.1	24.1						1980		1961	55	24.4	1.5	0.8			1975			1975	
NOVEMBER	I	23.2	18.1	33.4	19.1	36.8	14.4	38.8	02	11.1	30	60	16.9	1.1	0.2	15.8	0.6	141.5	0.0	100.3	01	10.5
	II	30.0	21.8						1986		1966	47	19.7	1.3	0.4			1982			1981	
DECEMBER	I	18.8	14.0	30.4	15.7	33.8	10.7	35.3	09	6.4	16	57	12.3	1.0	0.1	1.5	0.2	14.2	0.0	14.2	22	11.0
	II	27.5	19.1						1968		1986	43	15.5	1.1	0.1			1980			1980	
ANNUAL TOTAL	I	24.4	21.1	31.7	21.5	40.7	8.4	45.5		2.0		73	23.4	2.5	1.3	611.5	24.1	1758.9	63.7	511.4		13.7
	II	29.2	23.3									60	24.4	2.3	1.3			1983	1987			
NUMBER OF YEARS	I	30	30	30	30	30	30	34		34		30	29	30	25	30	30	30	30	30		30
	II	30	30									30	29	30	24							

Figure 3-5 Wind rose diagram of the study area



3.4.3 Climatology

The region has a moderate climate, unlike the regions in the rest of the state. Due to its location near the coast, the weather is generally breezy. Summers in the region start during the month of March and continue through the months of April, May and June. Temperatures can escalate to levels of around forty degrees (40°C) and the minimum temperature will range around twenty three degrees (23°C) during the summer months. Porbandar region has an unpredictable monsoon. Rainfall is heavy during some years and sparse otherwise. The city experiences very strong winds during the monsoon season, and rainfall is normally very heavy when it does occur. Monsoon months in Porbandar are between July and September.

Winters in the city of Porbandar normally extend through the months of October, November, December and January. Maximum temperatures during the winter will be around thirty six degrees (36°C) and the minimum temperature will range around ten degrees (10°C).

3.4.4 Ambient Air Quality

The prime objective of the baseline study with respect to ambient air quality is to establish the present air quality and its conformity to ambient air quality standards. This section describes the sampling locations, frequency of sampling and methodology adopted for monitoring

ambient air quality. The results of monitoring during the study period (March to May 2013) are presented in the report. The study area represents mostly rural environment. The sources of air pollution in the region are vehicular traffic, dust arising from unpaved village roads and domestic fuel burning.

3.4.4.1 Methodology adopted for the study

Sampling locations, parameters and frequency

Calibrated Respirable Dust Samplers were used for the sampling of PM_{10}, $PM_{2.5}$, SO_2 and NO_x. Ambient air sampling for PM_{10}, $PM_{2.5}$, SO_2 and NO_2. was performed continuously for 24 hours to determine 24-hour average concentrations. Ambient air quality monitoring was carried out with a frequency of two days per week at all five locations. The sampling was performed at a height of 1.5 m (approximately) from the ground level. Standard methods specified under "National Ambient Air Quality Standards" notification G.S.R. 176(E) were adopted for sampling and analysis. Five locations within the study area were scientifically selected and are based on the following considerations:

- Meteorological conditions;
- Topography of the study area;
- The direction of the wind;
- Representation of the region for establishing baseline status; and
- Representation with respect to likely impact areas.

The location of the monitoring stations with reference to the proposed plant site is given in **Table 3-11** and shown in **Figure 3-4.**

Table 3-11 : Details of Air Monitoring locations

S.No.	Location code	Location Name	Distance (km)	Direction
1.	A1	Near Mine site	0.4	N
2.	A2	Village Dolatgadh	2	E
3.	A3	Village Aniali	3	SE
4.	A4	Village Bordi	3	N
5.	A5	Near Naliadhar RF	2	S

Sampling and analytical techniques

Particulate Matter (10), (2.5)

Calibrated 'Respirable Dust Samplers' with Whatman GF/A microfibre filter paper (size: 8” X 10”) was used for the collection of PM (10). APM- 151 air sampler of Lata Envirotech

instrument was attached with Respirable Dust Sampler for monitoring particulate matter of size <2.5 microns. A known volume of ambient air is passed through the cyclone to the initially pre-processed filter paper. The centrifugal force in cyclone acts on particulate matter to separate them into two parts and collected as followings: -

i. Particles <10 µ size (Respirable) : GF/A Filter Paper

ii. Particles >10 µ size (Non Respirable) : Cyclone Cup

iii. Particles <2.5 µ size : Teflonbfilter paper 47mm

The differences in final and initial weight of filter paper and cyclone cup are used in estimation of particulate matter. The mass of particulates collected on the GF filter, divided by the volume of sampled air, gives the concentration of PM (10) whereas the mass of particulates collected on the teflon filter, divided by the volume of sampled air, gives the concentration of PM(2.5). The results are expressed in µg/m^3.

Sulphur Dioxide

Sampling and analysis of ambient SO_2 was performed by adopting the 'Improved West and Gaeke Method'. The ambient air, drawn through the draft created by the RDS, is passed through an impinger, containing a known volume of absorbing solution of *sodium tetrachloromercurate,* at a pre-determined and measured flow rate of 1 liter/minute (L/min). SO_2 in ambient air reacts with the *tetrachloromercurate* to form a stable complex, *dichloro-sulphito mercurate*. On reacting with *formaldehyde* and *p-rosaniline hydrochloride,* the sulphite ion forms an intensely coloured compound, p-*rosaniline methyle sulphonic acid*. The intensity of the colour developed is estimated by spectrophotometer at 560 nm wave length. The measured Optical Density (OD) is used to determine the concentration of SO_2 from the calibration curve already prepared against known concentrations of sulphite ion. The mass of SO_2 in the absorbing reagent, divided by the volume of sampled air provides the concentration of SO_2, which is expressed as µg/m^3.

Nitrogen Oxides

Sampling and analysis of ambient NO2 was performed by adopting the 'Jacob Hochheister Modified' (Na arsenite) method. Ambient air is drawn through an impinger at a pre determined flow rate of 1 ppm. The impinger contains known volume of absorbing solution of *sodium arsenite* and *sodium hydroxide*. Oxides of nitrogen react with the absorbing reagent to form a

stable solution of *sodium nitrite*. The nitrate ion produced during the sampling is estimated calorimetrically, after reacting with *phosphoric acid*, *sulphanilamide* and *naphthyl ethylenediamine dihydrochloride* (NEDA), using spectrophotometer at 540 nm wavelength. The measured Optical Density is used to determine the concentration of NOx from the calibration curve already prepared against known concentrations of nitrite ion. The mass of NOx in the absorbing reagent, divided by the volume of sampled air provides the concentration of NOx, which is expressed as μg/m^3.

Table 3-12 : Techniques Used for Ambient Air Quality Monitoring

Parameters	Technique	Technical Protocol	Minimum Détectable Limit (ug/m^3)
PM_{10}	CPCB Guideline (Gravimetric method)	IS-5182 (Part-IV)	1.0
$PM_{2.5}$	Gravimetric	As per CPCB Guideline	1.0
Sulphur Dioxide	West and Gaeke (Modified)	IS-5182 (Part-II)	5.0
Oxide of Nitrogen as (NO_2)	Jacob & Hochheiser (Improved)	IS-5182 (Part-VI)	9.0

3.4.4.2 Air Quality Standards

National Ambient Air quality standards (18 June 2009) along with the prescribed method of measurement is given in **Table 3-13.**

Table 3-13 : National Ambient Air Quality Standards

Pollutants	Time-weighted average	Concentration in Ambient Air		Method of measurement
		Industrial Areas, residential, rural and other area	Ecologically Sensitive Areas (notified by Central Government	
Sulphur Dioxide (SO_2)	Annual Average*	50 µg/m³	20 µg/m³	- Improved West and Geake Method -Ultraviolet fluorescence
	24 hours**	80 µg/m³	80 µg/m³	
Oxides of Nitrogen as (NO_2)	Annual Average*	40 µg/m³	30 µg/m³	- Modified Jacob & Hochheiser (Na-Arsenite) Method - Gas Phase Chemiluminescence
	24 hours**	80 µg/m³	80 µg/m³	
Particulate Matter (Size less than 10µm) or PM_{10} µg/m³	Annual Average*	60 µg/m³	60 µg/m³	- Gravimetric -TOEM -Beta attenuation
	24 hours**	100 µg/m³	100 µg/m³	
Particulate Matter (size less than 2.5 microns) $PM_{2.5}$ µg/m³	Annual Average*	40 µg/m³	40 µg/m³	- Gravimetric -TOEM -Beta attenuation
	24 hours**	60µg/m³	60 µg/m³	

*Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.
**24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

3.4.4.3 Ambient air quality results

The results of ambient air quality monitoring for the period (March to May 2013) are presented in the report. Data has been complied for three months. Various parameters monitored during the study have been described by their maximum, minimum and average

values from their study site locations. The results for five locations have been discussed under the following pages. The results of ambient air quality monitoring are presented in **Table 3-14 to Table 3-18.**

Particulate Matter 10 (PM_{10}):

The maximum value for PM10 is observed, as 68µg/m3 at Bordi village while 24 hours applicable limit is 100µg/m3 for industrial and mixed use areas. The area observes PM10 in the range of 42-68 µg/m^3 with the lowest concentration recorded near Naliadhar RF.

Particulate Matter 2.5 ($PM_{2.5}$):

The maximum value for PM2.5 observed is, 38 µg/m^3 at Bordi village while 24 hours applicable limit is 60 µg/m^3 for industrial and mixed use areas. The $PM_{2.5}$ value of 21 to 38 µg/m^3 is the lowest concentration recorded near Naliadhar RF.

Sulphur Dioxide (SO_2):

The maximum value for SO_2 is observed, as 15 µg/m^3 at Bordi village, while 24 hours applicable limit is of 80 µg/m^3 for residential, industrial and other areas. Highest average value of SO_2 is 11.8µg/m^3. All the villages have observed value well under the prescribed limit.

Nitrogen Oxides (NO_2):

The maximum value for NO2 is observed, as 26 µg/m^3 at Bordi village, while 24 hours applicable limit is of 80 µg/m^3 for residential, industrial and other areas. Highest average value of NO2 is 22.3 at µg/m^3. The area observes NO2 well below the prescribed range.

The graphical representation of Ambient Air Quality results is given in **Figure 3-6**.

Table 3-14 : Ambient Air Quality at A1- Mine Site

SITE	A1- Mine site(All values are in µg/m³)				
MONTH	**DATE**	**PM10**	**PM2.5**	**SO_2**	**NO_2**
March	6/3/2013	52	29	10	19
	7/3/2013	53	31	11	18
	13/3/2013	55	32	10	20
	14/3/2013	54	33	11	19
	20/3/2013	47	26	9	17
	21/3/2013	54	30	11	22
	27/3/2013	59	34	12	21
	28/3/2013	63	35	12	21
April	3/4/2013	62	35	11	24
	4/4/2013	63	34	12	24
	10/4/2013	64	35	12	19
	11/4/2013	66	34	11	25
	17/4/2013	62	36	13	19
	18/4/2013	66	35	12	23
	24/4/2013	64	34	11	24
	25/4/2013	65	35	12	22
May	8/5/2013	66	36	13	19
	9/5/2013	65	32	10	21
	15/5/2013	64	33	10	22
	16/5/2013	63	34	12	23
	22/5/2013	67	37	14	25
	23/5/2013	62	35	11	23
	28/5/2013	63	36	13	22
	29/5/2013	60	33	12	24
	Min	47	26	9	17
	Max	67	37	14	25
	Average	60.8	33.5	11.5	21.5
	98%tile	66.54	36.54	13.54	25

Table 3-15 : Ambient Air Quality at A2- Daulatgadh Village

SITE	A2- Daulatgadh Village (All values are in µg/m³)				
MONTH	**DATE**	**PM10**	**PM2.5**	**SO_2**	**NO_2**
March	6/3/2013	54	29	9	19
	7/3/2013	51	30	10	18
	13/3/2013	52	31	9	19
	14/3/2013	53	32	10	20
	20/3/2013	47	27	8	17
	21/3/2013	59	33	11	19
	27/3/2013	62	34	10	20
	28/3/2013	63	32	9	18
April	3/4/2013	59	31	10	19
	4/4/2013	58	32	11	20
	10/4/2013	63	35	10	19
	11/4/2013	64	33	12	21
	17/4/2013	62	32	10	20
	18/4/2013	60	31	12	22
	24/4/2013	61	30	11	21
	25/4/2013	62	33	12	22
May	8/5/2013	63	32	11	21
	9/5/2013	62	33	12	22
	15/5/2013	59	31	12	22
	16/5/2013	58	30	11	20
	22/5/2013	59	30	10	19
	23/5/2013	61	32	9	20
	28/5/2013	65	36	13	23
	29/5/2013	63	33	10	20
	Min	47	27	8	17
	Max	65	36	13	23
	Average	59.2	31.8	10.5	20.0
	98%tile	64.54	35.54	12.54	22.54

Table 3-16 : Ambient Air Quality at A3- Aniali Village

SITE	A3- Aniali Village (All values are in µg/m³)				
MONTH	**DATE**	**PM10**	**PM2.5**	**SO_2**	**NO_2**
March	4/3/2013	52	29	10	18
	5/3/2013	53	30	9	19
	11/3/2013	51	31	10	18
	12/3/2013	53	32	11	19
	18/3/2013	55	33	12	18
	19/3/2013	47	26	8	17
	25/3/2013	51	29	9	18
	26/3/2013	58	32	11	19
April	1/4/2013	59	34	11	20
	2/4/2013	62	35	12	20
	8/4/2013	61	36	11	21
	9/4/2013	57	34	12	19
	15/4/2013	62	32	12	19
	16/4/2013	65	31	11	20
	22/4/2013	62	35	10	20
	23/4/2013	63	34	11	20
May	6/5/2013	66	32	12	21
	7/5/2013	65	33	10	19
	13/5/2013	63	35	11	20
	14/5/2013	62	36	12	21
	20/5/2013	67	37	13	23
	21/5/2013	64	35	10	20
	26/5/2013	59	34	12	20
	27/5/2013	62	36	10	19
	Min	47	26	8	17
	Max	67	37	13	23
	Average	59.1	33.0	10.8	19.5
	98%tile	66.54	36.54	12.54	22.08

Table 3-17 : Ambient Air Quality at A4- Bordi Village

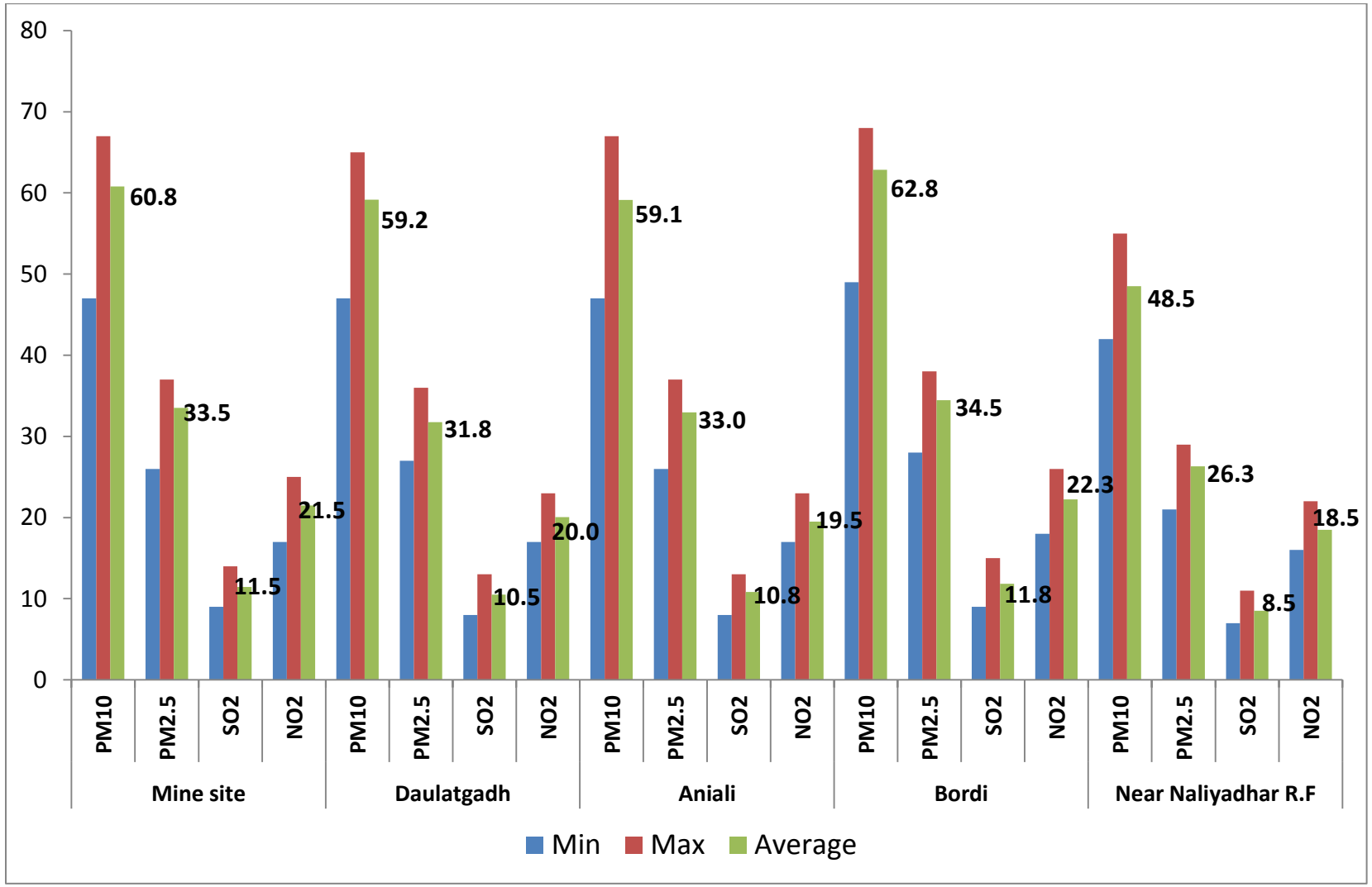
SITE	A4- Bordi Village (All values are in µg/m³)				
MONTH	**DATE**	**PM10**	**PM2.5**	**SO_2**	**NO_2**
March	6/3/2013	55	31	10	19
	7/3/2013	57	32	10	19
	13/3/2013	49	28	9	18
	14/3/2013	56	32	10	20
	20/3/2013	58	33	10	21
	21/3/2013	59	34	12	22
	27/3/2013	63	35	12	21
	28/3/2013	62	35	11	21
April	3/4/2013	63	34	12	24
	4/4/2013	64	35	12	24
	10/4/2013	66	34	11	19
	11/4/2013	62	36	13	25
	17/4/2013	66	35	12	19
	18/4/2013	64	34	11	23
	24/4/2013	65	35	12	24
	25/4/2013	66	36	13	22
May	8/5/2013	67	37	14	25
	9/5/2013	68	38	15	26
	15/5/2013	65	36	13	22
	16/5/2013	67	35	12	23
	22/5/2013	65	34	11	25
	23/5/2013	68	35	12	25
	28/5/2013	66	36	13	22
	29/5/2013	67	37	14	25
	Min	49	28	9	18
	Max	68	38	15	26
	Average	62.8	34.5	11.8	22.3
	98%tile	68	37.54	14.54	25.54

Table 3-18 : Ambient Air Quality at A5- Near Naliyadhar RF

SITE	A5- Near Naliyadhar RF (All values are in µg/m³)				
MONTH	**DATE**	**PM10**	**PM2.5**	**SO_2**	**NO_2**
March	8/3/2013	45	24	8	18
	9/3/2013	47	26	8	17
	15/3/2013	42	21	7	16
	16/3/2013	46	25	8	17
	22/3/2013	49	28	10	19
	23/3/2013	50	27	9	18
	29/3/2013	51	28	10	20
	30/3/2013	49	26	8	19
April	5/4/2013	48	24	8	18
	6/4/2013	44	23	7	19
	12/4/2013	46	28	8	19
	13/4/2013	50	29	10	20
	19/4/2013	52	28	8	19
	20/4/2013	49	27	9	19
	26/4/2013	45	24	9	18
	27/4/2013	47	26	8	17
May	10/5/2013	50	28	9	19
	11/5/2013	52	27	8	18
	17/5/2013	55	29	11	22
	18/5/2013	53	28	10	20
	24/5/2013	47	24	8	19
	25/5/2013	49	26	7	18
	30/5/2013	50	27	8	17
	31/5/2013	47	27	7	19
	Min	42	21	7	16
	Max	55	29	11	22
	Average	48.5	26.3	8.5	18.5
	98%tile	54.08	29	10.54	21.08

The graphical representation of Ambient Air Quality results is given in **Figure 3-6**.

Figure 3-6 : Graph showing Ambient Air Quality within Study Area



3.5 Noise Environment

Noise is said to be defined as an unwanted sound. It is, therefore, necessary to measure both the quality as well as the quantity of environment noise in and around the mining site.

Types of Sound Fields

Based on the distance from the source of sound generation, the types of sound field are identified. They are of three type's viz. (i) Free Field (ii) Near Field and (iii) Far Field.

I. Free Field

The sound waves that propagate without obstruction from source to the receiver are free field. The sound waves obey the inverse square law so that sound pressure level decreases by 6 dB (A) as the distance is doubled. Such a field is known as free field.

II. Near Field

This field is located within a few wavelengths of the source and it is also influenced by the dimensions of the source. The inverse square law does not apply in this field.

III. Far Field

The far field has two parts one is known as free part and the other as reverberation part. In the free part of the far field, the sound pressures level obeys the inverse square law and propagate without obstruction from source to the receiver. The reverberant part of the field exists for enclosed situation where the reflected sound waves are superimposed on the incident sound waves. If there are many reflected waves from all possible direction, a diffuse sound field exists.

The intensity of sound energy in the environment is measured in a logarithmic scale and is expressed in a decibel (dB) scale. Ordinary sound level meter measures the sound energy that reaches the microphone by converting it into electrical energy and then measures the magnitude in dB. In a sophisticated type of sound level meter, an additional circuit (filters) is provided, which modifies the received signal in such a way that it replicates the sound signal as received by the human ear and the magnitude of sound level in this scale is denoted as dB (A). The sound levels are expressed in dB (A) scale for the purpose of comparison of noise levels, which is universally accepted by the international community.

Noise levels were measured using an Integrating sound level meter manufactured by Cygnet (Model No. 2031). It has an indicating mode of Lp and Leq. Keeping the mode in Lp for few minutes and setting the corresponding range and the weighting network in "A" weighting set the sound level meter was run for one hour time and Leq was measured at all locations. The day

noise levels have been monitored during 6.00am to 10.00pm and night noise levels, during 10.00pm to 6.00am at all the ten locations covered in 10 km radius of the study area.

The L10, L50, L90, Leq, Ld and Ln were computed based on the sound pressure level recorded.

L_{eq} - 24 Hourly equivalent continuous noise levels

L_d - Daytime Leq that has computed from 6.00 a.m to 10.00 pm

L_n - Nighttime Leq, that is computed from10.00 p.m. to 6.00 a.m

3.5.1 Noise Level Survey

A preliminary reconnaissance survey was undertaken to identify the major noise generating sources in the area. The noise survey was conducted in the month of April, 2013 to assess the background noise levels in different zones viz. industrial, commercial, and residential and silence zones.

The sampling locations for noise are confined to residential, commercial and sensitive areas; however, no industrial area is present within the 10 km radius of the project site. 10 sampling locations were selected for the sampling of noise and are shown in Figure 3-4 and also given in **Table 3-19**.

Table 3-19 : Details of Noise Monitoring Locations

S.No.	Location code	Category	Location Name	Distance (km)	Direction
1	NQ1	Residential	Near Mine site	1	NW
2	NQ2	Residential	Valotra	6.1	SE
3	NQ3	Residential	Aniali	2.6	SE
4	NQ4	Commercial	Vadwala-rana	6	W
5	NQ5	Silence Zone	Near Barda wildlife sanctuary	3	NW
6	NQ6	Commercial	Jam Sakhpur R.S.	5	NE
7	NQ7	Residential	Khirasara	7	NE
8	NQ8	Commercial	Rana Kondorna	8.5	SE
9	NQ9	Silence Zone	Near Reserve forest	1.5	W
10	NQ10	Residential	Bapodar	9	SE

3.5.2 Ambient Noise Standards

Ministry of Environment & Forests (MoEF) has notified the noise standards vide gazette notification dated February 14, 2000 for different zones under the Environment Protection Act (1986). These standards are given in **Table 3-20.**

Table 3-20 : Ambient Noise Quality Standards in respect of Noise

Area Code	Category of Area	Noise dB (A) L_{eq}	
		Daytime*	Night time*
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Note:

1. Daytime from 6.00am to 10.00pm and Night time from 10.00pm to 6.00a m.

2. Silence zone is defined as area up to 100 meters around premises of hospitals, educational institutions and courts. Use of vehicle hours, loud speakers and bursting of crackers are banned in these zones

3.5.3 Noise Quality

The noise data compiled on noise levels for April, 2013 is presented in **Table 3-21.** It can be observed from the table that the noise levels ranges from 41.6 to 66.3 dB (A) during daytime and 36.6 to 58.9 dB (A) during night time.

Residential Area

In residential area, noise level are ranging between 47.6 dB (A) recorded at near mine site to 53.4 dB(A) recorded at Khirasra village during day time and 40.8 recorded at Khirsara Village to 43.5 dB(A) recorded at Valotra village during night time. During daytime and night time noise level within the residential area are well within the prescribed limit.

Commercial Area

The noise level are ranging between 50.1 dB (A) to 63.7 dB (A) during the daytime and 38.5 dB (A) to 57.6 dB (A) during night time recorded at Vadwala-rana village and Jam Sakhpur Railway Station in the former & latter values. In commercial area noise level is less than the prescribed limit.

Sensitive Area

The noise level are ranging between 46.1 dB (A) to 49.3 dB (A) during the daytime and 37.2 dB (A) to 38.2 dB (A) during night time recorded at near reserve forest and near Barda WLS in the former & latter values as mentioned.

Table 3-21 : Noise quality results of the study area

Location	NQ1	NQ2	NQ3	NQ4	NQ5	NQ6	NQ7	NQ8	NQ9	NQ10
Day Time Noise Level dB(A)										
Minimum	45.5	44.4	47.5	45.2	47.2	61.9	45.6	52.2	41.6	46.6
Maximum	51.5	53.4	54.5	52.6	53.7	66.3	57.6	59.1	66.0	64.2
Ld10	54.1	52.4	56.1	52.2	55.8	65.4	57.2	63.8	48.5	53.3
Ld50	47.6	48.7	49.6	49.2	49.3	63.4	50.7	60.5	45.2	50.3
Ld90	53.1	45.8	55.1	46.2	54.8	62.0	46.8	56.8	42.7	47.3
Leq(d)	47.6	49.8	49.6	50.1	49.3	63.7	53.4	61.7	46.0	51.2
Night Time Noise Level dB(A)										
Minimum	40.2	37.8	40.6	37.2	37.1	54.7	38.5	49.6	36.6	37.7
Maximum	44.5	45.6	44.4	39.4	39.1	58.9	42.5	54	39.2	47.5
Ld10	44.5	45.6	44.4	39.4	39.1	58.9	42.5	54	39.2	47.5
Ld50	42.8	42.6	42.8	38.4	38.1	57.4	40.6	51.2	37.1	43.2
Ld90	41.1	38.1	41.1	37.4	37.3	55.2	39.2	50.3	36.9	37.9
Leq(n)	43.0	43.5	43.3	38.5	38.2	57.6	40.8	51.4	37.2	44.7

3.6 Biological Environment

Biological environment of any area constitute all living beings of that area, it is an integral part of the environment. Hence, any change in the surrounding environment could cause loss of species or decrease in biodiversity of the area. Therefore, the present study is proposed to assess the impact of the proposed projects on biological environment of the project site and surrounding area within 10km radius. Accordingly, mitigation measures are evolved to sustain the biological diversity. In general biological environment is represented by flora and fauna. Flora constitutes the herbs, shrubs and trees and fauna constitutes the mammals, birds, reptiles, arthropods, amphibians, fishes etc.

3.6.1 Objectives of the study

The ecological study of the area has been conducted in order to understand the existing status of the flora and fauna to generate baseline information and evaluate the possible impacts on biological environment. The present study highlights the various issues pertaining to floristic diversity and faunal wealth in the surrounding area up to 10km radius of the proposed project sites.

3.6.2 Biogeography and Physiography of the study area:

The proposed project is situated at Aniali village in Ranavav taluka, district Porbandar in the State of Gujarat. As per the bio-geographical classification of Rodgers and Panwar, 1988 the project area comes under Bio-geographic province (4B) Semi-Arid Gujarat Rajputana region.

However, as per Champion & Seth, 1968 vegetation types of the area can be grouped as Dry tropical thorn forest. Most of the western part is arid where average rainfall is varying from 600-800mm. Soil of the area varies from Black soil to gray brown soil. Winter is severe and the summer is harsh, because the Tropic of Cancer passes through the northern borders of Gujarat.

3.6.3 Study Approach & Methodology adopted

The baseline study for existing ecological environment was carried out during March to May, 2013. A participatory and consultative approach was followed. Field visits were undertaken for survey of the vegetation and animals in the study area. The study area has been divided in to two parts as core area consisting of project site and the buffer area as the 10 km radius of the project site.

3.6.3.1 Sampling Methodology

FLORA

Floral status was assessed in different habitat types and project site of the study area. Quantitative data was collected using standard methods of quadrate method. Floral enumeration was done following standard sampling techniques. Random quadrates were laid in order to quantify the vegetation of the study area. Quadrate size for trees was 100 x 100 m, for shrubs it was 5 x 5 m and for herbs it was 1 x 1m. Plots of 1 x 1 m were laid within the tree quadrate at each corner to record grasses. In each of the quadrates, species and their number were recorded.

FAUNA

AVIFAUNA:

Standard methods were followed to survey the avifauna. The point count method was followed for counting the birds. Opportunistic surveys were also carried out with respect to avifaunal checklist. Identification by calls was also made for species which were not directly encountered or were hidden in the vegetation or canopy (Sridharan 1989, Bhupathy 1991, Bibby et al., 1992 and Hutto et al., 1986).

HERPETOFAUNA:

Area searches were done in the circular plots of 10 m radius to inventory all terrestrial habitats for reptiles and amphibians. Area searches consisted of turning cover objects like logs, boulders etc (Welsh, 1987).Sampling for these species involved capturing individuals by hand or observation through binoculars and aural surveys.

MAMMALS:

Presence of mammals was documented by using both direct and indirect evidences. Opportunistic sightings were also included. Circular Plots were used to search indirect evidence i.e. animal burrows / holes, scat, pellets, feeding signs, and tracks. Photographic (colored pictorial guide) field guide were used for interviews with local residents (Burnham et al. 1980, Rodgers 1991, Sale and Berkmuller, 1988, Daniel, 1992) The data collected in the field was analyzed for secondary parameters such as density, frequency and abundance following standard phyto-sociological methods.

Table 3-22 : Estimation of Phyto-sociological parameters

Estimation of Phyto-sociological parameters		
Frequency (%)	=	(No. of quadrates of occurrence of the species X 100) / Total No. of quadrates sampled
Abundance	=	Total No. of individuals of the species / No. of quadrates of Occurrence
*Density	=	Total No. of individuals of the species / Total No. of quadrates sampled
Relative Frequency	=	(Frequency of the given species X 100) / Sum of all frequencies
Relative Density	=	(Density of the given species X 100) / Sum of all densities
Relative Abundance	=	(Abundance of species X 100) / Sum of all abundances
Basal Area	=	(GBH)2 / 4π
Dominance	=	Total Basal Area / Total area sampled
Relative Dominance	=	(Dominance of given species X 100) / Dominance of all species
Important Value Index (I.V.I.)	=	Relative Density+Relative Frequency+Relative Dominance
Note: *Density refers to the number of individuals per unit area of a site.		

3.6.3.2 Statistical Analysis

Shannon-Wiener diversity index (Shannon and Wiener, 1963) was calculated for all life forms following:

Shannon- Wiener Information Function: $D = -\Sigma\ pi \ln pi$

Where: i = an index for the number of species sampled,

pi = ni/N =percentage of species i in the entire sample (N) of individuals, and

ln = natural log. Multiply the percentage (or proportion) of each species in the sample times the natural log of that same value, sum the products across all species, and then multiply by minus 1.

3.6.3.3 Threat Status Assessment/evaluation Criteria:

The biodiversity aspects in the form of endemic status, conservation status and life form have been enumerated for all the plant species found in the area during ecological survey. The Red Data Book of the Botanical survey of India has been screened to verify their conservation status. For wild animal species schedule of the Wildlife Protection Act (1972) has been screened. The information was also collected from secondary sources for authentication of the data from the office of the Conservator of Forests and Zoological Survey of India, Jodhpur.

3.6.3.4 Ecosystems/ Habitat & Vegetation of the study area:

Based on the Survey of India 1:50,000 Toposheet **(41 G/14),** the area falling within 10 km radius (Buffer Zone) from the Aniali (16.21 ha) mining site was predominately dominated by three major habitat types such as: agricultural land (Agro-ecosystem), wastelands and forest areas. However, for the study purpose they have been delineated into six sub-habitat types according to the nature of vegetation existing in the area.

1. **1. AGRO-ECOSYSTEM:**
   It consists of areas currently under intensive agriculture use (irrigated lands, un-irrigated lands/rain fed irrigation) and its surrounding hedge vegetation (locally known as - wadis) owned by the private people. Since these areas are rich in moisture availability due to continuous cultivation it supports diverse floral and faunal species and formed major habitat of the buffer zone of the study area.
2. **WASTE LAND WITH OPEN SCRUB FOREST:**
   These are mainly small patches of waste lands (Gauchar lands, cultivable waste) with wild species of scrub vegetation and scattered tree species which belong to revenue /government or private. These patches are not purely designated forest areas.
3. **WASTE LAND WITH PROSOPIS SCRUB:**
   All the categories of waste lands (Gauchar land, permanent fallow lands) but purely dominated with *Prosopis juliflora* (gando baval) *and Lantana* belongs to revenue or government.
4. **STREAM BEDS:**
   This includes the area on the banks of seasonal rivers, streams and small nallahs.
5. **WATER BODIES :**

This habitat type includes: village ponds, dams, perennial rivers and streams located within the study area of covering 10 km radius from the core zone of the proposed mine project site.

6. **FOREST LAND :**

This includes the forest area of the Barda Sanctuary which is overlapping with the buffer zone of the concerned mine lease project area. This sanctuary area has three major forest types like: *Acacia senegal* dense thorn forest, riverine forest with mixed tree species and mixed forest with *Euphorbia* domination.

3.6.4 Status of Flora

3.6.4.1 Taxonomic Status of plant species:

STUDY AREA:

: The floral species in Aniali mine lease (16.21ha) study area covering 10 km radius is reported as 133 species belonging to the 109 genera and 49 families. Species list with their life form and local names are given in **Annexure VIII.**

CORE ZONE:

: Core zone i.e. the mine lease area showed species richness of 24 species.

BUFFER ZONE:

The entire buffer zone covering areas of the Barda WLS, Naliyadhar Reserved Forest (NTF) and other outside habitats recorded 133 plant species of 109 genera and 49 families.

Table 3-23 : overall taxonomic status of Flora in the study area

Taxa	Core Zone	Buffer Zone	Study area
Family	17	49	49
Genera	23	109	109
Species	24	133	133
Percentage (%)	14.35	100	100

3.6.4.2 Life Form status of plant species:

STUDY AREA

All the 133 plant species reported from the Aniali mine lease study area fall under 10 types of life forms. Among the life forms maximum of 49 herb species were identified and they formed 33.01% followed by tree species 20.57% with 30 species. The third level domination was

observed from small trees (16 species), shrub (16 species) and grass (11 species) with the contribution 11.00% and 10.52% respectively. Sedges reported with four species

BUFFER ZONE

Buffer zone area showed the same trend as in case of the study area with the domination of herb (49 species) followed by tree (30 species), small trees (16 species) Shrub (14 species) and grass species dominated by 11 species at second level

Table 3-24: Status of Life forms reported in mine lease study area

S.No.	Life Forms	Core Zone	Buffer Zone	Study Area	Relative %
1	Climber	0	1	1	2.39
2	Grass	4	11	11	10.53
3	Herb	7	49	49	33.01
4	Sedge	0	4	4	1.91
5	Shrub	4	14	14	11.03
6	Small trees	4	16	16	11.00
7	Straggling shrub	0	1	1	1.43
8	Tree	2	30	30	20.57
9	Twiner	0	1	1	2.39
10	Under Shrubs	3	6	6	5.74
TOTAL		**24**	**133**	**133**	**100.00**

STATUS OF CROP SPECIES

Status of agriculture crops was assessed only in the buffer zone covering outside the sanctuary area. The list of species was prepared based on the casual observation while collecting data in and around the agriculture habitat. Based on the survey a total of 36 crop species were reported in the study area of Aniali mine lease area and based on their use value they have been grouped into four categories. Among the species list 8 species fall under grain crops, 10 species fruit crops, 11 vegetable crops and 6 commercial crops of the study area. Within the grain crops, Bajri, Juwar, Makai and Arenda were cultivated extensively. Though, 10 fruit yielding species were reported, they grown in small extent of areas along the agricultural hedges and mainly for local use and market. All the six commercial crops cultivate extensively and they for major income of the local agriculturalists (**Table** 3-25**)**

Table 3-25 : List of cash crops in the study area

S. No.	Botanical Name	Family	Local Name	Habit
	Grain crops			
1	*Pennisetum typhoides* A. Rich.	Poaceae	Bajri, Bajaro	Herb
2	*Sorghum bicolor* (L.) Moench.	Poaceae	Jawar, Baru	Grass
3	*Cajanus cajan* (L.) Millsp.	Fabaceae	Tuver	Herb
4	*Triticumaes tibvum* L.	Poaceae	Wheat - Gahun	Grass
5	*Vigna radiate* (L.)wilczek.Var. *radiata*	Fabaceae	Udad	Herb
6	*Ricinus communis* L.	Euphorbiaceae	Arando, Divel	Shrub
7	*Vigna trilobata* (L.) Verdcourt	Fabaceae	Mung, Math	Herb
8	*Zea mays* L.	Poaceae	Makai	Grass
	Fruit crops			
1	*Annona squamosa* L.	Annonaceae	Sitafal	Small Tree
2	*Annona reticulate* L.	Annonaceae	Ramphal	Small Tree
3	*Psidium guajava* L.	Myrtaceae	Jamphal	Tree
4	*Citrus aurantifolia* (Chr.) Swingle	Rutaceae	Kag Ji Limbu	Small Tree
5	*Limonia elephantum* (Correa) Panigrahi	Rutaceae	Kotha	Tree
6	*Citrus limon* (L.) Burm. f.	Rutaceae	Limbu	Shrub

7	*Musa paradisiacal* L.	Musaceae	Kela, Kelu	Small Tree
8	*Punica granatum* L.	Punicaceae	Dadam	Small Tree
9	*Phyllantus embelica*	Euphorbiaceae	Amala	Small tree
10	*Morus alba* L.	Moraceae	Shetur	Tree
	Vegetable Crops			
1	*Abelmoschus esculentus* (L.) Moench	Malvaceae	Bhinda, Bhindo	Under Shrub
2	*Capsicum annuum* L. var *acuminatum* Fingerh.	Solanaceae	Marchi	Herb
3	*Cucumis sativus* L.	Cucurbitaceae	Kakadi	Climber
4	*Lageneria leucantha* (Duch.) Rusby.	Cucurbitaceae	Dudhi	Herb
5	*Cicer arietinum* L.	Fabaceae	Chana	Herb
6	*Momordica charantia* L.	Cucurbitaceae	Karela	Climber
7	*Allium sativum vineale*	Liliaceae	Lasun	
8	*Moringa oleifera* Lam.	Moringaceae	Mitho Saragvo	Tree
9	*Lycopersicon lycopersicum* (L.) Karst.	Solanaceae	Tamata,	Herb
10	*Solanum melongena* L.	Solanaceae	Ringana,	Under Shrub
11	*Daucus carota L. var.sativa*	Apiaceae	Gajar	Under Shrub
	Cash/Commercial crops			
1	*Saccharum officinarum* L.	Poaceae	Sherdi, Ganna	Grass
2	*Gossypium herbaceum* auct. Non L. var. *acerifolium* (Guill. & Perr.)	Malvaceae	Kapas, Desi Kapas	Shrub

	Chevalier			
3	*Arachis hypogea* L.	Fabaceae	Magphali	Herb
4	*Cocus nucifera* L.	Arecaceae	Neriel,Tarafoo	Tree
5	*Mangifera indica* L.	Anacardiaceae	Ambo, Kheri *	Tree
6	*Manilkara zapota* (L.) van Royen	Sapotaceae	Chiku	Tree

3.6.5 Status of Fauna

This section includes the discussion of major faunal groups like amphibians, reptiles, birds (terrestrial and aquatic) and mammals. Among the groups, due to taxa specific nature of life, direct sightings of herpetofauna and mammalian fauna are always lower than the avifauna which is comparatively more active. Therefore status of herpetofauna and mammals groups were discussed at species richness and abundance levels predominately based on indirect evidences for mammals reported within the sample area.

STATUS OF HERPETOFAUNA:

TAXONOMIC STATUS-AMPHIBIANS:

During the study period only three species of amphibians were reported from the study area. They belong to three genus under single family. Within buffer zone the area falling inside the sanctuary had these species. Due to the absence of perennial water resources within the core zone resulted no amphibian species within the proposed mine lease area. Below table represents the status of the Amphibian's in the study area.

Table 3-26 : Status of amphibian species in the study area

S.No	Zoological name	Common Name	WL Act, 1972 Schedule	Presence in Core Zone	Presence in Buffer Zone
1.	*Euphlictis cyanphylictis*	Indian skipping frog	IV	-	√
2.	*Fejevarya limnocharis*	Cricket frog	IV	-	√
3.	*Hoplobarahus tigerinus*	Indian bull frog	IV	-	√

TAXONOMICAL STATUS – REPTILES:

Status of Reptiles in the study area shows moderate species richnesswith overall 10 species belonging to 08 genera and 05 families. Core zone area identifies only two reptilian species. However all 10 species were reported from the buffer zone. *Hemidactylus flaviviridi, Calotes versicolar, Mabuya carinata, Mabuya macularia,* is some common reptiles of the area. Detailed status of the reptiles is given in the table below.

Table 3-27: Status of reptiles in the study area

S. No.	Zoological name	Common Name	WL Act, 1972 Schedule	Presence in Core Zone	Presence in Buffer Zone
1.	*Calotes Sp.*	-	-	-	All around
2.	*Calotes versicolar*	Indian garden lizard *	-	√	BWLS
3.	*Cyrtopodion Sp.*	-	-	-	
4.	*Echis carinatus*	Indian saw scaled viper	IV	-	BWLS
5.	*Hemidactylus flaviviridis*	Yellow-green house gecko *	-	-	All around
6.	*Mabuya carinata*	Keeled grass skink *	-	√	All around
7.	*Mabuya macularia*	Common bronze-back skink	-	-	BWLS
8.	*Naja naja*	Spectacled cobra	II	-	BWLS
9.	*Ptyas mucosa*	Indian rat snake	II	-	BWLS
10.	*Sitana ponticeriana*	Fan-throated lizard		-	BWLS

(*)- Direct evidence during survey

STATUS OF AVIFAUNA

The study area of the Aniali limestone mine (16.21 ha) covering both thecore and buffer zone represents a total of 21 bird species under 21 genera. Out of these 21 species, 05 were reported from the core area during the survey.

Table 3-28 : Status of avifauna reported from the study area

Sl. No	Zoological name	Common Name	WL Act 1972 Schedule	Presence in Core Zone	Presence in Buffer Zone
1.	*Acridotheres tristis*	Common Myna	IV	√	√
2.	*Alcede atthis*	Small Blue Kingfisher	IV	-	√
3.	*Anas strepera*	Gadwall	IV	-	√
4.	*Columba livia*	Rock Pigeon	IV	√	√
5.	*Dendrocygna javanica*	Lesser Whistling Duck	IV	-	√
6.	*Eudynamys scolopacea*	Asian Koel	IV	-	√
7.	*Francolinus pondicerianus*	Grey Francolin	IV	-	√
8.	*Grus grus*	Common Crane	IV	-	√
9.	*Halcyon smyrensis*	White-throated	IV	-	√

		Kingfisher			
10.	*Lanius schach*	Long-tailed Shrike	-	-	√
11.	*Lonchura malabarica*	Indian Silverbill	IV	-	√
12.	*Merops orientalis*	Green Bee-eater	-	√	√
13.	*Milvus migrans*	Black Kite	-	-	√
14.	*Nectarinia asiatica*	Purple Sunbird	IV	-	√
15.	*Passer domesticus*	House Sparrow	IV	√	√
16.	*Pavo cristatus*	Indian Peafowl	I	-	√
17.	*Ploceus philippinus*	Baya Weaver	IV	-	√
18.	*Pseudibis papillosa*	Black Ibis	IV	-	√
19.	*Psittacula krameri*	Parakeet	IV	-	√
20.	*Pycnonotus cafer*	Red-vented Bulbul	IV	-	√
21.	*Upupa epops*	Common Hoopoe	-	√	√

STATUS OF MAMMALS

Status of mammalian fauna in the study area shows moderate levelof species richness with overall 11 species under 11 genera and 10 families. The core zone shows comparatively less no of species richness than thebuffer area. It has six species under six genera and six families. The list of mammalian species is given in the following table.

Table 3-29 : Status of the mammalian species in the area

Sl. No	Zoological name	Common Name	WL Act, 1972 Schedule	Presence in Core Zone	Presence in Buffer Zone
1.	*Boselaphustrago camelus*	Nilgai *	III	-	BWLS + NFR
2.	*Canis aureus*	Jackal	II	-	BWLS+ NFR
3.	*Felis chaus*	Jungle Cat *	II	-	BWLS+ NFR
4.	*Funambulus pennant*	Five-striped Palm Squirrel *	IV	√	All around
5.	*Herpestes edwardsi*	Common mongoose*	IV	-	
6.	*Hyaena hyaena*	Striped Hyena	III	-	BWLS
7.	*Hystrix indica*	Porcupine	IV	-	BWLS + NFR
8.	*Lepus nigricollis*	Indian Hare *	IV	-	All around
9.	*Panthera pardus*	Leopard	I	-	BWLS
10.	*Rattus rattus*	House Rat *	IV	√	All around
11.	*Sus acrofa*	Wild boar *	III	-	BWLS + NFR

(*) Direct evidence during survey
BWLS- Barda Wildlife sanctuary, NFR- Naliyadhar Reserve Forests

3.6.6 Status of threatened Biota

FLORA:

No rare, endangered or threatened (RET) plant species is reported from the study area.

FAUNA (AMPHIBIANS):

This group is very poorly reported from the study area. No RET species is reported from the area.

FAUNA (REPTILES):

No RET species belonging to reptiles is reported.

AVIFAUNA:

Indian Peafowl (*Pavo cristatus*) is the only species reported under Schedule-I of Wildlife (Protection) Act from the study area.

MAMMALIAN FAUNA:

Panthera pardus is the mammalian species reported from the sanctuary area, which is under Schedule-I of the Wildlife (Protection) Act, 1972.

WILDLIFE CORRIDORS/ ELEPHANT CORRIDORS:

The mine lease of Aniali (16.21 ha) is at the distance of 3.92 km from Barda WLS in South-east direction. Naliyadhar Forest reserve is in South- west to the lease area. The both Barda wild life sanctuary and Naliyadhar Reserve Forest are isolated from each other due to agricultural fields and human habitats and are not connected through any forest corridors. Hence no wildlife or elephant corridors are observed in the study area or passing through the lease area.

Table 3-30 : Location details of WLS & Reserve forest w.r.t. mine lease area

S. No	Name of the Reserved Forest	Location/direction	Distance from the mine lease
1	Barda wildlife sanctuary	North- west	3.92 Km
2	Naliyadhar Reserved Forest	South - west	0.11 Km

3.7 Socio-Economic Environment

In this section of the report an attempt has been made to assess the impact of the proposed Limestone mining project at village Aniali on Socio-economic aspect of the study area. The various attributes that have been taken into account are population composition, employment

generation, occupational shift, household income, consumption pattern, ethnic issue and law & order problem.

3.7.1 Objectives

The objectives of the socio-economic study are as follows:

- ✓ To study the socio-economic status of the people living in the study area of the proposed mining project.
- ✓ To assess the impact of the project on socio-economic environment in the study area.
- ✓ To assess the impact of the project on Quality of life of the people in the study area.
- ✓ To evaluate the community development measures proposed to be taken up by the project proponent, if any.
- ✓ To recommend Community Development measures needs to be taken up in the study area

3.7.2 Methodology adopted for the study

a. A mixture of both quantitative and qualitative approach has been adopted in the current socio-economic study.
b. The study has been conducted based on primary and secondary data. While primary data has been collected through a sample survey of selected households, the secondary data has been collected from the administrative records of the Government of Gujrat, Census 2011, district hand books etc.
c. The details regarding population composition, number of literates, workers etc. have been collected from secondary sources and analysed. Also village/city/town wise details regarding amenities available in the study area have been collected from secondary sources and analysed.
d. Two stage sampling design has been adopted to select the sampling units. The first stage units are census villages in the rural areas and towns/cities in urban areas. The ultimate stage units are households in the selected villages and towns/cities.
e. Estimation of various parameters has been made based on sample data and bottom top approach has been adopted.
f. On the basis of a preliminary reconnaissance survey, two questionnaires were developed to make it suitable to fulfil the objectives of the study. The questionnaires contained both open ended and close ended questions

g. The data collected during the above survey was analysed to evaluate the prevailing socio-economic profile of the area.

h. Based on the above data, impacts due to mining operation on the community have been assessed and recommendations for improvement have been made.

3.7.3 Concepts & Definition

a. **Study Area:** The study area, also known as impact area has been defined as the sum total of core area and buffer area with a radius of 10 Kilometres from the periphery of the core area. The study area includes all the land marks both natural and manmade, falling therein.

b. **QoL:** The Quality of Life (QoL) refers to degree to which a person enjoys the important possibilities of his/her life. The 'Possibilities' result from the opportunities and limitations, each person has in his/her life and reflect the interaction of personal and environmental factors. Enjoyment has two components: the experience of satisfaction and the possession or achievement of some characteristic.

c. **Household:** A group of persons who normally live together and take their meals from a common kitchen are called a household. Persons living in a household may be related or unrelated or a mix of both. However, if a group of related or unrelated persons live in a house but do not take their meals from the common kitchen, then they are not part of a common household. Each such person is treated as a separate household. There may be one member households, two member households or multi-member households.

d. **Sex Ratio:** Sex ratio is the ratio of females to males in a given population. It is expressed as 'number of females per 1000 males'.

e. **Literates:** All persons aged 7 years and above who can both read and write with understanding in any language are taken as literate. It is not necessary for a person to have received any formal education or passed any minimum educational standard for being treated as literate. People who are blind but can read in Braille are also treated as literates.

f. **Literacy Rate:** Literacy rate of population is defined as the percentage of literates to the total population aged 7 years and above.

g. **Labour Force:** The labour force is the number of people employed and unemployed in a geographical entity. The size of the labour force is the sum total of persons employed and unemployed. An unemployed person is defined as a person not employed but actively seeking work. Normally, the labour force of a country consists of everyone of working age (around 14 to 16 years) and below retirement (around 65 years) that are participating

workers, that is people actively employed or seeking employment. People not counted under labour force are students, retired persons, stay-at home people, people in prisons, permanently disabled persons and discouraged workers.

h. **Work:** Work is defined as participation in any economically productive activity with or without compensation, wages or profit. Such participation may be physical and/or mental in nature. Work involves not only actual work but also includes effective supervision and direction of work. The work may be part time, full time, or unpaid work in a farm, family enterprise or in any other economic activity.

i. **Worker:** All persons engaged in 'work' are defined as workers. Persons who are engaged in cultivation or milk production even solely for domestic consumption are also treated as workers.

j. **Main Workers:** Those workers who had worked for the major part of the reference period (i.e. 6 months or more in the case of a year) are termed as Main Workers.

k. **Marginal Workers:** Those workers who did not work for the major part of the reference period (i.e. less than 6 months) are termed as Marginal Workers

l. **Work participation rate:** The work participation rate is the ratio between the labour force and the overall size of their cohort (national population of the same age range). In the present study the work participation rate is defined as the percentage of total workers (main and marginal) to total population.

3.7.4 Description of the study area

The study area covers all the villages/ part of villages located in the 10 Km radius around the mine lease periphery. In case of Limestone mine in an area of 16.21 ha at village Aniali, the study area is spread over 29 villages in three sub-districts namely Porbandar, Ranavav and Kutiyana of District Porbandar in the state of Gujarat. The list of villages along with the sub-district is given in **Table 3-31.**

Table 3-31 : List of villages in the study area

S.No.	Village Name	Sub-District
i.	Amar	Kutiyana
ii.	Aniali	Ranavav
iii.	Bapodar	Ranavav
iv.	Bhod	Ranavav
v.	Bileshwar	Ranavav
vi.	Bordi	Ranavav

S.No.	Village Name	Sub-District
vii.	Daiyar	Ranavav
viii.	Devda	Kutiyana
ix.	Dhoria Nes	Ranavav
x.	Dolatgadh	Ranavav
xi.	Fataltem Nes	Ranavav
xii.	Hanumangadh	Ranavav
xiii.	Jarera Nes	Ranavav
xiv.	Karval Nes	Ranavav
xv.	Kandorana Rana	Ranavav
xvi.	Khambhala	Ranavav
xvii.	Kharavira Khunano Nes	Ranavav
xviii.	Kharavira Nes	Ranavav
xix.	Khirsara	Ranavav
xx.	Krushnay Nes	Ranavav
xxi.	Morivirda Nes	Ranavav
xxii.	Ramgadh	Ranavav
xxiii.	Ranavav	Ranavav
xxiv.	Sajanwada Nes	Porbandar
xxv.	Sakhpur	Porbandar
xxvi.	Shermlanki Khunano Nes	Ranavav
xxvii.	Tarsai	Kutiyana
xxviii.	Vadwala-Rana	Ranavav
xxix.	Valotra	Ranavav

3.7.5 Demographic Profile of study area based on 2011 Census Data

The proposed main Mine project covers 29 Villages of Porbandar District of Gujarat State. A study has been undertaken with respect to demography, occupational pattern, literacy rate and other important socio-economic indicators of these Villages to reveal the socio-economic structure of the entire project area**.**

3.7.5.1 Population of the study area

The statistics, regarding the human population and the no. of dwelling units of villages in the study area is given as 29 villages in the buffer zone, while in core zone there is no village. Population and dwelling units in the study area are given in **Table-49**. This information is used from the Census of India, 2011. Village boundaries do not match the study area boundaries and therefore populations of villages even partially in the study area have been considered in enumerating the study area population.

On this basis, the total population of study area is **107241.** The percentages of male & female population are **50.95 % & 49.05 %** respectively. Breakup of the population for male and

female is given in following - consisting of gender-wise details of population as per census data 2011.

3.7.5.2 Social Structure

The Schedule Caste (SC) population within the study area is 7.30 % of the total population with 51.07 % Male and 48.93 % are female.

3.7.5.3 Literacy

The total number of literate within the study area is 64291 which is 59.95 % of total population. Male literacy rate of the study area is 56.93% and female literacy rate is 43.07 %. Detailed status of literacy is given below in **Table 3-32**.

Table 3-32: Village-wise Demographic profile of the study area

S.No.	Village	Total Population	Male	Female	Sex Ratio	Total SC Population	SC Male	SC Female	Total ST Population	ST Male	ST Female	Total Literacy	Lit. Male	Lit. Female
1.	Amar	2122	1093	1029	941	160	86	74	0	0	0	1227	708	519
2.	Aniali	1771	916	855	933	240	131	109	434	221	213	1138	661	477
3.	Bapodar	1757	856	901	1053	60	27	33	137	68	69	1025	576	449
4.	Bhod	4540	2260	2280	1008	384	195	189	116	57	59	2372	1369	1003
5.	Bileshwar	1748	911	837	918	141	70	71	297	158	139	991	580	411
6.	Bordi	1979	990	989	998	63	30	33	465	249	216	1144	648	496
7.	Daiyar	1285	657	628	955	127	65	62	118	56	62	818	463	355
8.	Devda	3821	1980	1841	929	340	177	163	4	3	1	2469	1450	1019
9.	Dhoria Nes	34	21	13	619	0	0	0	0	0	0	0	0	0
10.	Dolatgadh	1703	847	856	1010	32	14	18	55	33	22	936	524	412
11.	Fataltem Nes	91	53	38	716	0	0	0	0	0	0	0	0	0
12.	Hanumang adh	1476	732	744	1016	0	0	0	154	79	75	856	488	368
13.	Jarera Nes	420	228	192	842	0	0	0	46	26	20	41	25	16
14.	Karval Nes	8	5	3	600	0	0	0	8	5	3	7	5	2
15.	Kandorana Rana	8690	4453	4237	951	432	217	215	678	345	333	5727	3263	2464
16.	Khambhala	1438	747	691	925	60	33	27	157	83	74	784	451	333
17.	Kharavira Khunano Nes	39	22	17	772	0	0	0	39	22	17	0	0	0
18.	Kharavira Nes	109	53	56	1056	0	0	0	109	53	56	0	0	0
19.	Khirsara	2335	1172	1163	992	324	163	161	126	62	64	1555	854	701
20.	Krushnay Nes	18	10	8	800	0	0	0	0	0	0	0	0	0
21.	Morivirda Nes	27	15	12	800	0	0	0	0	0	0	3	0	3
22.	Ramgadh	1494	763	731	958	5	3	2	447	218	229	866	488	378
23.	Ranavav	62678	31911	30767	964	4639	2367	2272	5132	2625	2507	37860	2147	16384

S.No.	Village	Total Population	Male	Female	Sex Ratio	Total SC Population	SC Male	SC Female	Total ST Population	ST Male	ST Female	Total Literacy	Lit. Male	Lit. Female
													6	
24.	Sajanwada Nes	263	144	119	826	0	0	0	1	1	0	10	7	3
25.	Sakhpur	686	338	348	1029	22	12	10	0	0	0	472	253	219
26.	Shermlanki Khunano Nes	143	75	68	906	0	0	0	0	0	0	20	14	6
27.	Tarsai	957	486	471	969	65	34	31	0	0	0	584	353	231
28.	Vadwala-Rana	3608	1848	1760	952	447	223	224	55	28	27	2142	1226	916
29	Valotra	2001	1050	951	905	295	155	140	0	0	0	1244	716	528
	Total	**107241**	**54636**	**52605**	**908**	**7836**	**4002**	**3834**	**8578**	**4392**	**4186**	**64291**	**36598**	**27693**

Source : Census Data 2011.

3.7.5.4 Occupation Pattern

The occupational profile has been classified based on the available 2011 Census classification. A person is treated as main worker if the person has worked for a major part of the year, i.e. 180 days or more. A marginal worker is a person who worked for sometime during the year but not for 180 days in total. Those who had not worked in the last year are treated as non-workers.

Total Workers

Work is defined as participation in any economically productive activity with or without compensation, wage. Such participation may be physical and/ or mental in nature. Work involves not only actual work but also include supervision and direction of work. It even includes part time help or unpaid work on farm, family enterprise or its economic activity. All persons engaged in 'work' as defined above are workers.

The number of total workers in the study area is **45287** which is 42.23% of total population. Out of which 69.81% is male and only 30.19 % is female. Total workers further divided into main workers and marginal workers.

Main Workers

Those workers who had worked for the major part of the reference period (i.e. 6 months or more) are term main workers. Total number of main workers in the study area is 36745 which is 81.14 % of total workers and 34.26 % of total population Out of which 80.24 % is male and only 19.76% is female.

Marginal Workers

The marginal workers are those workers, who are engaged in some work for a period of less than six months, during the reference year prior to the census survey. Total number of marginal workers in study area is **8542** which is approx. **18.86%** of the total workers and 7.97 % of total population Out of which 24.95 % is male and 75.05 % is female.

Cultivators :

A person is classified as cultivator if he or she is engaged in cultivation of land own or from government or held from private persons or institutions for payment in money, kind or share. Cultivation work includes effective supervision or direction in cultivation. A person

who has given out her/his land to another person or institution(s) for cultivation for money, kind or share of crop and who does not even supervise or direct cultivation process is not treated as cultivator. Similarly, a person working on another person's land for wages in cash or kind or combination of both is not treated as cultivator.

Total cultivators in study area are **13440** which is approx. **29.68 %** of the total workers and 12.53 % of total population out of which 88.21 % is male and 11.79 % is female.

Agricultural Labourers

Persons working on the land of others for wages or share in the yield have been treated as agricultural labourers. The total workers of this category are about **12173** which is approx. **26.88 %** of the total workers and 11.35 % of total population out of in which 68.82 % are male and 31.18 % are female.

Household Workers

Household industry is defined as an industry conducted by one or more members of the household at home or near area and only within the precincts of the house where the household lives in urban areas. The larger proportion of the household industry consists of the members of the household. The industry is not run on the scale of a register company or qualifies or has to be registered under the Indian Factories Act.

Household industry relates to production, processing, servicing, repairing or making and selling but not includes professions such as a pleader, Doctor, Musician, Dancer, Waterman, Astrologer, Dhobi, Barber, even if such professions, trade or services are run at home by members of the household. The total workers of this category are about 320 (0.3% of total workers) in which 80.62% are male and 19.38% are female.

Other Workers

All workers, i.e., those who have been engaged in some economic activity during the last one-year are other workers. The type of workers that come under this category is government servants, municipal employees, teachers, factory workers, plantation workers, those engaged in trading, transport, banking, mining, construction, political or social work, priests, entertainment artist, etc. In effect, all workers except cultivators or agricultural labourers or household industry workers are other workers. The total workers of this

category are about **10812** (23.83 % of total workers) in which 83.19% are male and 16.81% are female.

NON WORKERS

The non-workers include those engaged in unpaid household duties, students, retired persons, dependants, beggars etc. The total number of non-workers population is **61954** which is 57.77% of the total population. Out of which 37.16% is male and 62.84% is female

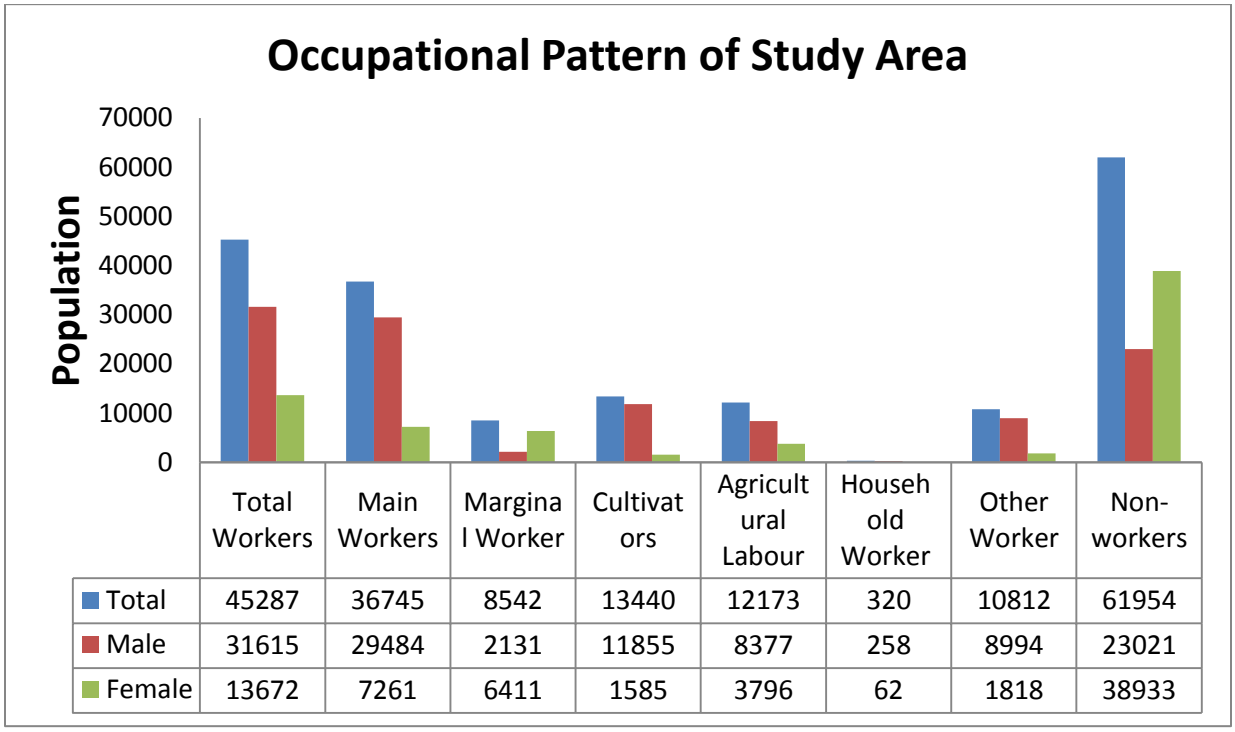
The percent distribution of Occupational pattern within the study area is given in **Table 3-33.**

Table 3-33: Occupational Pattern of the study area

S. No.	Particulars	Number of Workers in the study area			Proportion (%)
		Total	Male	Female	
1.	Total Workers	45287	31615	13672	43.25
2.	Main Workers	36745	29484	7261	24.63
3.	Marginal Worker	8542	2131	6411	300.84
4.	Cultivators	13440	11855	1585	13.37
5.	Agricultural Labour	12173	8377	3796	45.31
6.	Household Worker	320	258	62	24.03
7.	Other Worker	10812	8994	1818	20.21
8.	Non-workers	61954	23021	38933	169.12

(*Source: As per Census Data 2011*)

Figure 3-7 : Occupational Pattern of the study area



	Total Workers	Main Workers	Marginal Worker	Cultivators	Agricultural Labour	Household Worker	Other Worker	Non-workers
Total	45287	36745	8542	13440	12173	320	10812	61954
Male	31615	29484	2131	11855	8377	258	8994	23021
Female	13672	7261	6411	1585	3796	62	1818	38933

3.7.6 Public Amenities

Information on amenities has been provided based on information available in 2011 Census, since no additional published information or statistical outline for the area has been published. The information is provided in subsequent paragraphs of this section.

Education Facilities

The status of educational facilities within the study area are given in

Health and Medical Facilities

Out of total 29 villages health & medical facilities are available only in 41% of the total villages. The statistical data representing the type and number of medical facilities available within the study area is given in **Table 3-34.**

Table 3-34 Occupational Structure & Public Amenities of the study area

S.No.	Village	Total Population	Occupational Structure				Amenities of the Study Area												
							Education Facilities					Health Facilities							
			Total Worker	Main Worker	Marginal Worker	Non Worker	Primary School	Middle School	Secondary School	Senior Secondary	College	Allopathic Dispensary	Ayurvedic Dispensary	Maternity & C W C	PHC	PHSC	FWC	RPMP
1.	Amar	2122	932	929	3	1190		-	-	-	-	-	-	-	-	-	-	-
2.	Aniali	1771	768	550	218	1003	2	-	-	-	-	-	1	-	-			-
3.	Bapodar	1757	704	700	4	1053	2	-	1	-						1	1	1
4.	Bhod	4540	1859	1347	512	2681	3	-	-	-	-	-	-	-	-	1		-
5.	Bileshwar	1748	759	538	221	989	3	-	-	-	-	-	-	-	1	1	1	-
6.	Bordi	1979	808	747	61	1171	2	-	-	-	-	-	-	-	-	1	1	-
7.	Daiyar	1285	506	465	41	779	1	-	-	-	-	-	-	-	-	-	-	-
8.	Devda	3821	1585	1574	11	2236	-	-	-	-	-	-	-	-	-	-	-	-
9.	Dhoria Nes	34	16	15	1	18	-	-	-	-	-	-	-	-	-	-	-	-
10.	Dolatgadh	1703	885	610	275	818	1	-	-	-	-	-	-	-	-	1	-	-
11.	Fataltem Nes	91	43	39	4	48	1	-	-	-	-	-	-	1	-		-	-
12.	Hanumangadh	1476	493	342	151	983	1	-	-	-	-	-	-		-	1	1	-
13.	Jarera Nes	420	261	253	8	159	1	-	-	-	-	-	-	1	-	-	-	1
14.	Karval Nes	8	4	4	0	4	-	-	-	-	-	-	-	-	-	-	-	-
15.	Kandorana Rana	8690	3854	3385	469	4836	4	-	2	1		1			1	1	1	4
16.	Khambhala	1438	748	416	332	690	1	-	-	-	-	-	-	-	-	-	-	-
17.	Kharavira Khunano Nes	39	31	18	13	8	-	-	-	-	-	-	-	-	-	-	-	-
18.	Kharavira Nes	109	85	42	43	24	1	-	-	-	-	-	-	-	-	-	-	-
19.	Khirsara	2335	1046	788	258	1289	1	-	1	-	-	1	-	-	-	1	1	1
20.	Krushnay Nes	18	11	11	0	7	-	-	-	-	-	-	-	-	-	-	-	-
21.	Morivirda Nes	27	11	11	0	16	-	-	-	-	-	-	-	-	-	-	-	-
22.	Ramgadh	1494	621	449	172	873	2	-	-	-	-	-	-	-	-	-	-	-
23.	Ranavav	1771	25582	20708	4874	37096	2											
24.	Sajanwada Nes	263	181	181	0	82	1	-	-	-	-	-	-	-	-	-	-	-
25.	Sakhpur	686	224	206	18	462	-	-	-	-	-	-	-	-	-	-	-	-
26.	Shermlanki	143	90	83	7	53	-	-	-	-	-	-	-	-	-	-	-	-

S.No.	Village	Total Population	Occupational Structure				Amenities of the Study Area											
							Education Facilities					Health Facilities						
			Total Worker	Main Worker	Marginal Worker	Non Worker	Primary School	Middle School	Secondary School	Senior Secondary	College	Allopathic Dispensary	Ayurvedic Dispensary	Maternity & C W C	PHC	PHSC	FWC	RPMP
	Khunano Nes																	
27.	Tarkhai	957	378	291	87	579	-	-	-	-	-	-	-	-	-	-	-	-
28.	Vadwala-Rana	3608	1578	1443	135	2030	3	-	1	-	-	-	-	-	-	1	1	-
29.	Valotra	2001	1224	600	624	777	1	-	-	-	-	-	-	-	-	-	-	-
	TOTAL	**107241**	**45287**	**36745**	**8542**	**61954**	**33**	**0**	**5**	**1**	**0**	**2**	**1**	**2**	**2**	**9**	**7**	**7**

PHC-Primary health Centre,

PHSC – Primary Health Sub Centre,

FWC – Family Welfare Centre,

RPMP – Registered Private Medical Practitioner,

CWC – Child Welfare Centre.

(Source: As per Census Data 2011)

CHAPTER – 4: ANTICIPATED ENVIRONMENT IMPACTS & MITIGATION MEASURES

4 Anticipated Environmental Impacts & Mitigation Measures

4.1 General

Environmental impacts both direct and indirect on various environmental attributes due to proposed mining activity will be created in the surrounding environment, during the preoperational, operational and post–operational phases.

The occurrence of mineral deposits, being site specific, their exploitation, often, does not allow for any choice except adoption of eco-friendly operation. The methods are required to be selected in such a manner, so as to maintain environmental equilibrium ensuring sustainable development.

The impacts due to mining operations commence from the exploration activities, extend through extraction and processing of minerals, may continue up to post closure of the operation, with the nature and extent of impacts varying throughout the stages of project development.

In order to maintain the environmental commensuration with the mining operation, it is essential to undertake studies on the existing environmental scenario and assess the impact on different environmental components. This would help in formulating suitable management plans sustainable resource extraction.

Several scientific techniques and methodologies are available to predict impacts of physical environment. Mathematical models are the best tools to quantitatively describe the cause and effect relationships between sources of pollution and different components of environment. In cases where it is not possible to identify and validate a model for a particular situation, predictions have been arrived at based on logical reasoning / consultation / extrapolation.

The following parameters are of significance in the Environmental Impact Assessment and are being discussed in detail.

1. Land Environment
2. Water Environment
3. Air Environment

4. Noise Environment
5. Solid waste
6. Biological
7. Socio-Economic

4.2 Land Environment

Since mining is being carried out by opencast method, it is expected to affect the land environment essentially. Impact assessment study on land environment can be done by considering land use pattern/ land cover, Topography, Drainage pattern and geological features of the mine site as well as the study area.

4.2.1 Anticipated Impact

4.2.1.1 Land Use /Land Cover

Land use pattern for preoperational, operational & conceptual stage of the mining as per approved mine plan for the proposed mine site is given below in **Table 2-2**.

The existing land use / land cover pattern in the study area as studied through satellite imagery is given in **Table 3-1**.

As per the approved mine plan at conceptual stage most of the waste land will be converted into rain water harvesting pit and green belt Hence impact due to change in land use is positive.

4.2.1.2 Topography

The lease area is a government wasteland and part of Survey No. 207/P, which falls under the revenue limit of Aniali village. The highest and lowest elevation in the lease area is 61m AMSL to 73m AMSL respectively. The waste as inferior grade will not affect the topography because total undersize produced during mining will be sent to TCL Mithapur Cement Plant regularly.

4.2.1.3 Drainage pattern[25]

There is no permanent water body or any perennial stream located in the area /proposed working site. The proposed working will not touch the water table. During rainy season there is occasional flow in the hill slopes. The drainage pattern will not get disturbed due to mining activity. Hence no impact is anticipated.

[25] Reference : Page No 40 – Section 6.0 of Annexure XI.

4.2.1.4 Geology

Geology of the study area is studied to ascertain seismic sensitivity and also the effects on soil environment. The study area fall in seismic zone III i.e. moderate damage risk zone. Soil samples have been taken and analysis has been carried out and is discussed earlier in Chapter 3. In the mine lease area there is practically no soil cover and overburden that requires stacking or dumping and also no overburden is generated in the form of reject from the mining activity. Hence no impact is expected on the soil cover or geology of the project.

4.2.2 Mitigation Measures

Adopting suitable, site-specific mitigation measures can reduce the degree of impact of mining on land & soil. Some of the land & soil related mitigation measures are as follows:

- Present land use pattern of the lease area is waste land and at the conceptual stage the land use pattern will remain the same, hence will not be changed.
- As there is no overburden generated from the mining activity

4.3 Water Environment

Mining and its associated activities not only use a lot of water but also likely to affect the hydrological regime of the area. The major impact of deep and large mines (both underground and open cast) is of natural groundwater table. Lowering of water table may result in reduced groundwater availability. Extraction of different minerals is known to lead to water pollution due to heavy metal, acid discharges and increased suspended solids. Deep underground mines directly affect the water table of the area. However, the impact of mining project on groundwater hydrology and surface water regime are site specific and depends upon the characteristics of the mineral, hydrogeology and requirement of groundwater for other uses.

4.3.1 Anticipated Impact

- As there is no river or nallas passing through the mine site, hence no impact is anticipated on the hydrological regime of the area due to mining activity.
- No natural course of water stream is interrupted or diverted due to mining activity; hence no impact on natural drain is anticipated.
- Practically there is no overburden or reject generating from the mining activity, moreover the excavated mineral itself is non-toxic and hence no effect due to water flow during rains following the contours of the area is expected.

- No water is being drawn from the surface water body.
- Impact on ground water is anticipated as there is provision of consuming ground water for the purpose of various mining activities. Total water demand to be met by ground water is 30 KLD. Tata chemicals Ltd. has already taken clearance from CGWA for the requisite amount of 30 KLD.
- At the end of mine life excavated pit will be converted into a water reservoir. This will help in recharging the ground water table. As the mineral is non-toxic so contamination of ground water due to leaching is not anticipated.

4.3.2 Mitigation Measures

- Overall drainage planning has been done in such a manner that the existing pre-mining drainage conditions will be maintained to the extent possible so that run off distribution is not affected.
- Domestic sewage will disposed into Soak Pit.
- As there is no generation of overburden or mineral reject from the mining activity; hence the excavated pit will be converted into the water reservoir at the end of mine life. This will help in recharging ground water table by acting as a water harvesting structure.
- Ground water table will not be intersected during the mining activity.

4.4 Air Environment

Mining Operation carried out by opencast mechanized method generate dust particles due to various activities like drilling, blasting, Loading & Unloading of limestone, and Transportation. The air quality in the mining area depends upon the nature and concentration of emissions and meteorological conditions. Though it is an open cast mechanized mine with all possible air quality controlling measures but the major air pollutants from mining include:-

- Particulate Matter (Dust) of various sizes.
- Gases, such as, Sulphur Dioxide, Oxides of Nitrogen, Carbon Monoxide etc. from mining machinery & vehicular exhaust.
- Dust is the single air pollutant observed in the open cast mines. Diesel operating drilling machines, blasting and movement of machinery/ vehicles produce NOX, SO2 and CO emissions, usually at low levels. Dust can be of significant nuisance to surrounding land users and potential health risk in some circumstances.

4.4.1 Anticipated Impact

The major sources of air pollution in the proposed mine is dust generation due to drilling, blasting, excavation, loading and transportation of mineral& wind erosion of exposed material. In this present study, United States Environmental Protection Agency (USEPA–42 series) approved mathematical equations have been used to predict concentrations for different operations in mining including the mineral transportation.

4.4.2 Air Pollution Modeling

Air quality models are the primary tools for relating emissions to air quality impacts. Models, in turn, require acceptable input data for emissions, surface topography, meteorological parameters, receptor configurations, baseline air quality, and initial and boundary conditions for each modeling scenario. Since the quality and reliability of model outputs can never be any better than the inputs, quality control of the input data is important.

Prediction of impacts on air environment has been carried out employing mathematical model based on a steady state Gaussian plume dispersion model designed for area sources for short term. In the present case, Industrial Source Complex [ISC3] 1993 dispersion model based on steady state Gaussian plume dispersion, designed for area sources for short term and developed by United States Environmental Protection Agency [USEPA] has been used for simulations from point sources

4.4.2.1 POLLUTANTS CONSIDERED FOR COMPUTATION

The model simulations deal with the major pollutants viz., PM_{10}, SO_2, NO_2 emitted from the mining activity.

4.4.2.2 SOURCE STRENGTH ESTIMATION

An emissions factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant.

The general equation for emissions estimation is:

$$E = A \times EF \times (1-ER/100)$$

Where:

E = emissions;

A = activity rate;

EF = emission factor, and

ER =overall emission reduction efficiency, %

The proposed mining activity includes various activities like ground preparation, excavation, handling and transport of ore.

These activities have been analysed systematically basing on USEPA-Emission Estimation Technique Manual, for Mining AP-42, to arrive at possible emissions to the atmosphere and estimated emissions are given in **Table 4-1.**

Table 4-1 : Estimated Emissions of PM 10 from Different Sources

Emission source	details
DRILLING	
Drill dust emission (kg/hole)	0.59
Maximum no. of holes per day	20
Uncontrolled dust load in g/s	0.136574074
Controlled dust	0.013657407
MINERAL EXCAVATION	
Quantity (TPA)	93000
Operational hours per year	2400
Activity rate (t/hr.) (A)	38.75
USEPA emission factor (Kg/hr.) (EF)	0.94021
Emission in g/s	10.12
Area of influence (m2)	162100
Uncontrolled emission rate	0.0000624
Controlled emission rate	0.0000062
LOADING/UNLOADING	
Quantity	93000
Operational hours per year	4800
Activity rate (t/hr.)	19.37
USEPA emission factor (kg/ton)	0.00434
Emission in g/s	0.023
Area of influence	162100
Uncontrolled emission rate	0.0000001442
Controlled emission rate	0.0000000144
HAULAGE EMISSIONS (UNPAVED)	
Quantity	93000
Operational hours per year	2400
Activity rate (t/hr.)	38.75
Truck capacity	17
No. of trips per day	18.23
Road length travelled (km)	1
Emission factor	0.009528
Emission (g/VKmT)	2.777
Uncontrolled emission rate (g/s/m)	0.0000005862
Controlled emission (g/s/m)	0.0000000586

4.4.3 Modeling Procedure

Prediction of Ground Level Concentrations (GLC's) due to proposed mines has been made by Industrial Source Complex, Short Term (ISCST3) as per CPCB guidelines. ISCST3 is US-EPA approved model to predict the air quality. The model uses rural dispersion and regulatory defaults options as per guidelines on air quality models (PROBES/70/1997-1998). The model assumes receptors on flat terrain.

4.4.3.1 MODEL OPTIONS USED FOR COMPUTATIONS

- The plume rise is estimated by Briggs formulae, but the final rise is always limited to that of the mixing layer;
- Buoyancy Induced Dispersion is used to describe the increase in plume dispersion during the ascension phase;
- Calms processing routine is used by default;
- Wind profile exponents is used by default, 'Irwin';
- Flat terrain is used for computations;
- It is assumed that the pollutants do not undergo any physico-chemical transformation and that there is no pollutant removal by dry deposition;
- Washout by rain is not considered
- Meteorological inputs required are hourly wind speed and direction, ambient temperature, stability class, and mixing height.

4.4.3.2 MIXING HEIGHT

As site specific mixing heights were not available, mixing heights based on IMD publication, "Atlas of Hourly Mixing Height and Assimilative Capacity of Atmosphere in India", has been considered for Industrial Source Complex model to establish the worst case scenario.

4.4.3.3 METEOROLOGICAL DATA

Data recorded at the continuous weather monitoring station on wind speed, direction, and temperature at one hour interval for the monitoring period was used as meteorological input. The distribution of stability classes during this period is given under

❖ ***Stability Frequency occurrence in (%) – Pre- Monsoon Season***

Stability Class	A	B	C	D	E	F
Percentage	4.1	16.7	12.5	16.7	8.3	41.7

4.4.4 Presentation of results

4.4.4.1 RESULTANT CONCENTRATIONS AFTER COMMENCEMENT OF MINING OPERATIONS

Model simulations have been carried out using the hourly Triple Joint Frequency data viz., stability, wind speed, mixing height and temperature. Short-term simulations were carried to estimate concentrations at the receptors to obtain an optimum description of variations in concentrations over the site in 10-km radius covering 16 directions.

The maximum incremental GLCs for $PM_{10,}$ NO_2 and SO_2 due to mining are found to be 14.08 μg/$m^{3,}$ 1.934 μg/m^3 & 0.24 μg/m^3 respectively, within the mine lease area. The maximum incremental GLCs are superimposed on the maximum baseline PM_{10} concentrations recorded during monitoring period –Pre monsoon season 2013 to arrive at the likely resultant concentrations after implementation of the proposed mining. The cumulative concentrations (baseline + incremental) after implementation of the project are tabulated below in **Table 4-2**.

Table 4-2 : Predicted Incremental Concentrations of PM10, SO2 and NO2

Site Code	Site Name	PM_{10} concentration (µg/m³)			NO_2 concentration (µg/m³)			SO_2 concentration (µg/m³)		
		Baseline	Incremental	Cumulative	Baseline	Incremental	Cumulative	Baseline	Incremental	Cumulative
A1	Near mine site	67	3.332	70.332	25	0.247	25.247	14	0.030	14.030
A2	Daulatgadh village	65	0.875	65.875	23	0.075	23.075	13	0.009	13.009
A3	Aniali village	67	0.327	67.327	23	0.028	23.028	13	0.003	13.003
A4	Bordi village	68	0.062	68.062	26	0.008	26.008	15	0.001	15.001
A5	Near Naliyadhar R.F.	55	0.096	55.096	22	0.013	22.013	11	0.001	11.001
	Barda WLS	NR	0.178	--	NR	0.017	--	NR	0.002	--
	Maximum	**67**	**14.08**	**81.08**	**22**	**1.934**	**23.934**	**13**	**0.24**	**13.24**

*NR – Not Recorded.

The resultant concentrations of all the 3 parameters viz. PM_{10}, NO_2 and SO_2 at all locations are well within the NAAQS standard limits

Isopleths were drawn for the pollutant distribution in the area and are shown in

Figure 4-1 : Isopleth showing Incremental Concentration of PM 10 in Study Area.

Figure 4-2 : Isopleth showing Incremental Concentration of SO_2 in Study Area.

Figure 4-3 : Isopleth showing Incremental Concentration of NO_2 in Study Area.

From the above, it could be clearly seen that due effective implementation of various control measures, there will not be any significant impact on the ambient air quality in the region.

4.4.5 Cumulative Air Quality Modeling:

Impact assessment is an important part of Environmental Impact Assessment Study. There are various techniques to predict the impacts. Mathematical modeling is an established and accepted technique to predict the impacts. The open cast mines are potential sources of air pollution.

In this section Cumulative impact on air environment due to emissions generated from 5 Aniali Limestone mines & Ranavav Govalani Limestone Mine at Porbandar, Gujarat has been assessed.

The incremental ground level concentrations within an area covering at least 10 Km around each mine site has been predicted by mathematical modeling.

4.4.6 Air Quality Model Details

Air quality models are the primary tools for relating emissions to air quality impacts. Models, in turn, require acceptable input data for emissions, surface topography, meteorological parameters, receptor configurations, baseline air quality, and initial and boundary conditions for each modeling scenario. Since the quality and reliability of model outputs can never be any better than the inputs, quality control of the input data is important.

Prediction of impacts on air environment has been carried out employing mathematical model based on a steady state Gaussian plume dispersion model designed for area sources for short term. In the present case, Industrial Source Complex [ISC3] 1993 dispersion model based on steady state Gaussian plume dispersion, designed for area sources for short term and developed by United States Environmental Protection Agency [USEPA] has been used for simulations from point sources.

4.4.6.1 POLLUTANTS CONSIDERED FOR COMPUTATION

The model simulations deal with the major pollutants viz., PM_{10}, SO_2, NO_2 emitted from the mining activity.

4.4.6.2 SOURCE STRENGTH ESTIMATION

An emissions factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant.

The general equation for emissions estimation is:

$$E = A \times EF \times (1-ER/100)$$

Where:

E = emissions;

A = activity rate;

EF = emission factor, and

ER =overall emission reduction efficiency, %

The proposed mining activity includes various activities like ground preparation, excavation, handling and transport of ore.

These activities have been analysed systematically basing on USEPA-Emission Estimation Technique Manual, for Mining AP-42, to arrive at possible emissions to the atmosphere and estimated emissions are given in **Table 4-3** to **Table 4-5**.

Table 4-3: Estimated Emissions of PM_{10} from all six leases (Cumulative)

EMISSION SOURCE	Name of the mine					
	Aniali (6.07 ha)	Aniali (12.27 ha)	Aniali (15.99 ha)	Aniali (16.21 ha)	Aniali (21.04 ha)	Ranavav Govalani (25.45 ha)
DRILLING						
Drill dust emission (kg/hole)	0.59	0.59	0.59	0.59	0.59	0.59
Maximum no. of holes per day	20	20	20	20	20	20
Uncontrolled dust load in g/s	0.136574074	0.136574074	0.136574074	0.136574074	0.136574074	0.136574074
Controlled dust	0.013657407	0.013657407	0.013657407	0.013657407	0.013657407	0.013657407
MINERAL EXCAVATION						
Quantity (TPA)	53000	14000	53000	93000	45000	122000
Operational hours per year	2400	2400	2400	2400	2400	2400
Activity rate (t/hr.) (A)	22.08333333	5.83333333	22.0833333333	38.7500000000	18.7500000000	50.8333333333
USEPA emission factor (Kg/hr.) (EF)	0.940216686	0.94021669	0.9402166859	0.9402166859	0.9402166859	0.9402166859
Emission in g/s	5.767532911	1.52349926	5.7675329111	10.1203879383	4.8969619056	13.2762078330
Area of influence (m2)	60700	122700	159900	162100	210400	254500
Uncontrolled emission rate	0.0000950170	0.00001242	0.0000360696	0.0000624330	0.0000232745	0.0000521658
Controlled emission rate	0.0000095017	0.00000124	0.0000036070	0.0000062433	0.0000023275	0.0000052166
LOADING/UNLOADING						
Quantity	53000	14000	53000	93000	45000	122000
Operational hours per year	4800	4800	4800	4800	4800	4800
Activity rate (t/hr.)	11.04166667	2.91666667	11.0416666667	19.3750000000	9.3750000000	25.4166666667
USEPA emission factor (kg/ton)	0.004343728	0.00434373	0.0043437284	0.0043437284	0.0043437284	0.0043437284
Emission in g/s	0.013322778	0.00351922	0.0133227780	0.0233777048	0.0113117927	0.0306675267

EMISSION SOURCE	Name of the mine					
	Aniali (6.07 ha)	Aniali (12.27 ha)	Aniali (15.99 ha)	Aniali (16.21 ha)	Aniali (21.04 ha)	Ranavav Govalani (25.45 ha)
Area of influence	60700	122700	159900	162100	210400	254500
Uncontrolled emission rate	0.0000002195	0.00000003	0.0000000833	0.0000001442	0.0000000538	0.0000001205
Controlled emission rate	0.0000000219	0.0000000029	0.0000000083	0.0000000144	0.0000000054	0.0000000121
HAULAGE EMISSIONS (UNPAVED)						
Quantity	53000	14000	53000	93000	45000	122000
Operational hours per year	2400	2400	2400	2400	2400	2400
Activity rate (t/hr.)	22.08333333	5.83333333	22.0833333333	38.7500000000	18.7500000000	50.8333333333
Truck capacity	17	17.00000000	17.0000000000	17.0000000000	17.0000000000	17.0000000000
No. of trips per day	10.39215686	2.74509804	10.3921568627	18.2352941176	8.8235294118	23.9215686275
Road length travelled (km)	1	1.00000000	1.0000000000	1.0000000000	1.0000000000	1.0000000000
Emission factor	0.009528212	0.00952821	0.0095282123	0.0095282123	0.0095282123	0.0095282123
Emission (g/VKmT)	2.777473883	2.77747388	2.7774738829	2.7774738829	2.7774738829	2.7774738829
Uncontrolled emission rate (g/s/m)	0.0000003341	0.00000009	0.0000003341	0.0000005862	0.0000002836	0.0000007690
Controlled emission (g/s/m)	0.0000000334	0.00000001	0.0000000334	0.0000000586	0.0000000284	0.0000000769

Table 4-4 : Estimated Emissions of SO_2 from all six leases (Cumulative)

Emission source	Name of the mine					
DRILLING	**Aniali (6.07 ha)**	**Aniali (12.27 ha)**	**Aniali (15.99 ha)**	**Aniali (16.21 ha)**	**Aniali (21.04 ha)**	**Rananvav Govalani (25.45 ha)**
Fuel Consumption (TPD)	0.05	0.01	0.05	0.08	0.08	0.11
Fuel Consumption (KL/Annum)	16.95	3.39	16.95	27.12	27.12	37.29
Emission Factor (Kg/KL)	3.74	3.74	3.74	3.74	3.74	3.74
Emission Per year	63.393	12.6786	63.393	101.4288	101.4288	139.4646
Emission rate (g/s)	0.000007	0.000001	0.000007	0.000012	0.000012	0.000016
BLASTING						
Quantity (TPA)	53000	14000	53000	93000	45000	122000
Activity rate (T/day) (A)	176.67	46.67	176.67	310.00	150.00	406.67
Explosive efficiency (T/Kg)	4	4	4	4	4	4
Explosive used (Kg)	0.044	0.012	0.044	0.078	0.038	0.102
USEPA emission factor (Kg/T)	1	1	1	1	1	1
Emission (g/s)	0.000511	0.000135	0.000511	0.000897	0.000434	0.001177
Area of influence (m^2)	10000	10000	10000	10000	10000	10000
Emission rate ($g/s/m^2$)	0.00000005	0.00000001	0.00000005	0.00000009	0.00000004	0.00000012

Table 4-5 : Estimated Emissions of NO_2 from all six leases (Cumulative)

Emission source	Name of the mine					
DRILLING	**Aniali (6.07 ha)**	**Aniali (12.27 ha)**	**Aniali (15.99 ha)**	**Aniali (16.21 ha)**	**Aniali (21.04 ha)**	**Rananvav Govalani (25.45 ha)**
Fuel Consumption (TPD)	0.05	0.01	0.05	0.08	0.08	0.11
Fuel Consumption (KL/Annum	16.95	3.39	16.95	27.12	27.12	37.29
Emission Factor (Kg/KL)	34.29	34.29	34.29	34.29	34.29	34.29
Emission Per year	581.22	116.24	581.22	929.94	929.94	1278.67
Emission rate (g/s)	0.000067	0.000013	0.000067	0.000108	0.000108	0.000148
BLASTING						
Quantity (TPA)	53000	14000	53000	93000	45000	122000
Activity rate (T/day) (A)	176.67	46.67	176.67	310.00	150.00	406.67
Explosive efficiency (T/Kg)	4	4	4	4	4	4
Explosive used (Kg)	0.044	0.012	0.044	0.078	0.038	0.102
USEPA emission factor (Kg/T)	8	8	8	8	8	8
Emission (g/s)	0.004090	0.001080	0.004090	0.007176	0.003472	0.009414
Area of influence (m^2)	10000	10000	10000	10000	10000	10000
Emission rate ($g/s/m^2$)	0.00000041	0.00000011	0.00000041	0.00000072	0.00000035	0.00000094

4.4.7 Modeling Procedure

Prediction of Ground Level Concentrations (GLC's) due to proposed mines has been made by Industrial Source Complex, Short Term (ISCST3) as per CPCB guidelines. ISCST3 is US-EPA approved model to predict the air quality. The model uses rural dispersion and regulatory defaults options as per guidelines on air quality models (PROBES/70/1997-1998). The model assumes receptors on flat terrain.

4.4.7.1 MODEL OPTIONS USED FOR COMPUTATIONS

- The plume rise is estimated by Briggs formulae, but the final rise is always limited to that of the mixing layer;
- Buoyancy Induced Dispersion is used to describe the increase in plume dispersion during the ascension phase;
- Calms processing routine is used by default;
- Wind profile exponents is used by default, 'Irwin';
- Flat terrain is used for computations;
- It is assumed that the pollutants do not undergo any physico-chemical transformation and that there is no pollutant removal by dry deposition;
- Washout by rain is not considered
- Meteorological inputs required are hourly wind speed and direction, ambient temperature, stability class, and mixing height.

4.4.7.2 MIXING HEIGHT

As site specific mixing heights were not available, mixing heights based on IMD publication, "Atlas of Hourly Mixing Height and Assimilative Capacity of Atmosphere in India", has been considered for Industrial Source Complex model to establish the worst case scenario.

4.4.7.3 METEOROLOGICAL DATA

Data recorded at the continuous weather monitoring station on wind speed, direction, and temperature at one hour interval for the monitoring period was used as meteorological input. The distribution of stability classes during this period is given under:

❖ ***Stability Frequency occurrence in (%) – Pre- Monsoon Season***

Stability Class	A	B	C	D	E	F
Percentage	4.1	16.7	12.5	16.7	8.3	41.7

4.4.8 Presentation of Results

Resultant incremental Concentrations after Commencement of Mining Operations

Model simulations have been carried out using the hourly Triple Joint Frequency data viz., stability, wind speed, mixing height and temperature. Short-term simulations were carried to estimate concentrations at the receptors to obtain an optimum description of variations in concentrations over the area covering at least 10 Km radius from each mine site covering 16 directions. The Centre coordinate (0,0) of the study area is taken at Naliyadhar Reserved Forest and the whole study area is then further divided by a grid containing 200 m interval to get the incremental GLCs at various points within the study area.

The cumulative concentrations (baseline + incremental) of PM_{10}, SO_2 & NO_2 after implementation of the project are given in **Table 4-6 to Table 4-8**.

Table 4-6 : Predicted Incremental Concentration of PM_{10}(Cumulative)

S.No.	Location	PM_{10} Concentration (µg/m³)		
		Baseline	Incremental	Cumulative
1.	Near Barda WLS	58.2	0.018	58.218
2.	Near Naliyadhar R.F.	48.5	0.66	49.16

Table 4-7 : Predicted Incremental Concentration of SO_2(Cumulative)

S.No.	Location	SO_2 Concentration (µg/m³)		
		Baseline	Incremental	Cumulative
1.	Near Barda WLS	11.1	0.0002	11.1002
2.	Near Naliyadhar R.F.	48.5	0.0063	48.5063

Table 4-8 : Predicted Incremental Concentration of NO_2 (Cumulative)

S.No.	Location	NO_2 Concentration (µg/m³)		
		Baseline	Incremental	Cumulative
1.	Near Barda WLS	58.2	0.0016	58.2016
2.	Near Naliyadhar R.F.	48.5	0.0507	48.5507

The Maximum incremental concentrations for all the three pollutants are given below:

S. No.	Pollutant	Maximum incremental Concentration (µg/m³)
1.	PM_{10}	30.9
2.	SO_2	0.69
3.	NO_2	5.55

Isopleths showing incremental concentrations of all the pollutants viz. PM_{10}, SO_2 & NO_2 were drawn for the distribution in the study area and is given in **Figure 4-4** to **Figure 4-6**.

Figure 4-4 : Isopleth showing cumulative incremental concentration of PM_{10} in study area.

Figure 4-5 : Isopleth showing cumulative incremental concentration of SO_2 in study area.

Figure 4-6 : Isopleth showing cumulative incremental concentration of NO_2 in study area.

4.4.9 Mitigation Measures

A) Drilling: - To control fugitive dust at source, wet drilling will be provided. Where there is a scarcity of water, suitably designed dust extractor will be provided for dry drilling along with dust hood at the mouth of the drill-hole collar.

Advantages of Wet Drilling:-

- In this system dust gets suppressed close to its formation. Dust suppression become very effective and the work environment will be improved from the point of occupational comfort and health.
- Due to dust free atmosphere, the life of engine, compressor etc. will be increased.
- The life of drill bit will be increased.
- The rate of penetration of drill will be increased.
- Due to the dust free atmosphere visibility will be improved resulting in safer working conditions after day light hours.

B) Blasting: -

Establish time of blasting to suit the local conditions. Avoid blasting i.e., when temperature inversion is likely to occur and strong wind blows towards residential areas.

Controlled blasting include Adoption of suitable explosive charge and short delay detonators, adequate stemming of holes at collar zone and avoiding blasting at foggy days, at night time and at time of high wind speeds, restricting blasting to a particular time of the day i.e. at the time lunch hours, controlled charge per hole as well as charge per round of hole and Adopting muffling (i.e. covering the blast holes by sand bags) when the distance from important features is less than 500 m which will reduce dust noise and ground vibrations in vicinity area

Considering the suitability of above options it is proposed controlled blasting, using Non-electric shock tube technology for the subject mine lease which is most suitable in the proposed mine. A comparative statement of Shock Tube with Conventional Blasting showing remarkably less adverse impacts on environment (Details have been provided in chapter 5)

C) Haul Road: -The long life WBM (Water Bound Macadam) haul roads will be constructed and maintained for traffic movement.

D) Transport: - The speed of dumpers/ trucks on haul road will be controlled as increased speed increases dust emissions. Overloading of transport vehicles will be avoided. The trucks/ tippers will have sufficient free board. Spillage of ore on public roads will be cleared immediately and vehicles will play in safe speed.

E) Green Belt: - Planting of trees all along main mine haul road and regular grading of haul roads will be practiced to prevent the generation of dust due to movement of dumpers/trucks. Green belt of adequate width will be developed around the lease area. Plantation will also be done in dumping area, mineral stockyard.

4.5 Noise Environment

Noise pollution is mainly due to operation of blast hole drilling, blasting and occasional plying of trucks. These activities will not cause any problem to the inhabitants of this area because there is no human settlement in close proximity to the lease area. Noise modeling has been carried out considering blasting and compressor operation. The result indicates that it would have minor impact on Naliyadhar reserved forest and nearby villages. Noise levels at source of blasting and Compressor operation; are 120 dB(A) and 85 dB(A) respectively.

For hemispherical sound wave propagation through homogeneous loss free medium, one can estimate noise levels at various locations at different sources using model based on first principle.

$Lp_2 = Lp_1 - 20 \log (r_2/r_1) - Ae_{1,2}$

Where:

Lp_1& Lp_2 are sound levels at points located at distances r_1& r_2 from the source.

$Ae_{1,2}$ is the excess attenuation due to environmental conditions. Combined effect of all sources can be determined at various locations by logarithmic addition.

$Lp_{total} = 10 \log \{ 10(Lp_1/10) + 10(Lp_2/10) + 10(Lp_3/10) + \ldots\ldots\}$.

4.5.1 Anticipated Impact

4.5.1.1. Prediction of Noise quality

In order to predict the noise propagation within the study area, Dhwani-Pro model Based on CPCB algorithm and standards was used to predict changes in Noise quality due to the

proposed mining activity. Attenuation due to Green Belt has been taken to be 4.9 dB (A). The inputs required for the model are:

- Source data
- Receptor data
- Attenuation factor

Table 4-9: List of machinery/ Activity and noise level produced by them

S.N.	Machinery/ Activity	Impact on Environment?	Noise Produced in dB(A) at 50 ft from source*
1.	ANFO Blasting	Yes	94
2.	Jack Hammer	Yes	88
3.	Compressor	No	81
4.	Excavator	No	85
5.	DG Set	No	81
6.	Front end loader	No	85
7.	Dump Truck/ Tippers	No	84
Total Noise Produced			**96.3**

*50 feet from source = 15.24 meters

SOURCE: U.S. Department of Transportation (Federal Highway Administration) – Construction Noise Handbook

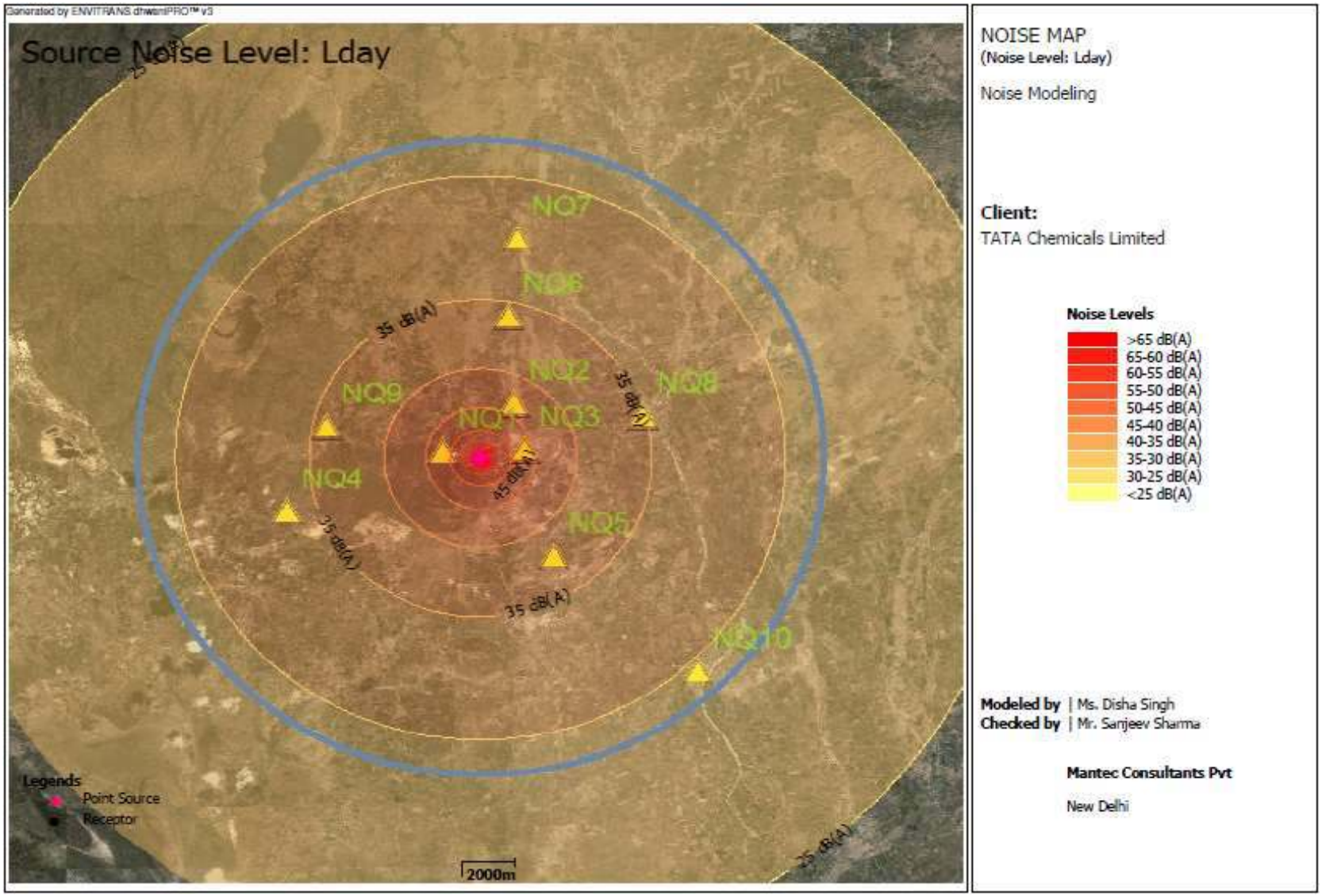
The total noise to be produced by mining activity is calculated to be 96.3 dB(A). Generally most mining operations produce noise between 100-109 dB(A). We have considered equipment and operation noise levels (max.) to be approx. 109 dB(A) for noise prediction modeling.

Results of the predicted noise quality at different location within the study area have been given in **Table 4-10** and the isopleth for the same has been provided in **Figure 4-7**

Table 4-10 : Predicted incremental noise at various monitoring location in the study area

Location code	NQ1	NQ2	NQ3	NQ4	NQ 5	NQ 6	NQ 7	NQ 8	NQ 9	NQ 10
Maximum Monitored Value (Day) dB(A)	51.5	53.4	54.5	52.6	53.7	66.3	57.6	59.1	66	64.2
Incremental Value dB(A)	47.6	43.2	46.6	33.6	37.2	36.1	32.2	35.3	35.8	29.6
Total Predicted Noise level dB(A)	53	53.8	55.2	52.7	53.8	66.3	57.6	59.1	66	64.2

Figure 4-7 : Isopleths showing Predicted incremental Noise in the study area



4.5.1.2. Prediction of Ground vibration

Vibration due to explosion has been modeled using USBM empirical equation for maximum explosive quantity charged per delay. The modeling results obtained are in ppv (mm/sec) versus distance in meter. PPV at nearest location from mine is given below. The ppv obtained at nearest village is 0.03 mm/sec. The allowable ppv for various structures is given in **Table 4-11**. By comparing the results with specified limit the nearest structure will not get affected due to blasting.

Table 4-11: Vibration at nearest location due to blasting

Location	Distance in (m) from mine boundary	ppv in mm/sec
Bordi	2230	0.03
BWLS	3920	0.01

Table 4-12: Permitted ppv for various frequencies

Limit Distance to	Permitted PPV (mm/sec) at Dominant Excitation Frequency (Hz)		
INDIAN STANDARDS			
TYPE OF STRUCTURE	<8	8-25	>25
Buildings & Structures not belonging to Owner			
i) Domestic houses /structures (Kuchha brick and cement)	5	10	15
ii) Industrial buildings (RCC and framed structures)	10	20	25
iii) Objects of historical importance and sensitive structures	2	5	10
Buildings & Structures belonging to Owner with Limited Lifespan			
i) Domestic houses /structures (Kuchha brick and cement)	10	15	25
ii) Industrial buildings (RCC and framed structures)	15	25	50

4.5.2 Mitigation Measures

A. **MAINTENANCE OF MACHINERY:** - Good and regular maintenance of machinery will be ensured to keep the noise generated at minimum. The vehicles operating will be maintained and provided with good silencers. All machines will be used at optimum capacity.

B. **TRAINED OPERATORS: -** Only trained operators will be allowed to operate machines.

C. **VEGETATION:** Plantation of trees around haul roads will be done to reduce the noise.

D. **HEARING PROTECTION:** Equipment like ear-muffs, ear-plugs, etc. are commonly used devices for hearing protection. Workers and operators working at drilling sites will be provided with earmuffs.

E. **BLASTING:** -Blasting will be avoided in the morning and evening hours, on foggy days, at night time and at times of high wind velocity and low cloud cover.

F. **DRILLING:** - Drilling will be carried out with the help of sharp drill bits.

4.6 Biological Environment

The impact on biodiversity is anticipated as Barda Wildlife Sanctuary is located at a distance of 3.92 Km from the mine site. The impact on biodiversity is difficult to quantify because of its diverse and dynamic characteristics.

4.6.1 Anticipated Impact

Mining activities generally result in the deforestation, land degradation, water, air and noise pollution which directly or indirectly affect the faunal and floral status of the project area. However, occurrence and magnitude of these impacts are entirely dependent upon the project location, mode of operation and technology involved. Impact prediction is the main footstep in impact evaluation and identifies project actions that are likely to bring significant changes in the project environment. The present study was carried out to predict the likely impacts of the proposed Limestone mine project of Tata Chemicals Limited at village Aniali in the surrounding environment with special reference to biological attributes covering habitats/ecosystems and associated biodiversity.

The proposed works are sited within the area which has been subject to existing mine lease granted in 1964. The proposed mining activities will include removal of some scattered bushes of Babool and other thorny species. Although impacts on key habitat elements will occur on a local scale, but on a regional scale they would not be critical for the life cycle needs of the species observed or expected. Moreover the successive reclamation of mined out areas, following completion of mining activities, will replace habitat resources for fauna species in this locality over a longer time. Existing roads will be used; new roads will not be constructed to reduce impact on flora.

Wild life is not commonly found in the plains outside the Barda Wild Life Sanctuary and its immediate environs because of lack of vegetal cover, and surface water. Except domestic animals, wild animals commonly observed are reptiles, fox, hares and some birds.

4.6.2 Mitigation Measures

Keeping all this in mind the mitigations have been suggested under environmental management plan. With the understanding of the role of plant species as bio-filter to control air pollution, appropriate plant species (mainly tree species) have been suggested conceding the area/site requirements and needed performance of specific species. The details of year wise proposed plantation program are given in **Table 4-13**.

Table 4-13 : Details of Proposed Plantation[26]

Year	No. of Plants	Area (Ha)
1st	100	0.1
2nd	100	0.1
3rd	100	0.1
4th	100	0.1
5th	100	0.1

In order to compensate the loss of vegetation cover, it is suggested to carry out afforestation program mainly in mine lease area earmarked for plantation program by IBM in different phases. This habitat improvement program would ensure the faunal species to re-colonize and improve the abundance status in the core zone.

However, the sanctuary area located far from the mining site and the mining site not having high fodder species richness considering the Barda Wild Life Sanctuary and Naliyadhar Reserved forest a grass plot development is suggested. In order to improve the fodder availability some of the grass species suggested to grow within the plantation area proposed by the IBM as silvopastural adaptation in the initial phase. Wherever, mining is completed, within that area (preferably flat terrain) these grass species can also grow simply sowing grass seeds in pellet form after plowing at sub-surface level before the onset of monsoon season in phase manner. This can provide fodder for the local livestock and thereby reduce grazing pressure in the Naliyadhar Reserved forest.

[26] Reference : Page No 56 of Annexure XI.

Table 4-14 : List of grass species to be planted

S. No.	Grass species	Local Name
1.	*Apluda mutica L.*	--
2.	*Cenchrus setigerus*	--
3.	*Cymbopogon martini+*	Kuyad
4.	*Cynodon dactylon*	Doob
5.	*Eleusine compressa*	Madhanu
6.	*Eragrostis ciliaris*	Murmur
7.	*Eragrostis tenella*	--
8.	*Heteropogon contortus +*	Kagadiu, Sukhli
9.	*Sporobolus marginatus+*	Dhrabad
10.	*Urochondra setulosus +*	Khariyu ghas

4.7 Socio-Economic Environment

The socio-economic impacts of mining are many. Impacts of a mine project may be positive or Negative. The adverse impacts attribute to physical displacement due to land acquisition, which is followed by loss of livelihood, mental agony, changes in social structure, and risk to food security etc. People are also directly affected due to pollution. Social Impact Assessment (SIA) is a process of analysis, monitoring and managing the social consequences of a project. Study on Socio-economic status has already been carried out using primary socio-economic survey for generating the baseline data of Socio-economic status.

4.7.1 Anticipated Impact

From the primary Socio-economic survey & through secondary data available from established literature and census data 2011, it is found that there would be positive impact on Socio-economic condition of the nearby area.

There is no habitation within 1 Km of the mining lease area. Therefore, no major impact is anticipated on the nearby habitation during the entire life of the mine.

4.7.2 Mitigation Measures

Mining in this lease will give 150 job opportunities to the local people. Thus, limestone mining will create beneficial effect on local people. With the operation of mining lease, various indirect employment opportunities will also be generated. Several persons of the neighbouring villages have been benefited with contract works, employment through contractors, running jeeps, trucks, tractors and buses on hire, running canteens, different kinds of shops and transport related business avenues.

Villagers have been provided with either direct employment or indirect employment such as business, contract works and development work like roads etc. Villagers also get access to the other welfare amenities such as drinking water, foods and provisions, shed etc.

4.8 Mine waste Management

As per approved mining plan the mineral limestone is exposed on the surface and stratified. There is no overburden to handle. The mineable area is devoid of top soil, hence, no proposals are made for top soil management but efforts shall be made to recover even thin layer of soil (incidental soil), it shall be scrapped in separate slice and kept preserved for utilisation in plantation work. There is no sub grade mineral to be separated hence no proposal for disposal of waste in mining plan are provided.

4.9 Mine Closure

Mine closure plan is the most important environmental requirement in mineral mining projects.

The mine closure plan should cover technical, environmental, social, legal and financial aspects dealing with progressive and post closure activities. The closure operation is a continuous series of activities starting from the decommissioning of the project. Therefore, progressive mine closure plan should be specifically dealt with in the mining plan and is to reviewed every five years in the scheme of mining. As progressive mine closure is a continuous series of activities, it is obvious that the proposals of scientific mining have included most of the activities to be included in the closure plan.

While formulating the closure objectives for the site, it is important to consider the existing or the pre-mining land use of the site; and how the operation will affect this activity. Some operations such as mining in agricultural areas have clearly defined this objective of returning the land to viable agricultural purposes or for bringing the land for economically viable productive purposes.

The primary aim is to ensure that the following broad objectives along with the abandonment of the mine can be successfully achieved:

- ✓ To create a productive and sustainable after-use for the site, acceptable to mine owners, regulatory agencies, and the public.

- ✓ To protect public health and safety of the surrounding habitation.
- ✓ To minimize environmental damage.
- ✓ To conserve valuable attributes and aesthetics.
- ✓ To overcome adverse socio-economic impacts.

4.9.1 Mine Closure criteria

The criteria involved in mine closure are discussed below:

4.9.1.1 Physical Stability

All anthropogenic structures, which include mine workings, waste dumps, buildings, etc., remaining after mine decommissioning should be physically stable. They should present no hazard to public health and safety as a result of failure or physical deterioration and they should continue to perform the functions for which they were designed. The design periods and factors of safety proposed should take full account of extreme events such as floods, hurricane, winds or earthquakes, etc. and other natural perpetual forces like erosion, etc.

4.9.1.2 Chemical Stability

The solid wastes on the mine site should be chemically stable. This means that the consequences of chemical changes or conditions leading to leaching of metals, salts or organic compounds should not endanger public health and safety nor result in the deterioration of environmental attributes. If the pollutant discharge likely to cause adverse impacts is predicted in advance, appropriate mitigation measures like settling of suspended solids or passive treatment to improve water quality as well as quantity, etc. could be planned. Monitoring should demonstrate that there is no adverse effect of pollutant concentrations exceeding the statutory limits for the water, soil and air qualities in the area around the closed mine.

4.9.1.3 Biological Stability

The stability of the surrounding environment is primarily dependent upon the physical and chemical characteristics of the site, whereas the biological stability of the mine site itself is closely related to rehabilitation and final land use. Nevertheless, biological stability can significantly influence physical or chemical stability by stabilizing soil cover, prevention of erosion/wash off, leaching, etc.

A vegetation cover over the disturbed site is usually one of the main objectives of the rehabilitation Programme, as vegetation cover is the best long-term method of stabilizing the site. When the major earthwork components of the rehabilitation Programme have been completed, the process of establishing a stable vegetation community begins. For re-vegetation, management of soil nutrient levels is an important consideration. Additions of nutrients are useful under three situations.

- ✓ Where the nutrient level of spread topsoil is lower than material in-situ e.g. for development of social forestry.
- ✓ Where it is intended to grow plants with a higher nutrient requirement than those occurring naturally e.g. planning for agriculture.
- ✓ Where it is desirable to get a quick growth response from the native flora during those times when moisture is not a limiting factor e.g. development of green barriers.

The mine closure should be as per approved mining plan.

The mine closure is a part of approved mine plan and activities of closure shall be carried out as per the process described in mine closure plan **(Annexure XI)**.

CHAPTER – 5:
ANALYSIS OF ALTERNATIVES

5 ANALYSIS OF ALTERNATIVES

5.1 Introduction

Consideration of alternatives to a project proposal is a requirement of EIA process. During the scoping process, alternatives to a proposal can be considered or refined, either directly or by reference to the key issues identified. A comparison of alternatives help to determine the best method of achieving the project objectives with minimum environmental impacts or indicates the most environmentally friendly and cost effective options.

5.2 Factor behind the Selection of Project

Limestone Mine of Tata Chemical Limited at village Aniali is a mining project for excavation of Limestone deposit, which is mineral specific. The mining lease has been granted by Indian Bureau of Mines.

The proposed mining lease area has following advantages:-

- ✓ The mineral deposit occurs in a non-forest area.
- ✓ There is no habitation within the lease area; hence no R & R issues exist.
- ✓ There are no river, stream, nallas and water bodies in the mine lease area.
- ✓ Availability of skilled, semi-skilled and unskilled workers in this region.
- ✓ All the basic amenities such as medical, firefighting, education, transportation, communication and infrastructural facilities are accessible.
- ✓ Mine connectivity through road and rail is good. The nearest highway is NH – 8 B passes at a distance of approx. 5.0 Km from the lease Boundary. The Nearest Railway Station is Ranavav Railway Station.
- ✓ The proposed mining operations do not intersect the ground water level. Hence, no impact on ground water environment.
- ✓ Study area falls in seismic zone – III, and there is no major history of landslides, earthquake, subsidence etc.

5.3 Analysis of Alternative Site

No alternatives are suggested as the mine site is mineral specific

5.4 Factor behind selection of proposed technology

Mechanized open cast mining operation with deep hole drilling and blasting method will be used to extract Limestone in the area. The mining lease area has following advantages:-

- There is practically very thin or negligible soil cover and overburden over the limestone deposit; hence it does not require any blasting.
- As the mineral deposition is superficial and not deeply embedded, therefore opencast method of working out deposit is preferred over underground method.
- There is lesser chance of subsidence in case of opencast mining.
- The material will be loaded with the help of excavators / JCB into dumpers / trippers and transported to the desired chemical plant at Mithapur.
- The high production levels projected in the scheme requires mechanization to cater large volumes. This technology is economically viable.
- Blasting and availability of drills along with controlled blasting technology gives desired fragmentation so that the mineral is handled safely and used with the minimum secondary blasting.
- Availability of power resources in the region makes mechanization a preferred technology over manual method.
- Human resource is easily available from the nearby villages because of presence of other mines in the area.

5.5 Analysis of Alternative Technology

Open cast mechanized method has been selected for this project. This technology is having least gestation period, economically viable, safest and less labour intensive. The method has inbuilt flexibility for increasing or decreasing the production as per market condition.

5.5.1 Opencast Mining Technology Alternatives

To minimize the impact of Conventional Blasting on surrounding environment two alternative processes were considered in environmental impact study of proposed mining operation i.e.

5.5.1.1 USE OF SURFACE MINERS

The surface miner is machine which has been developed mainly for road repair and continuous selective mining of hard and semi hard material.

ADVANTAGES

- Continuous surface mining of hard and semi hard material

- High flexibility and manoeuvrability in combination with trucks as well as conveyors.
- High cutting rates can be achieved even in hard material without drilling and blasting.
- Short loading time of trucks compared to loaders.

DISADVANTAGES

- The machines are developed for hard material. But where the material is soft and sticky in nature the efficiency of machine reduce considerably.
- The limestone in Porbandar region (the source feeding the entire Soda ash industry in India) is very soft (miliolitic in origin, geologically young) and quickly breaks into small pieces. This problem is further aggravated by surface miner operation which generates smaller sizes
- Limestone that is obtained by using surface miners is not of proper size and shape for using in TCL's soda ash plant limestone kilns. The required size is 50 to 100 mm, while surface miners produce a product with smaller dimensions and chip like shapes whereas the desired shapes are cuboidal.
- Limestone of less than 50 mm size is not suitable Limestone kilns designed to recover Lime well as CO_2 of the highest possible purity needed in manufacturing of soda ash in TCL's soda ash plant. Such kiln designs are standard for the entire Soda ash industry.

Other operational limitations with surface miners include:

- Minimum length of the bench (more than 200 meters)
- Necessity of flat ground for unobstructed movement (undulations of ore body is not acceptable).
- The subject leases limestone deposits are confined to narrow undulating pieces of small ridges with sharp elevations with narrow widths (50 meters). Even if a surface miner can be deployed, it will require blasting to create a level operating area. The limestone in the ridge would be exhausted in the process of levelling it, leaving nothing to be mined by a surface miner.
- Surface miners are not being used presently anywhere where such specific right size material is required.

IMPROVED BLASTING PRACTICES:

These include Adoption of suitable explosive charge and short delay detonators, adequate stemming of holes at collar zone and avoiding blasting at foggy days, at night time and at time of high wind speeds, restricting blasting to a particular time of the day i.e. at the time lunch hours, controlled charge per hole as well as charge per round of hole and Adopting muffling (i.e. covering the blast holes by sand bags) when the distance from important features is less than 500 M which will reduce dust noise and ground vibrations in vicinity area

Considering the suitability of above options it is proposed controlled blasting, using Non-electric shock tube technology for the subject mine lease which is most suitable in the proposed mine. A comparative statement of Shock Tube with Conventional Blasting showing remarkably less adverse impacts on environment is detailed as below:

ADVANTAGE OF SHOCK TUBE VIS-À-VIS DETONATING FUSE:

- It's a Non-electric Initiation System.
- It consists of a hollow polymer tube of desired length containing a very small quantity of reactive explosive powder thinly layered in it's annular space, approximately 15 – 20milligram per meter. The detonation (shock wave) is contained within the tube and hence it doesn't rupture the tube. This tube is generally known as "SHOCK TUBE" or "SIGNAL TUBE" and it is the important component of the system.
- Controlled Blasting with Shock Tube gives "Down The Hole" Initiation.
- On the other hand, Detonating Fuse (DF) with Electric Detonator (ED) used in Conventional Blasting gives "Above The Hole" Initiation. As ED is initiated, detonation passes through DF from above to bottom of the hole and detonates the primary explosive charge placed at the bottom of the hole. In this process it makes a relief in the entire hole before actual blasting. Thus, it creates air blast, fly rock and poor fragmentation.

ADVANTAGE OF DOWN THE HOLE DELAY DETONATOR (DTH)

- 450 ms & Trunk Line Delay Detonator (TLD) - 25ms vis-à-vis Electric delay detonator
- The factory assembled delay detonator is fixed at one end of the tube. The other end is sealed to prevent ingress of moisture and other foreign matter. Plastic connectors are provided at the free end of the tube.

a. Down the Hole Initiation

It gives True Bottom Initiation. The detonation (shock wave) is contained within the tube and hence it doesn't rupture the tube.

b. Adequate Delay Timing

The delay is provided such that each hole breaks the burden rock in front of it and the broken rock moves out before the hole behind it detonates. In case of Conventional Blasting the inter – row delay is too short, the movement of row burdens is restricted which causes excessive burden in the second and subsequent rows and the rock tends to move vertically because of insufficient relief. This causes poor fragmentation, tight muck piles, high ground vibrations and fly-rock generation.

So, the Controlled Blasting using Shock Tube Technology remarkably reduces the adverse effects on environment than the Conventional Blasting generally practiced in mining operations country wide.

Comparison of Shock Tube with Conventional Blasting

S. No.	Feature	Shock Tube technology	Conventional blasting Electric Detonator & DF
1	Air pollution	Low	High
2	Fragmentation/ Fly-Rock generation	Excellent / contained within 75 m from blast site (mainly towards open face)	Average / extends up to 300 metre radius from blast site
3	Ground Vibration / No. of holes per delay	Very Low / max. 3	High / max. up to 12
4	Air pollution	Low – Nearly entire gaseous energy under pressure remains confined within the hole to dislodge the in-situ rock strata and fragment it to the desired level.	High – nearly 40 % of gaseous energy gets released through the hole under high pressure creating huge cloud of dust and nitrogenous gas causing high air pollution
5	Air Blast / Noise pollution	Non – existent / low	Average / high
6	Initiation	Down the Hole	Above the Hole
7	Blasting Capacity	Unlimited	Unlimited
8	External Electric Hazard	None	Electricity & Radio Energy

Impacts of Mining operations (including Blasting) were predicted in environmental impact study of proposed mining operation with respect to Air, Noise and Vibration. It was concluded in the study that the impacts due to mining operations will be mostly within mine lease area and it will have negligible impacts in the surrounding agricultural lands. Mitigatory measures like **Plantation** of dense hedges on the boundary of lease area will further reduce the impacts,

Proposed mining operations including blasting are covered in mining plan of subject mine lease which has been approved by Indian Bureau of Mines (Government of India) vide order no. 682(23) MP-437/2008-MCCM (N) UDP dated 01.04.2014.

Further mining operations including Blasting will be carried out as per the approved Mining plan and Standards laid down by Director General of Mines Safety (DGMS) and Mining Act/ Rules.

After the implementation of the mitigation measures and Environmental Management Plan, activities of TCL during the mining phase would have negligible impact on environment.

CHAPTER – 6: ENVIRONMENT MONITORING PROGRAMME

6 Environmental Monitoring Programme

6.1 General

Regular monitoring of environmental parameters is of immense importance to assess the status of 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, to enable taking up suitable mitigatory steps in time to safeguard the environment. Monitoring is important to measure the efficiency of control measures. An environmental impact assessment study is carried over for a specified period of time and the data cannot bring out all variations induced by the natural or human activities. Therefore, regular monitoring programme of the environmental parameters is essential to take into account the changes in the environmental quality. The objectives of monitoring are to:-

- Verify effectiveness of planning decisions;
- Measure effectiveness of operational procedures;
- Conform statutory and corporate compliance; and
- Identify unexpected changes.

6.1.1 Environmental Monitoring & reporting Procedure

Monitoring will conform that commitments are being met with. This will take the form of direct measurement and recording of quantitative information, such as quantity and concentrations of discharges, emissions and wastes, for measurement against corporate or statutory standards, consent limits or targets. It may also require measurement of ambient environmental quality in the vicinity of a site using ecological/ biological, physical and chemical indicators. Monitoring may include socioeconomic interaction, through local liaison activities or even assessment of complaints.

The preventive approach by management may also require monitoring of process inputs, for example, type and method used, resource consumption, equipment and pollution control performance etc. The key aims of monitoring are, first to ensure that results/ conditions are as per prediction during the planning stage and where they are or not, to pinpoint the cause and implement action to remedy the situation. A second objective is to verify the evaluations made during the planning process, in particular with risk and impact assessments and standard & target setting and to measure operational and process efficiency. Monitoring will also be

required to meet compliance with statutory and corporate requirements. Finally, monitoring results provide the basis for auditing.

6.1.1.1 Monitoring Schedule

Details of the Environmental Monitoring schedule, which will be undertaken for various environmental components, are detailed below in **Table 6-1**

Table 6-1 : Environmental Monitoring Programme for proposed Limestone Mine

S. No.	Activity	Schedule
Air Pollution Monitoring		
1.	Ambient air monitoring of parameters specified by SPCB in their air consents from time to time within the TCL's mining lease	Once in every season except monsoon
2.	Ambient air monitoring of parameters specified by GPCB in their air consents from time to time at stations outside TCL mining lease	Once in every season except monsoon
Water Quality Monitoring		
3.	Monitoring water quality from rain water collected in mine pit area. Rain water will be used for plantation purpose.	During Monsoon
4.	Monitoring of one sample of tube well and open well at mine/ nearby location. Parameters are essential parameters as per IS: 10500:1991.	Once in every season except monsoon
5.	Monitoring of water spray requirements	Log-sheet of water spray will be maintained on daily basis
Noise Quality Monitoring		
6.	Noise in the ambient atmosphere in TCL mining lease	Once in every season except monsoon
Greenbelt Maintenance		
7.	Monitor schedule for Greenbelt development as per approved mining plan	Yearly
Soil Quality Monitoring		
8.	Soil at two locations	Once in every year

6.1.1.2 Monitoring during construction (Site Preparation) phase

The proposed project is an existing Limestone Mine for which Lease was granted to Tata Chemicals Ltd. by State Government vide Grant Order No. MCR-1563/15740-G-V dated 12.06.1964. Mine lease was in operation during 1985-86 to 1993-94. Mine Lease is idle since 1994-95. Site clearing will be done to resume mining activities after Environmental

Clearance and Consent approvals. Surface soil removed during the site clearing will be utilized for greenbelt development in the non-mineral area of the same mine lease as per approved mining plan. Hence monitoring will be conducted as per schedule given in **Table 6-1**. All required, infrastructural facilities will be created to fulfil the various requirements as per approved mining plan.

6.1.1.3 Monitoring during operational phase

Limestone mining is proposed by mechanized opencast method of mining which will include wet drilling & controlled blasting as per approved mining plan. During operational phase, monitoring of environmental parameters, water spray & green belt development activities will be conducted as per schedule given in **Table 6-1**

Method of mining along with pollution control measures are given in **Figure 2-1:**

6.1.2 Environmental monitoring Cell

In order to maintain the environmental quality within the standards, regular monitoring of various environmental components is necessary. The company will have a full-fledged environmental management cell (EMC) which will report directly to Functional Head for environmental monitoring and control. The EMC team will take care of pollution monitoring aspects and implementation of control measures.

A group of qualified and efficient engineers with technicians will be deputed for maintenance, up keep and monitoring the pollution control equipment to keep them in working at the best of their efficiencies.

6.1.3 Responsibilities of EMC

The generalized responsibilities of the EMC will be as follows:

a) Conducting Environmental monitoring of the surrounding area.
b) Carrying out the Environmental Management Plan.
c) Organizing meetings of the Environmental Management Committee and reporting to the committee.
d) Ensuring that prescribed environmental standards are maintained.
e) Ensure that all different types of statutory returns / compliance report to be submitted to relevant regulatory bodies.
f) Commissioning of pollution control equipment/ measures.

g) Specification and regulation of maintenance schedules for pollution control equipment.

h) Developing the green belt.

i) Ensuring water use is minimized.

The composition of the environment management cell along with the responsibilities of respective members are given in **Table 6-2**.

Table 6-2 : Composition of Environment Management Cell (EMC)

S. No.	Designation	Proposed responsibility
1.	VP (Manufacturing)	Environmental policy and directions
2.	GM – Safety, Health & Environment	Overall responsibility for environment management and decision making for all environmental issues
3.	Manager – Environment Management System	Overall in-charge of operation of environment management facilities; Ensuring legal compliance by properly undertaking activities as laid down by various regulatory agencies from time to time and interacting with the same
4.	Assistance Manager – Environment Management System	Secondary responsibility for environment management and decision making for all environmental issues & ensure environmental monitoring as per appropriate procedures.

6.2 Activities

6.2.1 Monitoring Methods

Post project monitoring will be carried out as per conditions stipulated in Environmental Clearance Letter issued by MoEF, Consent issued by SPCB as well as according to CPCB guidelines. The Mine site is considered as core zone and the area lying within 10 km radius from the mine site is considered as buffer zone.

6.2.1.1 Slope Failure

Mining will be carried out by opencast mechanized method as per mining plan approved by Indian Bureau of Mines. Subsidence/ Slope failures are not envisaged because mineral limestone is exposed on the surface and stratified. There is no overburden to handle. The bench height will be 4.0m high[27]. Bench slope will be maintained 80^0 from horizontal and

[27] Reference: Page No 34 of Annexure XI.

bench width will be 15-20 meter. During the opencast working and allied activities, all the precautionary measures shall be taken in to account as per regulation 106 of The Metalliferous Mines Regulation 1961, Mines Act 1952, Mines Rules 1955 & M.C.D.R. 1988[28]. Moreover, all Safety standards/ safeguards will be implemented as per Guidelines prescribed by Director General of Mines Safety

6.2.1.2 Drainage

The general topography of the area surrounding the mine site represents the gently undulating to almost flat terrain intervening the prominent hill ranges of the high relief central area of the region. The lowest and highest elevation in the lease area is 61 m AMSL to 73m AMSL having an elevation difference of 12 m with general ground slope from west to east direction. There is no major water body or any other seasonal drainage channel or nallas existing in the lease area. During rainy season the surface runoff follows the natural contour and flows in the same direction.

The rain water collected in the pits after spell of rain will be used for plantation and dust suppression. At the end of life of mine, excavated area will be used as a rain water pit.

6.2.1.3 Blasting effects

Regular testing and inspection of blasting operations in work zone will be carried out with respect to noise, fly rock throw, vibration, dust and fume generation. These tests will be conducted regularly and whenever new patterns of blasting are adopted for rock fragmentation.

Blasting is proposed to be done using explosive Ammonium Nitrate – Fuel Oil (ANFO) as the column charge and cap sensitive explosive (normally slurry/ emulsion ex-plosives) as the booster charge. The ratio of column charge to the booster charge is 75:25. For drilling blast holes, wet drilling process will be adopted as to suppress dust emissions at the source of generation. Of the various firing patterns in vogue, the multi row staggered gird V pattern is proposed to be adopted sequencing with short delay detonator.

[28] Reference: Page No 70 Section 4.8 of Annexure XI.

6.2.1.4 Revegetation & Green Belt Development

During first five years, about 100 saplings of local varieties of trees will be planted every year in the un-worked area. Plant species act as bio-monitoring agent to monitor the air environment as well as to keep and maintain the project environ healthy. Trees have substantial inter-specific as well as intra-specific variation in air pollution tolerance. Green Belt development / tree plantation in organized manner will be carried out around the existing mine site by the end of the mining activity. The species suggested are Local tree species in the mine area and nearby villages, to reduce the impact of expansion activities in the surroundings of the existing mine site. The suggested plants are suitable for green belt development have characteristics like, fast growing, thick canopy cover, perennial and evergreen large leaf area, naturally growing, efficient in absorbing pollutants without major effects on natural growth.

On the basis of the general principles mentioned and as per the CPCB guidelines for the development of Greenbelts following species are recommended:

OUTER PERIPHERY TREES

- *Azadirachta indica*
- *Ficus religiosa*
- *Samanea saman*
- *Tamarindus indica*

INNER PERIPHERY TREES

- *Balanites roxburghii planch*
- *Bougainvillea spectabilis wild*
- *Derris indica*
- *Ficus benjaminalina*

MEDIUM SIZE TREES

- *Phoenix sylvestris*
- *Sesbania grandiflora*
- *Mimusops hexandra*

SMALL SIZE SHRUBS

- *Acacia catechu.*
- *Accacia ferruginea*
- *Clerodandrum inermeis*
- *Callistemon citrinus*

The year-wise afforestation programme under the green belt (safety zone) and non-mineralized area for five years is given in **Table 4-13**.

6.2.1.5 Air quality Monitoring

The concentration of air borne pollutants in the workspace/ work zone environment will be monitored periodically as per **Table 6-3**. If concentration is higher than threshold limit values are observed, the source of fugitive emissions will be identified and necessary measures taken. If the levels are high, suitable measures as detailed in Environment Management Plan will be taken. The ambient air concentrations of PM_{10}, $PM_{2.5}$, SO_2 and NO_X will be monitored as per frequency given in **Table 6-3**. Any abnormal rise will be investigated to identify the causes and appropriate action will be initiated. Greenbelt will be developed for minimizing dust propagation.

Table 6-3: Air pollution monitoring and control measures

Potential Impact	Action	Parameters for Monitoring	Timing
Air Emissions	All equipments are operated within specified design parameters.	Random checks of equipment logs/ manuals	During site clearing & Operation of Mine
	Vehicle trips to be minimized to the extent possible	Vehicle logs / Increase the capacity of vehicle	During site clearing, Operation of Mine
	Topsoil (if any) must be removed from the entire area to be mined and stored from where it can be recovered and utilized immediately in other areas.	Absence of stockpiles	During site clearing
	Ensure Regular Checks of vehicular pollution	Pollution under control certificate of vehicle	During Operation of mine
	Covering of Vehicles transporting the mined mineral	No of Trucks with covering / Random checks of trucks on roads	During operation of mine.

Potential Impact	Action	Parameters for Monitoring	Timing
	Plantation of dense hedges on the boundary of lease area, these will reduce dust and noise in the vicinity area.	No of Saplings per Year	During Each year. from operations till closure as per approved mining plan
	Use proper drills bits for drilling holes and wet drilling method.	Random check of equipment used for drilling	During blast hole drilling
	Regular water spraying shall be done	Quantity of water requirement shall be monitored	During site clearing, transportation etc.
	Ambient air quality within the premises of the proposed unit to be monitored.	The ambient air quality will conform to the standards for SPM, SO_2 and NO_2	As per GPCB requirement.

6.2.1.6 Water Quality Monitoring

The monitoring of water quality for water samples of rain water collected in the mine pit area will be conducted as per schedule given in **Table 6-4.** Analysis will be carried out as per GPCB consent condition. Record of analysis shall be maintained.

Table 6-4 : Water quality monitoring and control measures

Potential Impact	Action	Parameters for Monitoring	Timing
Water Quality	During extraction of mineral proper care should be taken such that it does not disturb the ground water table.	No discharge of waste water from mining operation	During mining operation
	After extraction of mineral, rainwater will be stored in void generated.	Quantity of water used for green belt development	During mining operation.

6.2.1.7 Noise level Monitoring

Noise levels will be monitored in the mine area as per the frequency given in **Table 6-5.**

Table 6-5 : Noise Quality Monitoring and Control Measures

Potential Impact	Action	Parameters for Monitoring	Timing
Noise	List of all noise generating machinery onsite along with age to be prepared. Equipment to be maintained in good working order.	Equipment logs, noise reading	During mining operation.
	Generation of vehicular noise	Maintenance records of vehicles	During trans-portation.
	Implement good working practices (equipment selection and siting) to minimize noise and also reduce its impacts on human health (ear muffs, safe distances and enclosures). Adopt good blasting practices to reduce impact on flora and fauna. Muffling will be done at the time of blasting	Site working practices records,	During blasting
	Noise to be monitored in ambient air near blasting shelter and at the lease boundaries.	Noise reading	As per GPCB re-quirement or quarterly whichever is lesser.
	The Noise level should not exceed the permissible limit both during day and night times.		
	All equipment operated within specified design parameters.	Random checks of equipment logs/ manuals	During mining operation
	Vehicle trips to be minimized to the extent possible	Vehicle logs	During mining operation
	Plantation of dense hedges on the boundary of lease area, these will reduce dust and noise in the vicinity.	No of saplings per Year	During Each year. from operations till closure as per approved mining plan

6.2.1.8 Occupational Health & Safety

The working conditions in the mines are governed by the enactments of the Director General of Mines Safety (DGMS). As per the guidelines of the Mines Act, the management will take all necessary precautions. Normal sanitary facilities will be provided within the lease area. The management will carry out periodic health check-up of workers.

Occupational hazards involved in mines are related to dust pollution, noise pollution, blasting and injuries from moving machineries & equipment and fall from high places.

DGMS has given necessary guidelines for safety against these occupational hazards. The management will strictly follow these guidelines.

All necessary first aid and medical facilities will be provided to the workers. The mine will be well equipped with proper fire protection and firefighting equipment. All operators and mechanics will be trained to handle fire-fighting equipments. Further all the necessary personal protective equipments such as safety helmets, safety goggles, earplugs, earmuffs, dust masks etc. will be provided to persons working in mines as per Mines Rules, 1955.

6.2.2 Reporting schedule of monitored data

It is proposed that voluntary reporting of environmental performance with reference to the EMP.

The Environmental Monitoring Cell will co-ordinate all monitoring programmes at site and data thus generated will be furnished as per statutory requirements.

The frequency of reporting will be on six monthly basis to the State PCB and to Regional Office of MoEF, New Delhi. The Environmental statement will be prepared for the entire year of operations and will be regularly submitted to regulatory authorities.

CHAPTER – 7:
ADDITIONAL STUDIES

7 ADDITIONAL STUDIES

7.1 Public Consultation

As per the EIA notification, 2006 and its subsequent amendments later, Public hearing for Aniali Limestone Mine (16.21 ha) covered under "Category – A" was scheduled on 11/12/2013 at 10:30 a.m. at Panchayat ground, Near Panchayat Kacheri, Village- Aniali, Taluka – Ranavav & District – Porbandar, Gujarat. Duly authenticated Public hearing proceedings including the advertisement, attendance and Videography is enclosed as **Annexure- XII**.

As required under the Public Hearing process prior advertisements for the public hearing was published in the local language i.e. Gujarati in the daily newspaper "Divya Bhaskar" dated 7/11/2013 and English Newspaper namely "Indian Express" dated 07/11/2013. As per the new amendment in notification advertisement for the same was also telecasted by the local TV Channel GTPL Porbandar. Public hearing was conducted as scheduled on 11-12-2013 under supervision of Shri B L Maru, Regional Officer and Shri M A Gandhi, Collector and District Magistrate, Porbandar.

Public Hearing was initiated by Shri B.L. Maru. He welcomed all persons present to the public hearing. He gave a brief summary about the status of all the statutory requirements of public hearing in his welcome speech. He then invited the Project Proponent i.e. TATA Chemicals Ltd. to begin their presentation. A detailed power point presentation was made in the local language i.e. Guajarati by Mr Paresh Tank (General Manager- Corporate Affairs). In his presentation He explained about background information of the project including its impacts on surrounding environment and people. He also explained about the mitigation measures that will be taken to loosen the negative impacts of project.

Shri M A Gandhi, briefed about the procedure of public hearing process as per EIA notification 2006 and its subsequent amendments later; and requested for one by one representation, queries or suggestions on Environmental Matters related to the proposed project.

The statement showing issues raised by the participants orally and responded by the representative of the project proponent during the Public Hearing is included in public hearing proceedings.

As per the Prescribed Terms of Reference and considering all the points & issues raised during Public hearing M/S TATA Chemicals Ltd. has evolved with a Time-bound Action Plan which will also contribute as a part of Corporate Social Responsibility as provided below:

Table 7-1 : Time –Bound action Plan and Budgetary allocation of points and issues raised during Public Hearing

S. No.	Name of the Representative	Representation	Reply given by Mr. Paresh Tank, Representative of M/s. Tata Chemicals Limited	Proposed Action Plan	Budgetary support with timeframe
1	Shri Sangabhai Jivabhai Mori, Sarpanch village Ranbordi and President District Sarpanch Association.	a. We welcome mining project if it follows regulations as explained during public hearing in presentation.	a. Company shall ensure compliance of all regulators norms.	a. Mining rules will be followed during mining operations. Company shall ensure compliance of prevailing regulations at the time of mining	**Allocated Budget : Approx.** Rs. 50 Lakhs / Annum which will include royalty and other applicable regulatory fee/returns. **Proposed Month and Year of Implementation:** From starting of operations.
		b. This area is hilly. Rain water (runoff) flows away immediately during monsoon due to hilly terrain. Mined out pits will provide storage of rain water. This will improve the availability of water and irrigation.	b. Rain water harvesting potential will be maximum in post mining phase.	b. The mine will be worked as opencast mechanised method and mining operations will generate rainwater storage pits at the end of mining. The total estimated area of pits will be 13.13 Hectare with maximum depth of	**Allocated Budget** : The proposal is for mining which will generate shallow pits, hence no budget allocation for rain water storage pits. **Proposed Month and Year of Implementation**: post mining phase

S. No.	Name of the Representative	Representation	Reply given by Mr. Paresh Tank, Representative of M/s. Tata Chemicals Limited	Proposed Action Plan	Budgetary support with timeframe
				8.5 meters. The shallow pit will cater water storage of 1,116,050 KL of water at site for green belt development and dust suppression.	
		c. Planation of trees like Peeple & Banyan by Company and maintain the plantation till self-sustenance. Plant trees at both sides of road having spacing of 10 to 15 meters.	c.Plantation activities will be done as per mining plan approved by IBM and Environment Management Plan (EMP) proposed in Environment Impact Assessment (EIA) study.	c. The year-wise afforestation programme under the green belt (safety zone) and non-mineralized area for four years is given in EIA Report section 9.3.6	Allocated Budget : Approx. Rs. 1.5 Lakhs / Annum Proposed Month and Year of Implementation: During pre-monsoon period on starting of operations.
		d. Village Dolatgarh is located near Mine. People of the Village go to outside for labour work, hence priority of employment in mining activity to be given to	Company believes in encouragement of local employment subject to requirement of company and availability of skill.	a. More than 150 unskilled persons are proposed to find employment in mining related activities during Mine lease operation. b. More than 40 skilled	a. **Allocated Budget**: TCL propose to allocate budget of Rs. 154 lacs/ Annum for sizing of limestone based on current rate of service contract i.e. Rs. 175 / Tone of limestone sizing. b. **Allocated Budget**: TCL propose to allocate budget of Rs. 440 lacs/

S. No.	Name of the Representative	Representation	Reply given by Mr. Paresh Tank, Representative of M/s. Tata Chemicals Limited	Proposed Action Plan	Budgetary support with timeframe
		village people.		and unskilled persons are proposed to find employment in transportation/ machinery maintenance related activities	Annum for transportation of limestone from 16.21 Ha lease to Mithapur based on current rate of service contract for transportation i.e. Rs. 500/ton of limestone **Proposed Month and Year of Implementation**: From starting of operations.
2	Shri Babubhai Chauhan – Social worker village - Ranavav	A. Today's hearing is on environmental conservation. The species of Ganda-Babool are observed in the region which are declared as harmful to environment by forest and environment department of government needs to be removed and replaced with other trees with help of NGO.	Plantation activities will be done as per mining plan approved by IBM and Environment Management Plan (EMP) proposed in Environment Impact and Assessment (EIA) study.	The year-wise afforestation programme under the green belt (safety zone) and non-mineralized area for four years is given in EIA Report section 9.3.6	Allocated Budget : Approx. Rs. 1.5 Lakhs / Annum Proposed Month and Year of Implementation: During pre-monsoon period on starting of operations.

S. No.	Name of the Representative	Representation	Reply given by Mr. Paresh Tank, Representative of M/s. Tata Chemicals Limited	Proposed Action Plan	Budgetary support with timeframe
		b. We welcome M/s Tata Chemicals Limited as it is beneficial to water and irrigation by creation of rain water storage pit in post mining stage	Noted. Rain water harvesting potential will be maximum in post mining phase.	The mine will be worked as opencast mechanised method and mining operations will generate rainwater storage pits at the end of mining. The total estimated area of pits will be 13.13 Hectare with maximum depth of 8.5 meters. The shallow pit will cater water storage of 1,116,050 KL of water at site for green belt development and dust suppression..	**Allocated Budget**: The proposal is for mining which will generate shallow pits, hence no budget allocation for rain water storage pits. **Proposed Month and Year of Implementation**: post mining phase

7.2 Risk Analysis & Disaster Management Plan

7.2.1 Background

The methodology for the risk assessment has been based on the specific risk assessment guidance issued by the Directorate General of Mine Safety (DGMS), Dhanbad, vide Circular No.13 of 2002, dated 31st December, 2002. The DGMS risk assessment process is intended to identify existing and probable hazards in the work environment and all operations and assess the risk levels of those hazards in order to prioritize those that need immediate attention. Further, mechanisms responsible for these hazards are identified and their control measures, set to timetable are recorded along with pinpointed responsibilities.

In the unlikely event that a consequence has occurred, disaster management kicks in. This includes instituting procedures pertaining to a number of issues such as communication, rescue, and rehabilitation. These are addressed in the disaster management plan.

Both, the RA and DMP, are living documents and need to be updated whenever there are changes in operations, equipment, or procedures

Assessment is all about preventing accidents and taking necessary steps to prevent it from happening.

7.2.2 Key Definitions

Hazard: Source of potential harm, injury, or loss.

Consequence: Size of the loss or damage. In terms of health and safety, it is the degree of harm that could be caused to people exposed to the hazard, the potential severity of injuries or ill health and / or the number of people who could be potentially affected. Consequence of a hazard need not only be in terms of safety criteria but could also be in terms of a money loss, incurred costs, loss of production, environmental impacts as well as public outrage.

Risk: Combination of the likelihood of a specific unwanted event and the potential consequences if it should occur.

Risk Assessment: Is a process that involves measurement of risk to determine priorities and to enable identification of appropriate level of risk treatment (used also to describe the overall process of risk management).

Risk Control: Implementation of strategies to prevent or control hazards

Risk Rating: The category or level or risk assigned following risk assessment (e.g. High, Medium or Low).

Risk Management: Overall description of the steps taken to manage risk, by identifying hazards and implementing controls in the workplace.

Emergency: A situation of process deviation that, if uncontrolled, may lead to a major accident /disaster with potential short term and/or long term risk damage consequence to life and property in and/or around the workplace.

Disaster: A catastrophic consequence of a major emergency / accident that leads to not only extensive damage to life and property, but also disrupts all normal human activity for a significant period of time and requires a major national and / or international effort for rescue and rehabilitation of those affected.

7.3 Scope of Work for RA & DMP Study

The scope of work has been framed as per DGMS requirements for risk and safety studies in mines and includes the hazard identification, risk assessment, and ranking, resulting in treatment controls and action plans.

7.3.1 Level 1: Hazard Identification

Hazard identification includes:

STUDY OF SAFETY ISSUES PERTAINING TO THE PROJECT

- Study of operational information, including safety concepts used in design of equipment and storages.
- Listing of hazardous inventory and identification of key hazardous substances to be used.
- Available procedures and the extent to which they are followed in operational mines by the same organization.
- Consultations with employees who carry out or are likely to carry out the jobs.
- Safety statistics for this and other mines, as applicable and available.
- Statutory mine inspection reports, where available.
- Past history of accidents and near misses.

The above are applicable to all the aspects of the mining activities including winning of minerals, crushing – sizing and transport.

IDENTIFICATION OF HAZARD SCENARIOS

- Identification of scenarios that can cause damage to life & property.

7.3.2 Level 2: Risk Assessment & Ranking

RISK ASSESSMENT

As defined earlier, risk is a function of likelihood and consequence. Likelihood is the chance that the hazard might occur. Since the risk of any hazard is dependent upon the chance that it will occur (likelihood) and the impact of an occurrence (consequence):

- **Risk Score = Likelihood x Consequence**

In some cases personnel are only exposed to the hazard for part of the time. Hence, a more detailed analysis of the risk ranking can be carried out by taking exposure (% time personnel are present) and probability (chance that they will be injured) into consideration. Thus:

- **Risk Score = (Probability x Exposure) x Consequence**

The values used for likelihood, consequence, exposure or probability need to be agreed by the risk assessment team, and there is an element of professional judgment in exercising these choices.

RISK RANKING

Risk ranking can be determined by qualitative and quantitative means. It should however be remembered that no one method is best. The best choice of method will depend on the circumstances and preferences at the mine, at the time the exercise is done. However, regardless of the method establishing risk ranking will set priorities for Hazard control. The most important purpose in hazard identification, risk assessment, and ranking is to draw up and implement plans to control these hazards. However, keeping the acceptance of the participants during workshops conducted at different mines, DGMS has suggested a criteria table for quantitative risk ranking to be used as in **Table 7-2**

Table 7-2 : Risk ranking criteria

Scale for consequence	Scale for exposure	Scale for probability
Several dead: 5	Continuous: 10	May well be expected: 10
One dead: 1	Frequent (daily): 5	Quite possible: 7
Significant fatality chance: 0.3	Seldom (Weekly): 3	Unusual but possible: 3
One permanent disability/ less chance of fatality: 0.1	Unusual (Monthly): 2.5	Only remotely possible: 2
Many lost time injuries: 0.01	Occasional (Yearly): 2	Conceivable but unlikely: 1
One lost time injury: 0.001	Once in 5 years: 1.5	Practically impossible: 0.5
Small injury: 0.0001	Once in 10 years: 0.5	Virtually impossible: 0.1

	Once in 100 years: 0.02	

On the basis of the above scoring format, and after a perusal of the resultant scores, professional judgment was exercised in selecting the following scale for assessing risk levels:

- Level 1: > 15; i.e., requiring immediate action
- Level 2: <15 but > 5; i.e., requiring management action
- Level 3: < 5; i.e., low risks requiring periodic review

7.3.3 Level 3: Treatment Controls and Action Plans

TREATMENT CONTROLS

After examining the high priority risks, consideration is given to consider the potential to reduce or eliminate the risk by using the hierarchy of controls. This assists establishing methods to reduce the risk. From experience, the effectiveness of each method is given as a percentage after each of the control descriptions. The desirability of control plans (with reducing effectiveness) is as follows:

- Elimination: Remove steps to eliminate the hazard completely.
- Substitution: Replace with less hazardous material, substance, or process.
- Separation: Isolate hazard from person by guarding, space, or time separation.
- Administration: Adjusting the time or conditions of risk exposures.
- Training: Improving skills making tasks less hazardous to persons involved.
- Personal protective equipment: Used as the last resort, appropriately designed and properly fitted equipment where other controls are not practicable.

Control measures can reduce either the likelihood or consequence of the event or both. Depending on the level of reduction of the hazard, there could still be a residual risk that needs to be monitored so that a secondary prevention process can be initiated when trigger points are reached.

ACTION PLANS

The team should develop an action plan recommending actions, responsibilities and when it should be completed. These require to be put forward to the decision-making authority and get reviewed, if necessary before taking a decision to proceed.

7.3.4 Level 4: Development of Disaster Management Plan

The suggested DMP has been organized in a Plan, Do, Check, Review (PDCR) cycle to enable effective implementation.

7.4 Hazard Identification

The proposed mining activities have been described in Chapter 3. The identification of hazards has been done considering these operations. The hazards have been covered under three broad activities that are part of the proposed surface mining operations: winning the mineral, transporting the mineral, and processing the mineral. While identifying the hazards, a consideration of issues discussed in Section 7.2.1 has been done. Hazard identifications under the three broad activities are discussed in subsequent paragraphs (with primary risk in brackets).

7.4.1 Hazards: Mineral Winning

7.4.1.1 Site Planning and Layout

SURVEYING

Travel in moving vehicles on uneven terrain (fall from height, hitting of head on vehicle body)

7.4.1.2 Laying Out of Site

- Moving vehicles on uneven terrain (fall from height, hitting of head on vehicle body)
- Operation of earthmoving equipment (fall from height, hitting of head on vehicle body)
- Blasting (hit by fly rock or exposure to overpressure)

7.4.1.3 Operations

BLASTING (TRANSPORT OF EXPLOSIVES)

Heavy impact during transport & handling (unintended explosion)

BLASTING (DRILLING OF HOLES)

- Drilling holes for blasting will be done manually by using water hence generation of dust and noise dose not arise.
- Working near edge of bench and at height (fall from height)
- Dust generation during drilling operations (chronic or acute exposure)

- Drilling noise (chronic or acute exposure)
- Moving debris or projectiles (hit by fly rock)

BLASTING (CHARGING OF HOLES)

- Unintended explosion or exposure (exposure to overpressure)

BLASTING (DETONATION)

- Generation of noxious fumes (chronic or acute exposure)
- Noise (chronic or acute exposure)
- Fly rock (hit by fly rock)

MECHANISED SIZING

- Generation of noise (chronic or acute exposure)
- Vibrations (chronic or acute exposure)
- Dust generation during crushing - sizing operations (chronic or acute exposure)
- Electrical Shock

LOADING

- Falling rock (hit by fly rock)
- Use of vehicle on uneven ground (fall from height, hitting of head on vehicle body)
- Fires involving fuel storages and transfer facilities (exposure to radiating heat)

GENERAL OPERATIONS: FACE STABILITY

- Working face in the mine will be quite stable and firm.
- Rock fall or slides (hit by rock)

INUNDATION DUE TO EXCESS WATER

- Flooding due to excessive rainfall (drowning)
- Area is located in very less rainfall prone area and hence this hazard possibility is less.
- However, in any event of excessive rainfall and storm water workers will be withdrawn from quarry area immediately.
- Flooding due to entry of storm water into working pit (drowning)

7.4.2 Hazards: Mineral Transport

- Vehicle roll over (impact on body)
- Vehicle collision (impact on body)
- Vehicle hitting pedestrians (impact on body of pedestrians)
- Vehicle related fires (burn injuries)
- Fuel related fires (exposure to radiating heat)
- Access & egress to cab (hitting of head on vehicle body)

7.5 Risk Assessment

A team comprising members amongst the project proponents, deliberated on the issues and carried out risk assessment for the subject mine, dwelling on the likely hazards faced by the site. The results of the risk assessment are given in **Table 7-3.**

Table 7-3 : Hazards faced in limestone mining operations

S.No.	Activity	Hazard Description (Risk)	Score				Risk Level
			Consequences	Exposure	Probability	Risk Score	
1.	Site planning and layout	Travel in moving vehicle in uneven terrain	1	2	1	2	Level 3
2.	Storage of explosives	Unintended explosions (exposure to overpressure)	1	5	3	15	Level 1
3.	Charging of explosives	Unintended explosion or exposure (exposure to overpressure)	1	3	1	3	Level 3
4.	Blasting	Hit by fly rock (bodily injuries)	1	2	1	2	Level 3
5.	Bench Formation	Rock falls or slide due to lack of bench face stability (bodily injuries)	5	1.5	2	15	Level 1
6.	Crushing and sizing of ROM	Hit by Machineries – Electrical Equipment (bodily injuries)	1	3	3	9	Level 2
7.	Transportation of minerals	Vehicle Accident (bodily injuries)	5	5	2	50	Level 1
8.	Transportation of minerals	Accidental 1fire in vehicle (bodily injuries, exposure to	1	5	1	5	Level 3

		heat radiation)					

By arranging the above hazards from highest to lowest, the hazards were re-arranged as per their risk levels. This is done in **Table 7-4.**

Table 7-4 : Hazards ranked by Risk level

Activity	Hazard Description (Risk)	Risk Score	Risk Level
Site planning and layout	Travel in moving vehicle in uneven terrain	2	Level 3
Storage of explosives	Unintended explosions (exposure to overpressure)	15	Level 1
Charging of explosives	Unintended explosion or Exposure (exposure to overpressure)	3	Level 3
Blasting	Hit by fly rock (bodily injuries)	2	Level 3
Bench Formation	Rock falls or slide due to lack of bench face stability (bodily injuries)	15	Level 1
Crushing and sizing of ROM	Hit by Machineries – Electrical Equipment (bodily injuries)	9	Level 2
Transportation of minerals	Vehicle Accident (bodily injuries)	50	Level 1
Transportation of minerals	Accidental 1fire in vehicle (bodily injuries, exposure to heat radiation)	5	Level 3

7.6 Consequences of Maximum Credible Loss Scenarios Consequence Study

Major consequences that can be modelled include:

- Explosion of material in the Main Magazine (6.5 METRIC TONS explosives), Service Magazine (0.9 explosives) and ANFO mixing shed (0.1 METRIC TONS explosives)
- Explosion of material being transported in explosives van (2.585 METRIC TONS explosives).

Consequences of the above scenarios were modelled using the software HAMS-GPS (originally developed based on funding by the MoEF), which has a specific module on explosives (including ANFO based explosives). Outputs were as follows:

OUTPUTS

- Magazines and explosive storage areas:
- Main Magazine: Maximum fatality distance: 29.0 m, maximum injury distance: 32.0 m.
- Service Magazine: Maximum fatality distance: 13.8m, maximum injury distance: 13.8 m.
- ANFO mixing shed: Maximum fatality distance: 7.7m, maximum injury distance: 7.7 m.
- Explosive Transport Van:

- Maximum fatality distance : 22.9 m, maximum injury distance :22.9 m

7.7 Hazard Analysis

Broadly, the hazards cover explosive material management, working at heights, slope and bench stability, mineral transport, mineral processing and force majeure conditions (rainfall & flooding). The mechanisms due to which hazards (coming under Risk Levels 1 & 2) may actually occur are covered in **Table 7-5.**

Table 7-5 : Cause analysis for level 1 & level 2 hazards

S.No.	Hazard Description (Risk)	Risk Score	Risk Level	Cause Analysis
1	Travel in moving vehicle in uneven terrain	2	Level 3	• Poor visibility • Incompetent driver • Poorly maintained vehicles
2	Unintended explosions (exposure to overpressure)	15	Level 1	• Defective explosives • Outdated explosives • Improper storage of explosives • Force majeure conditions such as lightning strike • Fire (can be caused by unsafe practices or as ignition) • Sabotage
3	Unintended explosion or exposure (exposure to overpressure)	3	Level 3	• Defective explosives • Outdated explosives • Improper storage of explosives • Force majeure conditions such as lightning strike • Fire (can be caused by unsafe practices or as arson) • Sabotage
4	Hit by fly rock (bodily injuries)	2	Level 3	• Poor access control of blast area • Poor blasting practices (leading to excessive fly rock)
5	Rock falls or slide due to lack of bench face stability (bodily injuries)	15	Level 1	• Improper design of bench • Force Majeure (such as heavy floods or rainfall) • Improper blasting practices • Incompetent blasting personnel
6	Hit by Machineries – Electrical Equipment (bodily injuries)	9	Level 2	• Improper design of equipment • Improper maintenance • Non usage of required PPE. • Incompetent Personnel
7	Vehicle Accident (bodily	50	Level 1	• Head on collision between vehicle and another vehicle (due to poor visibility

	injuries)			or incompetent drivers) • Poor vehicle maintenance
8	Accidental 1fire in vehicle (bodily injuries, exposure to heat radiation)	5	Level 3	• Accident to vehicle carrying fuel, and subsequent ignition of spilt fuel • Improper storage of fuel, in MS drums, leading to spillage followed by ignition • Driving with loaded material on uneven terrain, and subsequent ignition of spilt fuel

7.8 Controls and Action Plans

To ensure that causes leading to the possible consequences are prevented from occurring, control and action plans are developed and suggested as described in **Table 7-6.** It is required that these control and action plans be implemented and reviewed at least annually and also when there are changes to the work plan.

Table 7-6 : Control & Action Plan

S.No	Hazard	Causes	Control	Relevant Legislation	Procedure	Existing Procedure (Y/N)	Responsible Person (Designation)
1	Unintended explosions (exposure to overpressure) during storage of explosives in magazines	Defective explosives	Explosive used should be purchased only from approved and licensed authority If deteriorated or unserviceable explosive is found, seek advice of licensing authority	Metalliferous Mines Regulation – 1961. & Explosive act, 1884	If any defective explosive is found, it is returned back to the original supplier for disposal at their end as per Rule 16 of The Explosive Rules 1983	Y	Authorized supplier of explosives
		Outdated explosives	Records and accounts of explosive stock and issue is to be maintained Stock should be drawn upon strict rotation Well planning for requirement of explosives shall be exercised Disposal of outdated explosives as the chief controller or controller of explosive may issue	Explosive act, 1884,MMR –1961.	Maintaining registers for Explosives receipt, issue and stock as per Reg. 154, 156 of MMR 1961.	Y	Mines Manager
		Improper storage of explosives	Detonator are to be stored separately Explosives shall be stored in dry and well ventilated area Protect explosives from extreme temperatures	Explosive act, 1884,	Explosives and Detonators are stored separately as per approved design & licensed capacity of magazine under Explosive act, 1884	Y	Mines Manager
		Force majeure conditions such as lightning strike	Lightning conductor are to be installed on the top of magazine Lightning conductor should not have resistance more than 10 ohms	The Explosive Rules 1983	Lightning arrestors are provided and maintained as per the requirement under Rule 116 the Explosive Rules 1983	Y	Mines Manager
		Fire (can be caused by unsafe practices or as arson)	Empty packages shall be removed immediately and destroyed. No smoking or any source of light or fire shall be allowed near explosives storage	The Explosive Rules1983 MMR - 1961	Follow the instructions Specified in Rule 154, 156and 170 of MMR – 1961 for storage, and handling of Explosives. Rule 97and 101 of the ER 1983	Y	Mines Manager, Mines Foreman (Blasting)
		Sabotage	Security shall be provided at the magazine	The Explosive Rules,1983,	Round the clock security guards provided and immediate reporting to	Y	Mines Manager

S.No	Hazard	Causes	Control	Relevant Legislation	Procedure	Existing Procedure (Y/N)	Responsible Person (Designation)
			Shortage and theft of explosive shall be reported to the nearest police station and the licensing authority		nearest Police Station and Licensing Authority done in case of thefts or sabotage as per Rule – 123 of ER 1983		
2	Rock falls or slide due to lack of bench face stability (bodily Injuries)	Improper design of bench	Proper catch bench design and proper blasting pattern reduces over break Maintain the width to height ratio as per DGMS	MMR-1961	Procedure for opencast working as per Reg. 106	Y	Mines Manager
		Force Majeure (such as heavy floods or rainfall)	Dewatering or culverting the storm water may reduces slides of bench	MMR-1961.	Following procedures as per Reg. 127 and 130 of MMR –1961 for Dewatering or and culverting the water	Y	Mines Manager
		Improper blasting practices	Good design of blasting network is important to reduce rock fall and slides of bench face	MMR-1961.	Procedure for opencast working as per Reg. 106	Y	Mines Manager
		Incompetent blasting personnel	Shot firer should have shot firer's permit granted under explosive rules	MMR - 1961	Appointment of Shot firer as provided in Reg. 160 of MMR 1961	Y	Mines Manager
3	Vehicle accident (bodily injuries)	Head on collision between vehicle and another vehicle (due to poor visibility or incompetent drivers)	Haul road should be sprinkled Regularly Driving at night shall be avoided Driver should be RTO licensed holder for driving vehicle	MMR – 1961 Motor Vehicle Act	Sprinkling of water in haul road as per Reg. 124 MMR 1961 and appointment of RTO licensed drivers	Y	Mines Manager
		Poor vehicle maintenance	Periodic servicing of vehicle Brakes and steering apparatus should be in good condition Headlight and tail light of the vehicle should be in good condition	MMR 1961	Procedure for Maintenance of Vehicles under Reg. 176 of MMR - 1961	Y	Mines Manager
4	Unintended explosion or	Poor access control of blast	Well planning is required before and after charging of blast holes.	MMR 1961	Procedure for drilling charging stemming and	Y	Mines Manager

S.No	Hazard	Causes	Control	Relevant Legislation	Procedure	Existing Procedure (Y/N)	Responsible Person (Designation)
	exposure to overpressure, charging blast holes	area	Blast sites should be secured and warning signs posted before loading boreholes.		firing of holes as per Reg.162		
		Incompetent blasting personnel	Shot firer should have shot firer's permit granted under explosive rules	MMR 1961	Appointment of Shot firer as per Reg. 160 as per MMR 1961	Y	Mines Manager
		Poor blasting practices	Tamping rod of wood must be used, iron or steel rods should not be used. No smoking or any source of light or fire shall be allowed near explosives storage. Before loading the blast hole blaster should check the driller log Blast sites should be secured and warning signs posted before loading boreholes.	MMR – 1961 - The Explosive Rules, 1983,	Procedure for drilling charging stemming and Firing of holes as per Reg. 161, Rule 14 of ER ISO procedure QSP-760-06	Y	Certified Blaster
		Defective explosives	Explosive used should be purchased only from approved and licensed authority only If deteriorated or unserviceable explosive is found, seek advice of licensing authority	The Explosive Rules, 1983	Explosive are purchased from Approved manufactured or authorized license holder from CCE.	Y	Mines Manager
		Outdated explosives	Stock should be drawn upon strict rotation	The Explosive Rules, 1983	Issue of explosives on first come first ISO procedure QSP-760-06	Y	Mines Manager
5	Hit by fly rock (bodily injuries) During blasting	Poor access control of blast area	Adequate blast area security must be provided. Blast sites should be secured and warning signs posted before loading boreholes. Post guards at the access points to prevent unauthorized entry	MMR – 1961	Procedure for tacking shelter etc. during drilling and blasting Reg. 164 of MMR 1961	Y	Mines Foreman (Blasting)
		Poor blasting	Burden, spacing, hole diameter,	DGMS/(Tech)Cir.No.	Procedure for drilling	Y	Certified Blaster

S.No	Hazard	Causes	Control	Relevant Legislation	Procedure	Existing Procedure (Y/N)	Responsible Person (Designation)
		practices (leading to excessive fly rock)	stemming, sub drilling, initiation system, and type of explosive used matched the characteristics of the rock formation. Adequate blasting Shelter must be used for the persons whose presence is required in blasting Nobody should be present within 300 m radius of blasting site as per DGMS circular except blasting personnel. Practice for controlled blasting Technique with milli-second delay detonators/ electric shock tubes/ cord relays. Training of persons and their helpers engaged in such blasting operation.	2 of 2003	andblasting, tacking shelteretc. as per Reg. 164 MMR1961, DGMS (SOMA)/(Tech) Cir.No.2 of 2003		(MMR)
6	Hit by Machineries – Electrical Equipment (bodily injuries)	Poor machinery Maintenance	Periodic servicing of machineries Periodic Inspection / Audit of Machineries and Structures Non Compliance to SOP	MMR 1961	Procedure laid under Section 174 Chapter XVI – Machinery and Plant of MMR 1961	Y	Mines Manager
		Poor Cabling / Earthling To Rotating Equipments	Periodic servicing of electrical instruments. Periodic Inspection / Audit of Electrical equipments – cables and accessories Non Compliance to SOP	Indian Electricity Rules 2003	Section VII – Works of Licensees of Indian Electricity Rules 2003	Y	Electrical In charge under Mines Rules 1951

7.9 Mine disaster Management plan

The Disaster Management Plan (DMP) is a guide, giving general considerations, directions, and procedures for handling emergencies likely to arise from planned operations. The DMP has been prepared for the TCL on the basis of the Risk Assessment and related findings covered in the report.

7.9.1 Disaster Management Plan: Structure

The Disaster Management Plan (DMP) is supposed to be a dynamic, changing, document focusing on continual improvement of emergency response planning and arrangements. A structure working on a Plan, Do, Check & Review (PDCR) cycle has been therefore suggested. Another advantage of doing this is to have a system that is in synchronicity with commonly used SHE systems such as ISO 14001 and OHSAS 18001.

The DMP is covered in further detail in the remaining sections of this Chapter.

7.9.2 Policy

The Safety Health and Environmental (SHE) policy is existing & accessible to all at site and to other stakeholders. The policy has been framed considering legislative compliance, stakeholder involvement, continual improvement, and management by objectives.

7.9.3 Planning

7.9.3.1 Identification and Prevention of Possible Emergency Situations

Possible emergency situations can broadly be classified into unintended explosions, vehicle collision, and inundation. Additional emergency situations can be developed on the basis of audit or other procedures prior to commencement of operations.

EMERGENCY PREVENTION

Some of the ways of preventing emergencies are as follows:

- Preparation of a Preventive Maintenance Schedule Programme and also covering maintenance schedules for all critical equipments and instruments as per recommendations of the manufacturers user manuals,
- Importantly, it is of great importance to collect and analyse information pertaining to minor incidents and accidents at the site, as well as for recording near-misses or emergencies that

were averted. This information gives an indication of how likely or unlikely it is for the site to face actual emergency and what shall be further action to prevent them from occurring.

- Establishment of an ongoing training and evaluation programme, incorporating the development of capabilities amongst employees about potential emergencies and ways and means of identifying and averting the same. Most emergencies do not occur without some incident or an abnormal situation. So there is always sometime of few seconds to few minutes to arrest an incident of abnormal situation from turning in to an emergency. This is the role of the shift in-charge who is the incident controller (IC) along with his shift team.

EMERGENCY PLAN OBJECTIVES

Specific objectives of the Emergency Response Plan are to be clearly listed with regards to the responses desired for successful management of the possible emergency situations. Suggested Objectives could include:

- To define and assess emergencies, including risk and environmental impact assessment.
- To control and contain incidents.
- To safeguard employees.
- To minimize damage to property or / and the environment.
- To inform employees, the general public and the authority on the hazards / risks assessed.
- Safeguard provided residual risk if any and the role to be played by them in the event of emergency.
- To inform authorities like Safety and Fire Dept. and Mutual Aid Centres to come up for help.
- For effective rescue and treatment of casualties and to count the injured.
- To identify and list fatal accidents if any.
- To secure the safe rehabilitation of affected areas and to restore normally.
- To provide authoritative information to the news media.
- To preserve records, equipments etc. and to organize investigation into the cause of the emergency and preventive measures to stop its recurrence.
- To ensure safety of staff and patients and resume work.

- To work out a plan with all provisions to handle emergencies and to provide for emergency
- Preparedness and the periodical rehearsal of the plan.

The objectives are suggested in emergency preparedness plan of TCL. Responsibilities, resources and timeframes require to be allocated for implementing the objectives.

7.9.4 Implementation

7.9.4.1 Allocation of Resources

Key Personnel are identified for carrying out specific and assigned duties in case of any kind of Emergency. All such key personnel shall be available on call on holidays and off duty also.

- Commander (Manager Quarries)
- Deputy commander (Personnel Officer)
- Site Incident Controller (Shift in charge)
- Deputy Incident Controller (Senior Mining Mate)
- Other key personnel
- Essential workers

RESPONSIBILITIES OF COMMANDER / DEPUTY COMMANDER

- To take charge at the place of incident.
- To activate the Emergency Preparedness Plan according to severity of situation.
- Inform all the employees and relatives of the affected employees.
- Call all key personnel and inform Doctor to be ready for treatment.
- Commander shall deploy staff carry out following functions -

✓ To coordinate and reinforce Emergency Combat at Site along with Site Incident Controller

✓ To liaise with other Departments and guide their personnel

✓ To supervise Assembly and Evacuation at all points

✓ To look after Patients who are bed ridden and any Casualties and give psychological support

- Activate Assembly and Evacuation Plan if required as per situation by ordering Site Incident Controller
- Inform and liaise with Chief Operating Officer, Police department and District Emergency Authority.
- Arrange for chronological records of emergency to be maintained.
- Issue authorized statements to News Media.
- Ensure that proper consideration is given for preservation of evidence and arrange for video shooting / photographs.
- Deputy Commander shall carry out the responsibilities of Commander in his absence and assist him in his duties when present.
- Assign Medicare and Emergency Management tasks to all persons of management cadre

RESPONSIBILITIES OF MINES FOREMAN

- To take immediate charge at the site of incident.
- Ensure that immediate steps as per Emergency Preparedness Plan are taken and direct the worker staff.
- Inform Commander, Deputy Commander and other key personnel's.
- Shall blow the Siren / Hooter as per situation to declare Emergency.
- Supervise assembly and evacuation as per plan, if required.
- Appoint more than one Deputy Incident Controller to take charge if emergency occurs at more than one place.
- Ensure that Commander has been alerted.
- Take decisions for controlling the emergency till arrival by Commander.
- Ensure that casualties are receiving adequate attention and medical care.
- Ensure accounting for personnel and rescue of missing persons.
- Control traffic movement in Quarry premises.
- When emergency is prolonged arrange for relief of rescue workers and catering facilities.
- Deputy Incident Controller shall take charge at site of emergency in the absence of Site Incident Controller.

- In the presence of same, he shall assist Site Incident Controller or take charge at another location, if emergency exists in more than one place.

RESPONSIBILITIES OF ESSENTIAL WORKERS

A task force of essential trained staff is made available to get work done by Incident Controllers. Such work shall include -

- Firefighting and spill control till fire brigade takes the charge.
- To help the fire brigade, if it is so required.
- Emergency engineering work e.g. isolating equipment, materials, urgent repairing or replacement, electrical work etc.
- Provision of emergency power, water, lighting, material, etc.
- Movement of equipment, special vehicle and transport to or from the scene of the incident.
- Search, evacuation, rescue and welfare. First - Aid and medical help.
- Manning of assembly points to record the arrival of evacuated personnel. Manning of outside shelters and welfare of evacuated persons there.
- Assistance at casualty's reception areas to record details of casualties.
- Assistance at communication Centre to handle outgoing and incoming calls and to act as messengers if necessary.
- Control of traffic at Quarry premises.

7.9.4.2 Setting up of Emergency Infrastructure

To enable the key persons to implement the DMP, the following infrastructure will require to be set up:

ASSEMBLY POINTS

In case of emergency the site needs to be evacuated immediately. On evacuation people will go to pre-assigned assembly points. The charge will be taken by shift in charge and in his absence person deployed by Commander will be in charge of respective assembly points and will supervise Assembly and Head Count. A Board indicating the Assembly Point having relevant information is placed at point for guidance.

LIAISON WITH STATE AUTHORITIES

Government authorities, local hospital, police fire services, taluka mamlatdar, district collector will be kept informed about the occurrence and development of any incident by Commander and procure necessary help and guidance from these authorities.

TASK FORCE OF ESSENTIAL STAFF

A task force of essential trained staff is made available to get work done by the Commander. Task Force personnel shall be trained to perform tasks as mentioned above.

EMERGENCY CONTROL CANTER

- Manager-Quarry Office will act as Emergency Control Center and provided with required communication facilities. The Control Center is situated in an area of minimum risk and close to the road to allow for ready access by a vehicle if other systems fail or extra communication facilities are needed to be set up. The Emergency control center should consist of following items:
- External telephones
- Internal telephones
- E-Mail facilities
- Emergency plan
- Stationeries
- Torches and emergency lights.

7.9.4.3 Fire Fighting

Person noticing the fire shall immediately raise alarm and ask the nearest person to inform Matron and Manager-Quarry.

Portable Fire Extinguisher shall be used in an attempt to extinguish the fire, by the person at site.

Matron shall assess the severity of fire and if likely to be severe shall take following steps -

- Call fire tenders and mobile trailer pump from nearby fire department.
- Call for assembly of all persons at assembly points
- Arrange for turning "OFF" main switch of electricity supply.

- Manager-Quarry shall review the steps taken by Matron in his capacity as COMMANDER and establish a "Control Room" in his office.

IMMEDIATE STEP IN CASE OF EXPLOSION:

- At first the concerned security guard should inform about it to the shift-in-charge and Mgr.-Quarry.
- They will take the precaution described in the Work Instruction.

FURTHER STEPS IN CASE OF FIRE SPREADING

Commander shall continuously assess the situation and if it is not being controlled then ensure:

- Assembly of all persons at the assembly points.
- Arrival of fire tenders and / or Mobile Trailer Pump.
- Ensure evacuation in orderly fashion.
- Ensure that any vehicle parked near the Fire Site is taken away to safe area.
- Carry out responsibilities as detailed as above.

7.9.4.4 Emergency Preparedness for Electrical Shock / Accident (Applicable in Case of Mechanized Sizing):

- Source of power should be put off immediately in case of any electrical shock.
- Injured person should be shifted to safe place.
- Persons engaged in rescuing operation should use all PPEs and take appropriate precaution while removing the injured persons.
- Trained persons are engaged to give first-aid treatment to injured persons.
- In case of major injury the injured is shifted to the Dispensary/Hospital.
- In case of electrical fire, only CO2 type Fire Extinguisher is used.
- Accident report in prescribed form is sent to appropriate authority in case of reportable injury.
- All the persons engaged to carry out this operation should be equipped with appropriate PPEs (Personal Protective Equipments) like safety shoes, helmets, dust masks etc.

7.9.4.5 Natural Disasters

Quarry being a single storey building, built on elevated base is structurally safe from effects of Natural Disasters. It affords shelter against cyclone and flood.

CYCLONE AND FLOOD

- When warning of cyclone or heavy rains is received from Local Administration, the Commander shall alert Staff to be prepared.
- Matron shall withdraw the entire person from work place and accumulate them in quarry building.
- All the equipment should be withdrawn from mine and kept in a higher site.
- The Quarry Manager may advise to leave the staff depending on security of situation.

EARTHQUAKE

- When earthquake hits, all persons shall be encouraged to run out in the open areas designated as Assembly Points.
- All the electrical supply should be disconnected by the electrical department.
- All key personnel shall reach Quarry immediately and carry out designated responsibilities
- All the electrical supply should be disconnected by the electrical department.
- Steps detailed in Emergency preparedness are to be carried out.
- As soon as earthquake tremor stops - Site Incident Controller (Matron) shall :
- Check all areas to ensure that all fires and doused.
- Check all areas for persons trapped inside.
- Search and Rescue Operation shall be launched with help of Workers, if there is obvious damage to building.

7.9.4.6 First Aid

Basic items in a first aid kit consist of items listed in **Table 7-7**.

Table 7-7: Suggested Items in First Aid Kit

S. No.	Description	Quantity
1.	First aid leaflet	1 copy
2.	Sterilized finger dressing	10 nos.
3.	Sterilized hand or foot dressing	10 nos.
4.	Sterilized body or large dressing	6 nos.
5.	Sterilized burns dressing - small	4 nos.
6.	Sterilized burns dressing - large	2 nos.
7.	Sterilized burns dressing – extra large	6 nos.
8.	Sterilized cotton wool (25 gm)	2 tubes
9.	Cetavolon (28 gm)	2 tubes
10.	Eye pads	6 nos.
11.	Adhesive plaster	1 spool
12.	Assorted roller bandage	6 nos.
13.	Triangular bandages	6 nos.
14.	Safety pins	6 nos.
15.	Scissors, ordinary, 12.7cms, both sides sharp	1 pair
16.	Savlon liquid, 150 ml, or equivalent	2 nos.
17.	Cotton wool for padding, 100 gm	2 packets
18.	Eye Ointment of sulphacetamide preparation	1 tube
19.	Loose woven gauze (28”x8”), compressed pack	1 packet
20.	Aspirin, 300 mg (10 tablets)	5 strips
21.	Scribbling Pad, 4”x 6” with a pencil in a plastic cover	1 no.
22.	Adhesive dressing strips	10 strips
23.	Field dressing of modified army pattern	3 nos.
24.	Record cards in a plastic cover	1 set
25.	Torch, medium size without cells	1 no.
26.	Eye wash	1 no.
27.	Wooden splints, small	1 set
28.	Wooden splints, big	1 set

7.9.4.7 Treatment of affected persons

1. Injured / Affected persons shall be provided suitable first-aid treatment and sent to Co.'s Doctor for further treatment depending on injury.
2. Patients requiring further treatment shall be sent in Ambulances to Hospitals in Porbandar.
3. Patients suffering from minor problems shall be discharged and sent home after preliminary treatment

7.9.4.8 Post Emergency Activities

Medical check-up: Medical check-up of affected persons if any and suitable medical aid shall be provided.

Collection of Records: Exact information shall be collected regarding cause of Emergency and remedial measures suggested preventing recurrence.

Inquiry: Detailed inquiry shall be carried out to find out cause which will be in the form of fact finding and recommendations made to suitable authority.

Insurance Claims (if any): Insurance claims for damage due to consequences of emergency shall be filed.

7.9.4.9 Mock Drill

Full scale mock drill shall be conducted at least once a year in coordination with Safety Department.

Manager-Quarry shall declare the emergency for mock drill and all persons concerned shall perform duties as per Responsibilities given in this Plan.

7.9.4.10 Training

Regular training of all concerned personnel will be conducted to enable the Staff to face any type of Emergency be it Natural Disasters, Fire in Equipment, Building or any explosion in quarry.

7.9.5 DMP Audit, Non Conformance and Corrective Action and Preventive Action

Since this DMP has been designed as a dynamic document, it is required that its performance be audited at regular intervals. Ideally, persons auditing the DMP should be external auditors (i.e. not employed at the site being audited). The audit should result in a set of findings that are put before the site management for review.

Audits will be periodic, at intervals that are decided by the Head Office. Audit reports shall state the exact non-compliance with the particular clause of this DMP, and should include steps to be taken to attain compliance, through corrective and preventive actions.

7.9.6 Review of Emergency Performance

The site / head office management will review the findings of the audit and the non-compliances. It will consider whether the DMP is providing adequate safety assurance to the management, delivering performance as desired, and whether it continues to be in the spirit of Environment, Health and Safety Policies, and changing requirements. On the basis of these, the management will record its decisions and consider modifying the DMP, as deemed appropriate.

7.10 Natural Resource Conservation

As far as possible, efforts shall be made to minimize the use of natural resources like fuel, mineral etc. A conservation strategy shall be followed according to which the use of energy will be minimized at all level of organization. All the machineries and equipments shall be properly maintained so as to reduce the green house gas emissions and to conserve the fuel & energy.

7.11 Rehabilitation & Resettlement

Mine lease area is existing mine lease granted by state government in 1986. This mine site is free from habitation and settlements; hence no rehabilitation & resettlement (R & R) Plan is required.

7.12 Corporate Social Responsibility

Central to the corporate philosophy of Tata Chemicals is its passionate commitment to the social development of the communities in which it operates. Improving the quality of life

and fostering sustainable and integrated development in the communities where it operates is central to Tata Chemicals' corporate philosophy.

This objective of social responsibility is equally well-entrenched in the minds of its employees, who play an active part in providing financial support and empowering rural communities to chart their own development.

Tata Chemicals Limited (TCL) set up the Tata Chemicals Society for Rural Development (TCSRD) in 1980 to promote its social objectives for the communities in and around, where its facilities are located.

The Society works to protect and nurture the rural populations in and around TCL's facilities, and helps people achieve self-sufficiency in natural resource management, livelihood support and the building of health and education infrastructure.

Tata Chemicals Society for Rural Development (TCSRD) – that works towards holistic community development, including managing water, land and other natural resources, encouraging enterprise development, and promoting health and education. TCSRD is on track to achieve its goal of impacting the lives of a million people by 2015.Broadly, the community development initiatives are divided into six thematic areas:

1. Natural resource management (NRM): this includes program on integrated water management; Agriculture development; land reclamation; animal husbandry program and pond management
2. Environmental care and conservation: this includes Dharti Ko Arpan program initiated by TCSRD
3. Empowerment: this includes formation of self-help groups,; saksham and volunteering program
4. Livelihood development: this includes vocational training; group based enterprise; rural entrepreneur development program and traditional handicraft promotion enterprise.
5. Health and Education: this includes Swasth Aagan project and other health awareness program. While in the education various initiatives are undertaken to enhance the education status in all the three locations.

6. Infrastructure development support: this includes various infrastructure support structure being provided to improve the standard of living of the rural communities in and around its plant sites

Company has well laid down policy for Community Development and Social Accountability. Policies are detailed as below:

Community Development Policy:

Tata Chemicals pledges itself to care for and serve the community by:

- Designing, evolving and implementing sustainable, replicable and scaleable development models, that leads to measurable socio-economic development of the community and ecological development in its area of influence
- Involving the community in all stages of the process, in the true spirit of participatory development
- Having focused and transparent processes, that provides for equal opportunity, while improving the quality of life
- Partnering and networking with government, development agencies, corporate bodies and NGOs to implement appropriate community development programs
- Creating knowledge resource centers to transfer and share information and help build capacities of partners and the community
- Involving the employees in volunteering for community Development programs

Social Accountability Policy:

It is our policy to conduct our business in a socially responsible manner by complying with all the requirements of SA 8000 standard

To that end we are committed to:

- Comply with applicable state, national and international legislations, ILO and UN conventions on ethical business.
- Continual improvement in our performance through management reviews, open communications and providing a favourable employment environment.
- Actively promote and encourage the pursuit of ethical excellence not only within the company but also amongst our suppliers and customers

"TCL is proposing to spend Rs. 25 lacs on CSR related activities in proximity of TCL mine leases in Village Aniali and Village Ranavav area during a period of five years". Details of proposed community development activities are summarised in **Table 7-8**.

Table 7-8 Details of Community Development Activities

#	CSR Activities	Area	Budget allocation in Rs.
1	Cattle camp development & cattle protection program –	Villages – Aniali, Daulatgarh, Ranabordi, wadvala and Ranavav	5 Lac
2	Creation of drinking Water facility and check dam for water harvesting – by creating 5 bore wells with submersible pumps and participating in check construction	Villages at Aniali, Daulatgarh, Ranabordi, Vadwala and Ranavav	10.00 Lac
3	Health & Medical camps for villagers -. 10 camps will be arranged	Villages Aniali, DaulatGarh, Ranabordi, Vadwala and Ranavav	5.00 Lac
4	Village Road maintenance and children education facility	For village roads in Aniali, Wadvala & Ranavav villages	5.00 Lac

CHAPTER – 8:
PROJECT BENEFITS

8 PROJECT BENEFITS

8.1 General

Various benefits are envisaged while planning for the mining of Limestone at village Aniali. This chapter gives a comprehensive description of various advantages and benefits anticipated from the proposed project to the locality, neighbourhood, region and nation as a whole.

Lime stone is very important chemical mineral and is the principal raw material for the production of soda ash and clinker for cement, etc. The need for mining of the chemical grade limestone from the project (mine lease area) has arisen to meet the current situation of demand supply gap faced by company,

Limestone Mining is a very important economic activity in Saurashtra region of Gujarat. Chemical Grade Limestone is mainly found in this region. This high purity lime stone is essential for soda ash manufacturing. For soda ash industry to remain competitive, availability of chemical grade lime stone in nearby area is extremely important. The Soda Ash based limestone mining industry contributes significantly to the State Gross Domestic Product and provides direct employment to about 7500 labourers. Additional jobs are created by way of transportation and related jobs, ancillary to mining. Subject mine lease aims to augment the limestone supply to TCL, Mithapur.

The products of TCL's Mithapur plant, especially soda ash, are a vital input for a number of basic industries such as glass, pulp and paper, chemicals and detergents, besides others. Consequently, this project aims at keeping many of the key industries within the country well supplied with an essential raw material.

At present, the company's annual requirement for chemical grade limestone is about 2.20 million tonnes (ROM), of which, 1.30 million tonnes are sourced from captive mines and the balance from domestic and overseas merchants. The gap between the annual demand and the quantity of RoM received from captive mines is substantial and thus the company intends to bridge this gap by winning limestone from the proposed project.

The proposed project is expected to bring down the imports.

8.2 Improvements in Physical Infrastructure

As it is captive limestone mine, it will have direct and indirect impacts to improve physical infrastructure in nearby community.

The project will improve the physical infrastructure of the adjoining areas. This will include the following:-

- Improved road communication;
- Strengthening of existing community facilities through the existing Community Development Programme;
- Mine pits will be converted into Rain water reservoir to augment the water availability for irrigation and plantation;
- Awareness program and community activities, like health camps, medical aids, family welfare programs, immunization camp sports & cultural activities, plantation etc.

8.3 Improvements in Social Infrastructure

The proposed project is expected to provide employment to local people in different activities such as Mining, sizing, transportation and plantation activities. The project activity will not have any major impact on the environment. At Post mining stage of proposed project, the existing waste land shall be converted to water harvesting bodies and green belts.

Also the company's Corporate Social Responsibility initiatives will have a positive impact on socio economic fabric of the region.

8.4 Employment Potential

The local labours shall be engaged for sizing of limestone and loading and handling of mineral in mining area, besides, watch and ward and plantation activity with proper maintenance. On assumption that one man on and average can size 1.5 tonnes of material per man-day. The total manpower required for material handling and loading works out to 150. Beside this, TCL Shall engage skilled and managerial staff to meet the statutory requirement under MMR 1961 and MCDR 1988. At present, the mine is not functional. The

following skilled / unskilled and semi-skilled workers besides managerial and administrative staff shall be employed at the time of re-opening of mine.

8.5 Tangible social benefits

There will be positive impact in socio-economic area due to increased economic activities, creation of new employment opportunities, infrastructural development and better educational and health facilities.

Health

Company will undertake awareness program and community activities like health, camps, medical aids, family welfare camps, AIDS awareness program etc.

Periodic medical check-ups as per Mines Act/ Rules and other social development and promotional activities will be undertaken. All this will assist to lift the general health status of the residents of the area around mines.

Plantation

A massive plantation has been done in the mine area so far and lot many are proposed to mitigate the ill-effects of mining and to improve the vicinity and environment of mine and it surrounding area. The management will give emphasis on plantation and will also motivate local persons for plantation during rainy season. This will also increase the consciousness in workers and near-by villagers for greenery. Fruit trees can contribute towards their financial gains.

8.6 Other Benefits

Apart from all the above mentioned benefits there will be other benefits to the region in terms of up gradation of lifestyle, overall area development etc.

CHAPTER – 9:
ENVIRONMENT MANAGEMENT PLAN

9 ENVIRONMENTAL MANAGEMENT PLAN

9.1 General

The environmental management plan consists of a set of mitigation, management, monitoring and institutional measures to be taken during implementation and operation of the project, to eliminate adverse environmental impacts or reduce them to acceptable levels. The present environmental management plan addresses, the components of environment, which are likely to be affected by the different operations in a Limestone mine.

The Objectives of EMP are:

- Overall conservation of environment.
- Minimization of waste generation and pollution.
- Judicious use of natural resources and water.
- Safety, welfare and good health of the work force and populace.
- Ensure effective operation of all control measures.
- Vigilance against probable disasters and accidents.
- Monitoring of cumulative and long term impacts.
- Ensure effective operation of all control measures.

9.2 Environment Management System

9.2.1 Policy

Company has a well laid down Safety Health and Environment Policy approved by its Board of Directors. The Policy prescribe for Comply with all applicable safety, health and environment laws and regulations

Safety, Health and Environment Policy

Tata Chemicals shall uphold its position as a leader in the chemical industry by conducting all its operations in a manner that is protective of the environment and health and safety of employees, customers and the community.

In fulfilment of this commitment, we shall maintain continuing efforts to:

- Comply with all applicable safety, health and environment laws and regulations.
- Enhance Safety, Health and Environment (SHE) awareness among employees and associated stakeholders through effective communication and training

- Investigate all workplace incidents and illness in order to promptly correct any unsafe conditions or practices.
- Integrate SHE considerations into business planning and decision making.
- Champion SHE responsibility among our employees in their practices, and promote and value their involvement in achieving the goals of this policy.
- Increase shareholder value through SHE excellence

9.2.2 Standard Operating Procedures

M/s TATA Chemicals Ltd. conforms to the standard operating procedures for legal and quality system. All sites in India are certified to ISO 9001 (Quality Management System), ISO 14001 (Environment Management System) & OSHAS 18001 (Occupational Safety & Health Assessment System).

9.2.3 Environment Cell

Company has well established Environmental Management System which is headed by General Manager- Safety, Health & Environment. Company has implemented online Legal Compliance management system with well-defined compliance owners. The system generates Email alerts for meeting compliances and has inbuilt escalation mechanism to keep the senior management informed on compliance updates. The details of Environmental Monitoring Cell are given in **Table 6-2**.

Hierarchical System for environmental compliance

TCL has instituted a system of periodic compliance reviews at all levels in the organization (from MD to the Geologist-in-charge & Assistant Manager Environment). Compliance with EC Conditions will be part of the compliance reviews. As per the **Figure 9-1,** the Managing Director is responsible for day to day management of the company. The Vice president manufacturing at Mithapur reports to Chief Operating Officer India chemical business who intern reports to Managing Director. The VP Manufacturing conducts a quarterly review of all environmental matters including related compliances. The General Manager mines and General Manager safety, health & Environment and report to the VP Manufacturing and are responsible for mining and environmental related compliances respectively.

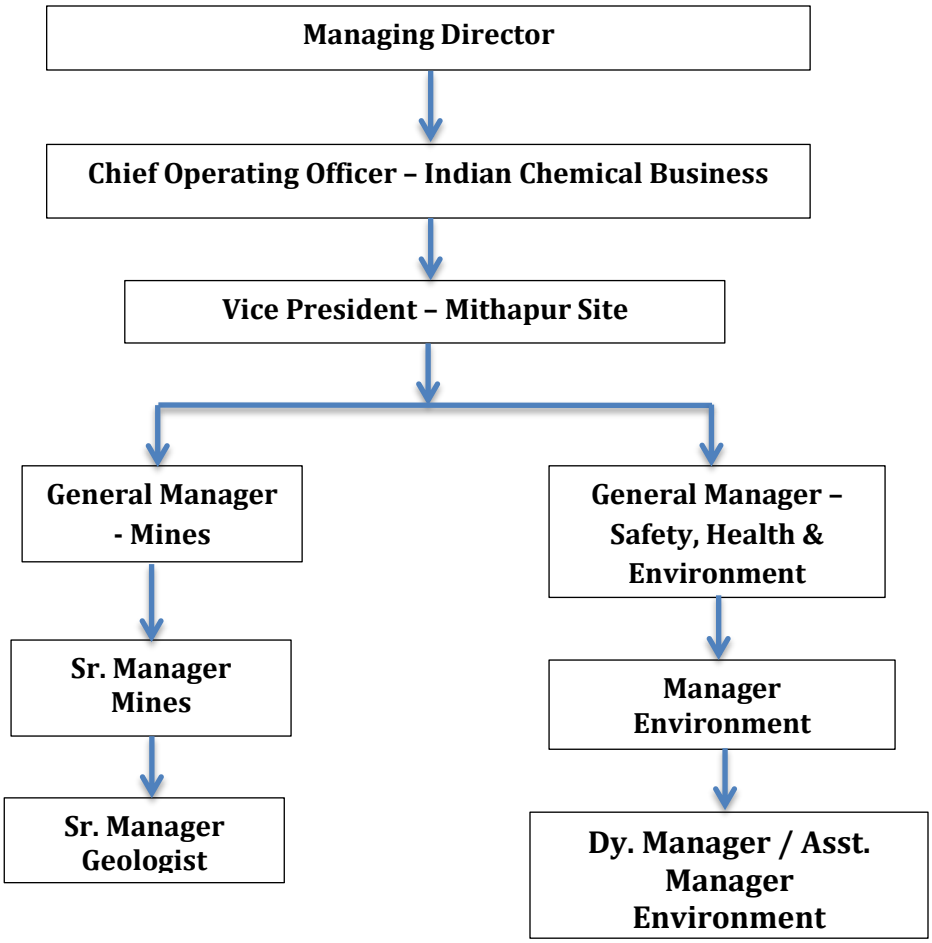


Figure 9-1 : Hierarchal System of Tata Chemicals Ltd, Mithapur

9.2.4 Public Reporting

Company publishes Corporate Governance Report as part of Annual Financial Reporting. The corporate governance philosophy of the Company has been strengthened with the adoption of the Tata Code of Conduct, Tata Business Excellence Model, and Code of Corporate Disclosure Policies. The Company, through its Board and Committees, endeavours to strike and deliver the highest governing standards for the benefit of its stakeholders. Audit committee of Board of Directors ensures Company's compliance with the legal and regulatory requirements and the Tata Code of Conduct (TCoC).

9.3 Proposed Environmental Management Plan

The environment management plan is prepared with a view to facilitate effective environmental management of the project, in general and implementation of the mitigation

measures in particular. The EMP provides a delivery mechanism to address potential adverse impacts and to introduce standards of good practice to be adopted for all project works. For each stage of the Programme, the EMP lists all the requirements to ensure effective mitigation of every potential biophysical and socio-economic impact identified in the EIA. For each impact or operation, which could otherwise give rise to impact, the following information is presented:

- A comprehensive listing of the mitigation measures (actions);
- The parameters that will be monitored to ensure effective implementation of the action;
- The timing for implementation of action to ensure the objectives of mitigation is fully met.

In order to minimize impacts of mining on different environmental parameters and to keep air and water quality within prescribed limits of CPCB, an Environmental Management Plan (EMP) has been prepared. This will help in resolving all environmental and ecological issues due to mining in the area. The environmental management plan includes all preventive as well as mitigation measures to minimize impact on environment along-with reclamation and rehabilitation measures form in and out land.

9.3.1 Air Pollution Management &Control

Potential Impact	Action	Parameters for Monitoring	Timing
Air Emissions	All equipments are operated within specified design parameters.	Random checks of equipment logs/ manuals	During site clearing & Operation of mine
	Vehicle trips to be minimized to the extent possible	Vehicle logs / Increase the capacity of vehicle	During site clearing, & Operation of mine
	Topsoil (if any) must be removed from the entire area to be mined and stored from where it can be recovered and utilized immediately in other areas.	Absence of stockpiles	During site clearing
	Ensure regular checks of vehicular pollution.	Pollution under control certificate of vehicle	During operation of mine.
	Covering of Vehicles transporting the mined mineral	No of Trucks with covering / Random checks of trucks on roads	During operation of mine.
	Plantation of dense hedges on the boundary of lease area, these will reduce dust and noise in the vicinity area.	No of Saplings per Year	During Each year from operations till closure as per approved mining plan

Potential Impact	Action	Parameters for Monitoring	Timing
	Use proper drill bits for drilling holes and wet drilling method.	Random check of equipment used for drilling	During blast hole drilling
	Regular water spraying shall be done	Quantity of water requirement shall be monitored	During site clearing, transportation etc.
	Ambient air quality within the premises of the proposed unit to be monitored.	The ambient air quality will conform to the standards for SPM, SO_2 and NO_X	As per GPCB requirement.

9.3.2 Noise and Vibrations Mitigation

Potential Impact	Action	Parameters for Monitoring	Timing
Noise	List of all noise generating machinery onsite along with age to be prepared. Equipment to be maintained in good working order.	Equipment logs, noise reading	During mining operation.
	Generation of vehicular noise	Maintenance records of vehicles	During transportation.
	Implement good working practices (equipment selection and siting) to minimize noise and also reduce its impacts on human health (ear muffs, safe distances and enclosures). Adopt good blasting practices to reduce impact on flora and fauna. Muffling will be done at the time of blasting	Site working practices records, noise reading	During blasting
	Noise to be monitored in ambient air near blasting shelter and at the lease boundaries.	Noise reading	As per GPCB requirement or quarterly whichever is earlier.
	The Noise level should not exceed the permissible limit both during day and night time.		
	All equipment operated within specified design parameters.	Random checks of equipment logs/ manuals	During mining operation
	Vehicle trips to be minimized to the extent possible	Vehicle logs	During mining operation

Potential Impact	Action	Parameters for Monitoring	Timing
	Plantation of dense hedges on the boundary of lease area, these will reduce dust and noise in the vicinity area.	No of Saplings per Year	During Each year from operations till closure as per approved mining plan
Ground Vibrations due to Blasting	Good blasting layout must be adopted Adopting less number of holes per delay	Vibrations to be modelled	At the time of blasting or based on the blasting data

9.3.3 Control of Noise, Vibration and fly rock during blasting

Following control measures shall be taken to reduce noise pollution due to mining activity.

1 Drilling will be done with sharp drill bits, which reduces generation of noise during drilling.

2 Controlled Blasting will be carried out to minimize noise generation.

3 Hydraulic Rock breaker will be used to avoid secondary blasting.

4 Blasting with optimum charge per hole and use of milli-second delay detonators reduces generation of noise.

5 In order to reduce the effect of noise pollution, earmuffs will be provided to all operators and employees working at mining site as a safety measure.

6 Proper maintenance, oiling and greasing of machines at regular intervals will be done to reduce generation of noise.

7 Periodical monitoring of noise level near vicinity of operating mining machines and at some locations in the surrounding area of mine working will be done with the help of sound level meter & records will be maintained.

8 Silencers and mufflers on mining equipment, wherever required, will be properly fitted and maintained.

9 Drilling &blasting parameters shall be optimized so as to cause the minimal vibration and fly rock.

10 Secondary blasting shall be avoided.

9.3.4 Water Management & Pollution Control

SURFACE WATER MANAGEMENT

There is no river stream, nallas or any other water body passing through the lease area. Two rivers namely Minsar & Bileshwari flow in the study area at distance of 5.60 Km NW & 4.86 Km NW respectively. During rains some natural drains may form in the area. For that, garland drains all along the quarry surface edge keeping a barrier from the mine surface will be constructed to arrest incoming water to and from the mine. Moreover the possibility of surface water contamination due to erosion and effluent from the mine is already stroked out as there is practically no soil and no waste will be produced from the mine. The surface run off during the rainy season will be prevented from entering into the active pits. This will be channelized to the mined out pit or proposed water reservoir via Garland drains.

GROUND WATER MANAGEMENT

The general ground level in the area is 67 mR.L. The water table in the area is 20m BGL (Below ground level) during pre-monsoon and 14 m BGL (Below ground level) during post-monsoon season. Water table will not be intersected during any stage of mine life. Hence contamination of ground water is ruled out.

DETAILS OF WATER CONSERVATION MEASURES PROPOSED

The rain water collected in the pits after spell of rain will be used for plantation and dust suppression. At the end of life of mine, excavated area will be used as a rain water pit.

DETAILS OF RAINWATER HARVESTING PROPOSED

Mined out pits area 13.13 ha will be used to harvest rainwater progressively. The area is shown in Conceptual plan attached as **Plate 8 of Annexure-XI.**

9.3.5 Land Reclamation and waste management

9.3.5.1 Land use planning and mine closure

The reclamation plan, post mine land use and progressive greenbelt development plan

As per Approved Mine plan Land use pattern for Pre-operational, Operational and Post-operational phases are given in Table 2-2.

A schematic diagram showing conceptual mine land use along with relevant cross-sections is attached as **Plate No 8 of Annexure-XI.**

9.3.6 Green belt development

Greenbelt development programme will be designed within the natural constraints of the site and in particular species selection reflects flora known to be resistant to the local conditions.

Greenbelt development is necessary for:

1. Landscaping and providing shelter
2. Improvement in site conditions
3. Surface air purification by providing oxygen and letting SPM to settle on the leaves.
4. To attenuate noise generation by movement of vehicles and other machinery.
5. To check soil erosion.

The following characteristics will be taken into consideration while selecting plant species for green belt development and tree plantation.

(i) They should be local indigenous and drought resistant species.

(ii) They should be fast growing and tall trees.

(iii) They should be perennial and evergreen.

(iv) They should have thick canopy cover.

(v) The planting should be in appropriate alternate rows around the site to prevent lateral pollution dispersion.

(vi) The trees should maintain regional ecological balance and conform to soil and hydrological conditions. Indigenous species should be preferred.

(vii) Species will be planted as per CPCB guidelines and native species.

9.3.6.1 A forestation programme:

The proposed mine lease area (core zone) falls under the land use of waste land and thereby no designated protected forest land existing within it. Therefore the proposed project activities will not have any impacts like loss of true forest habitat and associated floral and faunal diversity.

However, in order to compensate the loss of vegetation cover, it is proposed to carry out afforestation program mainly in mine lease area earmarked for plantation program as per mining plan approved by the Indian Bureau of Mines in different phases. This habitat improvement program would ensure the faunal species to re-colonies and improve the abundance status in the core zone.

The year-wise afforestation programme under the green belt (safety zone) and non-mineralized area for five years is given in **Table 4-13**:-

On the basis of the general principles mentioned and as per the CPCB guidelines for the development of Greenbelts following species are recommended:

OUTER PERIPHERY TREES

- *Azadirachta indica*
- *Ficus religiosa*
- *Samanea saman*
- *Tamarindus indica*

INNER PERIPHERY TREES

- *Balanites roxburghii*
- *Bougainvillea spectabilis*
- *Derris indica*
- *Ficus Benjaminalina*

- **MEDIUM SIZE TREES**

- *Phoenix sylvestris*
- *Sesbania grandiflorapers*
- *Mimusops hexandra*

SMALL SIZE SHRUBS

- *Acacia catechu.*
- *Accacia ferruginea*
- *Clerodandrum inermeis*
- *Callistemon citrinus*

9.3.6.2 Post plantation care

The post plantation care will be an important aspect to be taken care of for better survival rate of plantation. The following care will be taken:-

i. PROTECTION FROM GRAZING AND FIRE

Fencing will be provided around the area where mass plantation has been proposed.

This will help in preventing cattle from entering in to such area and will protect unauthorized entry of out-side person. Due care will be taken to protect plantation as well as the fencing by the guards.

ii. WATER IN DURING DRY SPELL

During dry spell, water will be sprinkled using water tanker provided with hose pipes.

iii. MANURING

Initially fertilizer/ manure will be given to the plants before and after plantation. Thereafter, manuring will be continued on reduced scale till the plant attains growth of 2 to 3 m height. Provision of utilizing bio-manure will also be made within the lease area.

iv. WEEDING AND SOIL WORKING

Man power will be engaged in mulching the soil frequently along with removal of weeds.

9.3.7 Solid waste management

As per approved mining plan the mineral limestone is exposed on the surface and stratified. There is no overburden to handle. The mineable area is devoid of top soil, hence, no proposals are made for top soil management but efforts shall be made to recover even thin layer of soil (incidental soil), it shall be scrapped in separate slice and kept preserved for utilisation in plantation work. There is no sub grade mineral to be separated hence no proposal for disposal of waste in mining plan are provided.

Potential Impact	Action	Parameters for Monitoring	Timing
Undersize limestone Man-agement	Undersized mineral sent to cement plant at Mithapur and nearby other cement plants.	Quantity of Limestone extracted. Quantity of Limestone used for soda ash plants Quantity of Limestone used for cement plants	During Transportation operation
Hazardous waste management	Hazardous waste (Used oil and oil containers) will be managed as per Hazardous Wastes (Management and Handling) Rules 2008, as amended till date	Quantity of oil used	During operation
Batteries of vehicles	Batteries will be managed as per Battery (Management & Handling) Rules; 2000.	Quantity of batteries used	During operation
Non-routine events and accidental releases	Plan to be drawn up, con-sidering likely emergen-cies and steps required to prevent/limit conse-quences.	Mock drills and records of the same	During blasting operation

9.3.8 Plan for reduction of Impact on Fauna

The impact on fauna species in the mining area is mostly due to noise vibration and loss of vegetation cover. The measures proposed to reduce the impact are discussed below and will be strictly followed.

- The blasting is to be carried out during day time only.
- The migrating routes of wild animals will not be disturbed and action should be taken as per the guideline of State Forest Department. This is also regulated under the Wildlife (Protection) Act, 1972.
- Mining operation will be restricted to day time only.

9.3.8.1 Wild life Conservation plan:

- TCL applied for wild life clearance as per requirement of MoEF Guidelines F No: 6-10/2011 WL dated 15th march 2011 superseded by guidelines dated December 19th 2010.
- A copy of wild life clearance application is enclosed as **Annexure – IX A**. This application has been scrutinized by DCF Porbandar and Chief Conservator of Forest Junagadh and requested for wild life conservation plan vide DCF Porbandar Letter No : B/JMN/133/12-13 dated 17.12.2012 (Annexure IX – B). TCL has submitted wild life conservation plan vide TCL letter No A/WG/0976/2012 dated December 24th 2012 (Annexure IX - C) with afforestation plan for subject mine lease as below.

Wild Life Conservation Plan :

The subject mine lease area is an existing mine lease due for renewal and it falls under the land use of Government waste land. Further, the mine lease boundary is 3.92 km from the boundary of Barda Wildlife Sanctuary and 0.11 km from the Naliyadhar Reserved forest.

A detailed study to assess the potential impacts due to proposed project activities on sanctuary and other forest areas was conducted by Gujarat Institute of Desert Ecology; Bhuj during 2009. The study concludes that:

1. The proposed mine lease is a waste land, located in the eastern side of Barda Wildlife sanctuary.

2. The sanctuary is predominated by hilly terrain and isolated by agriculture and human habitations not connected with any other protected area and large extent of reserved forest through forest corridor.
3. The nearest reserved forests to the Barda Wildlife Sanctuary are located only in the eastern side and far from the sanctuary and they were also isolated by agriculture habitats, villages, roads and ephemerals rivers.
4. Only common species were found outside the sanctuary specifically in the agricultural habitats and waste lands with scrub vegetation.
5. These common species also do not show any specific spatial and temporal movement pattern with larger herds, due to wider availability of agriculture habitat around the sanctuary which they preferred to use.

It can be concluded that due to the above discussed ecological and environmental setup of the Barda Sanctuary and the area in and around, the proposed mining activity will not have any impact on the wildlife of the sanctuary. At Post mining stage of proposed project, the existing waste land shall be converted to water harvesting bodies and green belts. Mitigation - Environmental Management Plan of flora fauna in study area of subject mine lease (10 km surrounding of mine lease boundary) is part of the above study report.

Afforestation programme:

The proposed mine lease area (core zone) falls under the land use of waste land and thereby no designated protected forest land existing within it. Therefore the proposed project activities will not have any impacts like loss of true forest habitat and associated floral and faunal diversity.

However, in order to compensate the loss of vegetation cover, it is proposed to carry out afforestation program mainly in mine lease area earmarked for plantation program as per mining plan approved by the Indian Bureau of Mines in different phases. This habitat improvement program would ensure the faunal species to re-colonies and improve the abundance status in the core zone.

The year-wise afforestation programme under the green belt (safety zone) and non-mineralized area will be as under:-

Year	No. of Plants	Area (Ha)
1st	100	0.1
2nd	100	0.1
3rd	100	0.1
4th	100	0.1
5th	100	0.1

TCL has also submitted additional information vide TCL Letter No : A/WG/0165/2013 dated February 25th 2013 (Annexure IX – D) as requested by forest department as follows.

- Proposed mining lease is existing limestone lease granted by state Government in year 1964. The lease area is government waste land. The mine lease was operated during 1985 to 1994 and the lease is idle after 1994. No forest land is involved. The nearest distance of Barda Wild life Sanctuary from mine lease boundary is 3.92 Km.

- TCL has appointed Gujarat Institute of Desert Ecology, Bhuj to conduct Biodiversity study (Flora and Fauna status, Impact on Sanctuary and Wild Life Assessment) in 10 km surrounding area from mine lease boundary. The study report concluded that:

  a. Proposed mining activity will not have any impact on the WL sanctuary.

  b. At post mining stage of proposed project, the existing mined out area shall be converted to: 1. Water harvesting bodies in the deeper portion & 2. Green belts in shallow area. This will improve ecological balance and ground water table in nearby area.

- Environmental management plan for proposed mining activity will include:
  a. Plantation/ grass plot development to improve vegetation cover and biodiversity.
  b. Creation of mining pits for rain water harvesting.
  c. Water spray system to control fugitive dust emissions.
  d. Machinery/ vehicle preventive maintenance & regular checkups.
  e. Controlled blasting methods.
  f. Maintenance of road conditions.
  g. Covering of all loaded vehicles, visual display of sufficient traffic signs.

- The proposed project is expected to provide employment to local people in different activities such as Mining, sizing, transportation and plantation activities.

- In line with the company's Corporate Social Responsibility Activities at other operational sites, relevant developmental assistance shall be rendered depending on the local needs identified through studies.

- Tata Chemicals is committed to a sustainable way of doing business. With its vision of serving society through science , The Company's developmental initiatives are divided into four inter-related components:

a) Natural resource management which encompasses integrated water management program Agriculture development program, pond management and animal husbandry program.
b) Environmental conservation and care program encompassing rural energy and biodiversity reserve plantation project.
c) Income generating program focuses on micro -enterprise development , aimed at Building capacities through extensive training.
d) Health , Education and Infrastructure Program

- TCL expects to spend a very significant sum of money over the first five years of mines operation on afforestation of mined out areas

- TCL is proposing to spend an additional sum of Rs 10 (Ten) lakhs (in consultation with local forest authorities) on wild life conservation in Barda Sanctuary.

9.3.9 Occupational Safety and Health

The working conditions in the mines are governed by the enactments of the Director General of Mines Safety (DGMS). As per the guidelines of the Mines Act, the management will take all necessary precautions. Normal sanitary facilities will be provided within the lease area. The management will carry out periodic health check-up of workers.

Occupational hazards involved in mines are related to dust pollution, noise pollution, blasting and injuries from equipments and fall from high places. DGMS has given necessary guidelines for safety against these occupational hazards. The management will strictly follow these guidelines.

All necessary first aid and medical facilities will be provided to the workers. The mine will be well equipped with proper fire protection and firefighting equipment. All operators and mechanics will be trained to handle fire-fighting equipments. Further all the necessary protective equipments such as helmets, safety goggles, earplugs, earmuffs, etc. will be provided to persons working in mines as per Mines Rules, 1955.

Initial & periodical examination will be conducted as prescribed in "FROM – O" for every employee as per rule 29B of Mines Rule – 1955. Details of tests are given in the form. Initial medical examination will be carried out prior to employment of every person and periodical medical examination will be carried out of persons employed in the mine once in a five years. Provided that in case any dust related disease need to be confirmed, the pertaining tests may be conducted more frequently as the examining authority deems necessary.

9.4 Socio-Economic conditions of the region

Implementation of the Aniali Limestone Mine project will generate both direct and indirect employment. Besides, it will provide a check on existing system of mining operation. Mining operation will be legally valid and it will bring income to the state exchequer. The project will also provide impetus to industrialization of the area. At present agriculture is the main occupation of the people as more than half of the population depends on it. With the implementation of the proposed mining project the occupational pattern of the people in the area will change making more people engaged in mining based activities rather in agriculture. Thus there will be a gradual shifting of population from agriculture to mining and related activities.

9.4.1 Community Development Activities

Tata Chemicals has set up a non-governmental organization – Tata Chemicals Society for Rural Development (TCSRD) – that works towards holistic community development, including managing water, land and other natural resources, encouraging enterprise development, and promoting health and education. TCSRD is on track to achieve its goal of impacting the lives of a million people by 2015. Broadly, the community development initiatives are divided into six thematic areas:

1. Natural resource management (NRM): this includes program on integrated water management; Agriculture development; land reclamation; animal husbandry program and pond management
2. Environmental care and conservation: this includes Dharti Ko Arpan program initiated by TCSRD
3. Empowerment: this includes formation of self-help groups,; Saksham and volunteering program
4. Livelihood development: this includes vocational training; group based enterprise; rural entrepreneur development program and traditional handicraft promotion enterprise.
5. Health and Education: this includes SwasthAagan project and other health awareness program. While in the education various initiatives are undertaken to enhance the education status in all the three locations.
6. Infrastructure development support: this includes various infrastructure support structure being provided to improve the standard of living of the rural communities in and around its plant sites
7. Company has well laid down policy for Community Development and Social Accountability. Policies are detailed as below:

COMMUNITY DEVELOPMENT POLICY

Tata Chemicals pledges itself to care for and serve the community by:

- Designing, evolving and implementing sustainable, replicable and scaleable development models, that leads to measurable socio-economic development of the community and ecological development in its area of influence
- Involving the community in all stages of the process, in the true spirit of participatory development
- Having focused and transparent processes, that provides for equal opportunity, while improving the quality of life
- Partnering and networking with government, development agencies, corporate bodies and NGOs to implement appropriate community development programs
- Creating knowledge resource centres to transfer and share information and help build capacities of partners and the community
- Involving the employees in volunteering for community Development programs

SOCIAL ACCOUNTABILITY POLICY

It is our policy to conduct our business in a socially responsible manner by complying with all the requirements of SA 8000 standard

To that end we are committed to:

- Comply with applicable state, national and international legislations, ILO and UN conventions on ethical business.
- Continual improvement in our performance through management reviews, open communications and providing a favourable employment environment.
- Actively promote and encourage the pursuit of ethical excellence not only within the company but also amongst our suppliers and customers

DHARTI KO AARPAN (ENVIRONMENT CONSERVATION) PROGRAM

TCSRD has been involved in various environmental conservation activities such as Save Whale Shark, Coral Reef restoration, Mangroves plantation. TCSRD seeks to continue with these initiatives, but more under the umbrella of creating sustainability for the entire coastal ecosystem in the region. It recognizes the need to develop and implement an integrated coastal zone management approach for the area as a whole, involving various stakeholders, including Government departments with whom they are already cooperating at a more substantive level and institutions of excellence like Wild Life Trust of India, International Union for Conservation of Nature etc. For this reason, the "*Dharti Ko Aarpan*" (Giving back to Mother Earth) program was launched in 2008, with the objective to integrate all ongoing and planned efforts into one program so that awareness, conservation efforts and greening link up to provide multiple benefits.

The major initiatives taken under "Dharti Ko Aarpan" program are:

<table>
<tr><td> </td><td> </td></tr>
<tr><td>Coral Reef Restoration Project</td><td>Save the Whale Shark Project</td></tr>
<tr><td> </td><td> </td></tr>
<tr><td>Biodiversity Reserve Plantation</td><td>Conservation of Lion Project</td></tr>
<tr><td> </td><td> </td></tr>
<tr><td>Nesting sites for waterfowl</td><td>Regeneration of mangroves</td></tr>
<tr><td> </td><td> </td></tr>
<tr><td colspan="2">Greening of Alkaline solids- Sedimentation Basins</td></tr>
</table>

COMMUNITY DEVELOPMENT AND GREEN BELT DEVELOPMENT ACTIVITIES IN NEARBY AREAS OF PROPOSED PROJECT SITE

Table 9-1 : Details of community development work in the region from 2006 to 2013

Year	Village	Details of CSR
2006-07	Pachhtar	Cattle shed, C.C. Road
	Pachhtardi	Cattle shed, grass godown room, C.C. Road
	Ranpur	Cattle shed, stand post, water trunk, grass godown room
	Rozda	Cattle Shed
	Gadu	Repair of Check Dam
2007-08	Ishwarya	Medical camp and blood donation camp Computer room construction at village school Cattle shed, grass godown room
	Adityana	Assistance in Pulse Polio Camp
2008-09	Mokhana	Medical Camp
	Pachhtardi	Medical Camp
	Adityana	Assistance in Pulse Polio Camp
2009-10	Adityana	Assistance in Pulse Polio Camp
	Devda	Filling of low laying area
2010-11	Chorwad	Participation in Save Whale Shark Campaign
	Adityana	Assistance in Pulse Polio Camp
	Porbandar	Assistance in GaribKalyanMailo
	Ishwariya	Earth Day Celebration and World Environment day celebration with community and school children participation
	Ranpar	Medical Camp
	Ishwariya	Medical Camp
2011-12		Assistance in Pulse Polio Camp
	Ishwaria and Adityana	Earth Day Celebration and World Environment day celebration with community and school children participation
	Sutrapada	Participation in Save Whale Shark Campaign
2012-13	Porbandar	Developing green belt at Collector's Office premise
	Adityana	Assistance in Pulse Polio Camp
	Ishwariya	Earth Day Celebration and World Environment day celebration with community and school children participation

The major initiatives taken in existing mining areas of TCL are:

<table>
<tr><td colspan="3"> </td></tr>
<tr><td colspan="3">Greenbelt development in 70 Ha Area</td></tr>
<tr><td colspan="3"> </td></tr>
<tr><td colspan="3">Award received during Environment Week Regeneration of mangroves</td></tr>
<tr><td colspan="2"> </td><td> </td></tr>
<tr><td colspan="2">Medical Camp activities</td><td>Water reservoir in TCL Adityana mined out area</td></tr>
</table>

PUBLIC HEALTH IMPLICATION OF THE PROJECT AND RELATED ACTIVITIES FOR THE POPULATION

As already indicated earlier, there is no habitation within the mining lease area. Mining activities will be away and will not progress closure to the nearest human habitation. However following remedial measures are proposed to be undertaken:

1. Regular water sprays,
2. Scheduled maintenance of machineries
3. Covered transportation of vehicles
4. Green belt / plantation as a green barrier will be carried out to protect the village habitation from the dust pollution

5. Regular medical check-up / eye-camps will be organized for the villagers. Allocation of funds towards public health has been indicated in the CSR activities of Chapter-7.
6. No site specific ailments have been detected so far affecting the health of persons/ public.

MEASURES OF SOCIO ECONOMIC SIGNIFICANCE AND INFLUENCE TO THE LOCAL COMMUNITY PROPOSED

1. The existing project will provide job opportunities to 150 local workers directly employed for mining work earning wages as per the minimum wages act applicable for un-skilled, semi-skilled and highly skilled categories.
2. Training of employed workers to improve their skills for safe workings.
3. Free medical camp will be organized for the villagers.
4. Applicant will co-operate with the Govt. for the development of the area, nearby schools and basic amenities.

9.5 Cost of Environment Control Measures

As a part of its responsibility towards protection of environment, project proponent has allocated budget for Environment protection measures. The same is detailed in **Table 9-2**.

Table 9-2 : Proposed Cost of Environment Management

Particulars	Approximate recurring cost per annum (Rs. in lacs)	Approximate Capital cost (Rs. In lacs)	Basis for cost estimates
Air pollution monitoring	2	-	As in mining lease there are no any stacks hence capital cost is nil. Re-curring cost would include cost of monitoring of ambient air environment at 5 locations in the mining lease season wise
Water pollution control	0.75	-	There are no treatment plants so capital cost for water pollution control is nil. While TCL will be monitoring tube well samples of 5 villages in each season.
Noise pollution control	0.1	-	Recurring cost includes monitoring cost of noise measurement at different lo-cations.
Environment monitoring and management	1.0	-	The recurring cost would be incurred on hiring of consultants and payment of various statutory fees to regulatory agencies.
Green belt	0.5	1.5	Capital cost includes tree plantation cost and hedges on the boundary. And recurring cost includes cost of wire fencing and cost of post plantation care.
Total	**4.35**	**1.5**	

CHAPTER – 10:
SUMMARY & CONCLUSION

10SUMMARY AND CONCLUSION

10.1 PROJECT DESCRIPTION

10.1.1 Introduction

The proposed project is for mining of limestone at village Aniali, taluka – Ranavav, District Porbandar, Gujarat, categorized under category "B" 1 (a) (mining lease area <50 hectare) - {Mining of Minerals} as the lease area is 16.21 ha. However due to the presence of Barda Wildlife Sanctuary within 10 km radius of the mine lease area , the project is categorized as Category "A" and will be considered at MoEF, New Delhi.

The Project aims to augment supply of limestone to TCL's Mithapur plant, as part of TCL's business requirements of maintaining adequate availability of soda ash for its customers.

The production rate of the mine will be 0.088 Million Tons Per Annum (MTPA) as per Mining plan approved by IBM. The lease area is 16.21 ha which comprises totally of Govt. waste land. The mineable reserves are 0.444 Million Tonnes. The expected life of the mine is 6 years. Limestone produced will be transported to the Mithapur chemical complex by road.

10.1.2 Project Importance

The products of TCL's Mithapur plant, especially soda ash, are a vital input for a number of basic industries such as glass, pulp and paper, chemicals and detergents, besides others. Consequently, this project aims at keeping many of the key industries within the country well supplied with an essential raw material. Cement, another product of TCL, also dependent on limestone inputs, is a key input to the infrastructure development of India.

10.1.3 Regulatory Compliance

- ✓ The original lease deed was granted vide grant order no 1563/15740/-G-V-dated 12.06.1964 and same was executed on 31.10.1964 for a period of 20 years.
- ✓ The First renewal was executed on 21.07.1987 vide letter MCR-1583(T-4) GOI-184-CHH dated 09.09.1986 for 20 years.
- ✓ The TCL has applied for 2nd renewal vide letter No A/WG/2558/ 2003 dated 21.10.2003 for 20 years and the lease renewal is pending with the Gujarat Govt.

- ✓ Mine Lease was in operation during 1985-86 to 1993-94 with highest production of 55,065 tons during 1987-88.
- ✓ Mine is Idle (not in operation) since 1994-95. No mining carried out after EIA Notification 1994.
- ✓ Application for wildlife clearance has been applied vide letter no. A/WG/0118/2012 dated 09.02.2012.
- ✓ Approved Scheme of Mining with progressive mine closure plan by Indian Bureau of Mines vide letter No. 682(23) MS 473/2008-MCCM (N) UDP; dated 21.10.2008.
- ✓ Approved Mining plan along with progressive mine closure plan by Indian Bureau of Mines vide letter No. 682(23) MP 473/2008-MCCM (N) UDP; dated 01.04.2014.
- ✓ Mining related information has been updated in EIA Report as per latest approved Mining Plan approved by IBM letter no 682(23)MP473/2008 – MCCM (N) UDP dated 01-04-2014.
- ✓ TCL has applied for fresh Environmental Clearance to MoEF First Time for Aniali 16.21 Ha. Lease.

10.1.4 Environmental Setting of the project in study area (10 Km)

Particulars	Details
Location	Aniali Limestone Mining Lease
Village	Aniali
Taluka	Ranavav
District	Porbandar
State	Gujarat
Latitude	As per **Table 1-2**
Longitude	As per **Table 1-2**
Total Mine Lease area	16.21Hectare
Elevation	73 – 61 M.RL
Land use of the lease area	Govt. Waste land – 16.21Ha
Nearest Habitation	Aniali Village
Nearest Highway	SH-27&NH – 8B
Nearest Railway station	Sakhpur
Nearest Airport	Porbandar
Nearest educational institutions	Ranavav

Nearest Medical facilities	Ranavav
Nearest place of worship	Ranavav
Nearest communication & post-office	Ranavav
Tourist places	None
Archaeological Features	None
Defence installation	None
Reserved/ Protected Forests	Nearest reserve forest is Naliyadhar reserve forest which is located at 0.11 km in South west direction
Protected Area	Barda wildlife sanctuary (Notified by Government of Gujarat) is located at 3.92 km from site in north west direction.
Water bodies	Minsar River (Distance5.60 KM) Bileshwari River (Distance 4.86 KM)
Other Industries	Limestone Mine leases of Tata Chemicals and other leases belongs to different owners
Seismic Zone	Seismic Zone –III
Water Demand & Supply	30 KLD from Ground water source

10.1.5 Project Nature, Size & Location

The mining lease of Limestone mine is categorized as Government waste land. State Government has granted the Lease for mining of Limestone. The production rate of the mine will be 0.088 Million Tons Per Annum (MTPA) as per Mining plan approved by IBM.

The mine is situated near in survey No. 207/part, Village Aniali, Taluka- Ranavav of Porbandar District (Gujarat). The geographical location of the lease area is as under:-

Pillar No	Latitude	Longitude
1	21^0 42’ 20.15”	69^{0}49’38.56”
2	21^0 42’ 17.62”	69^{0}49’31.80”
3	21^0 42’ 23.13”	69^{0}49’29.44”
4	21^0 42’ 21.73”	69^{0}49’25.69”
5	21^0 42’ 19.84”	69^{0}49’26.50”

6	21⁰ 42' 18.43"	69⁰49'22.72"
7	21⁰ 42' 27.06"	69⁰49'19.01"
8	21⁰ 42' 35.11"	69⁰49'40.53"
9	21⁰ 42' 32.82"	69⁰49'41.52"
10	21⁰ 42' 30.11"	69⁰49'34.29"

The lease area is a government wasteland and part of Survey No. 207/P, which falls under the revenue limit of Aniali village. There is no reserve forest or protected forestland within the lease area. There is no village or hutment within the lease area. Existing land use pattern is given in Table below:

Present land use pattern of the lease area

Particulars	Aniali16.21 Ha Mine (Area in Ha)		
	Preoperational phase	Operational Phase (after mining plan period)	Post Mining (Conceptual phase) at the end of Mine Life
Pits	9.544	13.08	13.13*
Roads / Building	0.49	0.32	0
Plantation	0.02	0.52	0.86
Remaining Virgin area	6.156	2.29	2.22
Total area	**16.21**	**16.21**	**16.21**

***** 3.51 Ha remaining mine out and 9.62 Ha reclaimed.

10.1.6 Mineral Reserves, proposed rate of production & life of mine

The category and grade wise updated recoverable reserves as per approved Mining Plan are as given under:-

Estimated Reserves (Million Tonnes)

Category	UNFC Code	Quantity in Million MT.
Total Mineral Resources (A+B)		1.0176
C. Mineral Reserve		
3. Proved Mineral Reserves	111	0.4439
4. Probable Mineral Reserves	121 & 122	-
D. Remaining Resource		
7. Feasibility Mineral Resource	211	0.0598
8. Pre-Feasibility Mineral Resource	221 & 222	-
9. Measured Mineral Resource	331	0.5139
10. Indicated Mineral Resource	332	-

11. Inferred Mineral Resource	333	-
12. Inferred Mineral Resource	334	-

10.1.7 Proposed rate of production and expected life of mine

The proposed rate of production for the next five years as per the approved mine plan is given as under:

Proposed rate of production in Million Tonnes per Annum

Year / Production Million Tons	First Year	Second Year	Third Year	Fourth Year	Fifth Year
Chemical & Inferior grade Total Production (ROM)	**0.087**	**0.087**	**0.088**	**0.087**	**0.084**

Estimation of Mine life

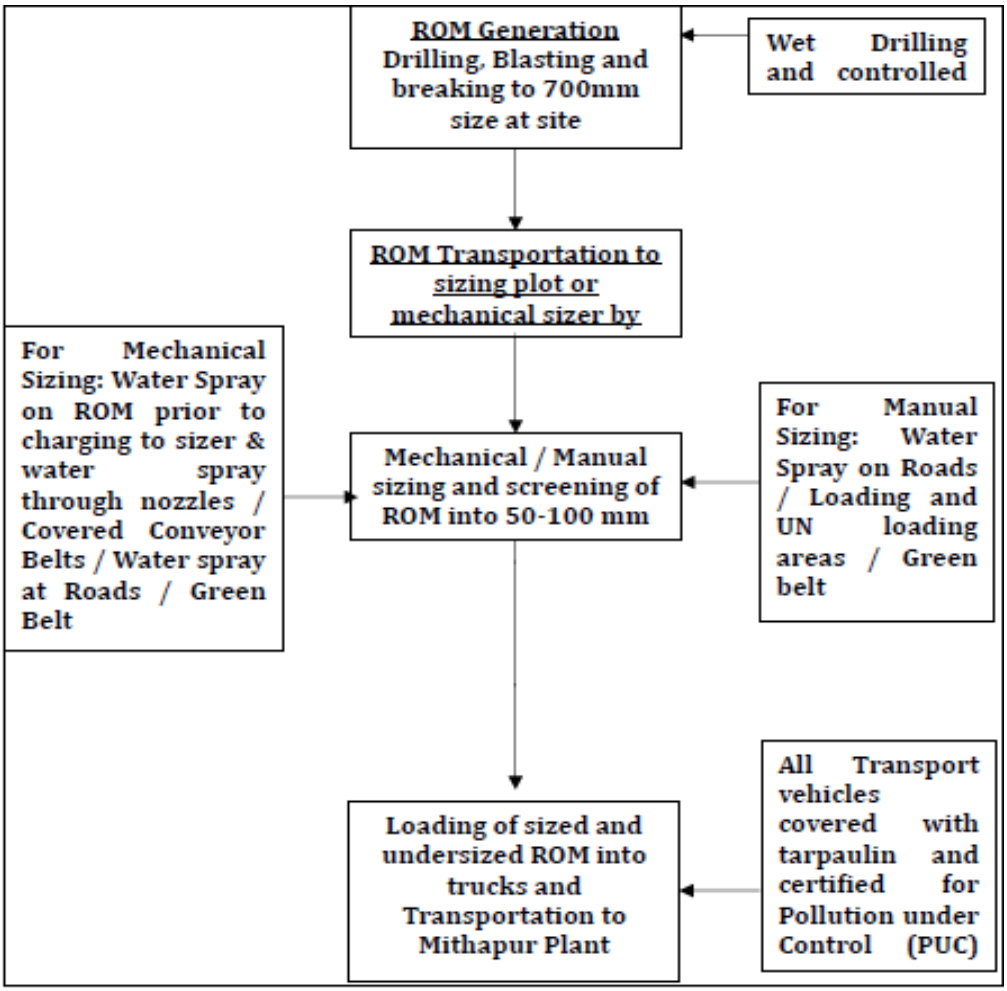
S.No	Particulars	Details
1..	Net Mineable Reserves	0.444 million tones
2.	Mineral to be mined during mining plan period	0.361 million tones
3.	Remaining reserves at the end of plan period	0.083 million tones
4.	Rate of production per year	0.077million tones
5.	Life of mine at the end of plan period	1 Years
6.	Total life of mine	6 years

10.1.8 Method of Mining

Primary mining is done by conventional drilling & blasting (using explosives) as per the guidelines of Directorate General of Mines Safety, Dhanbad as well as Indian Bureau of Mines, Udaipur.

Blasted material (ROM) is loaded into tippers and shifted to a nearby sizing yard outside the leasehold area where sizing of limestone is done manually using contract labourers. Alternately in the event of Labourer shortage, a mobile sizer & screening equipment will be deployed at Aniali 21.04 Ha Mine lease for sizing and screening of limestone. Method of Mining along with the pollution control measures is given as follows:

Mining process flow diagram with Pollution Control Measures: -



10.1.8.1 Sizing:

Boulders are broken into sized Limestone manually employing contractual Labourers. However in case of labour shortage/ crisis, sizing will be done in a Mobile Sizer & screening unit at Aniali 21.04 Ha Lease.

10.1.8.2 Mineral Beneficiation:

Except manual/ mechanized sizing and sorting of the Limestone, no other processing is proposed for the ROM Limestone at the mines.

10.1.8.3 Transportation:

Sized Limestone is transported by trucks to Mithapur Soda-Ash & Cement Plants of Tata Chemicals Limited. Under size limestone left after sizing will be stacked temporarily at mined out area and will be dispatched to Mithapur Cement plant as and when required.

10.1.8.4 Solid waste management

As per approved mining plan the mineral limestone is exposed on the surface and stratified. There is no overburden to handle. The mineable area is devoid of top soil, hence, no proposals are made for top soil management but efforts shall be made to recover even thin layer of soil (incidental soil), it shall be scrapped in separate slice and kept preserved for utilisation in plantation work. There is no sub grade mineral to be separated hence no proposal for disposal of waste in mining plan are provided.

10.1.8.5 Proposed Mechanization

The heavy earth moving machinery at present available at Adityana mining lease is given in Table below. This machinery will be shifted to Aniali 16.21 Ha mining leases.

Mining Machinery Details

S. No.	Machinery	Quantity
1.	Wagon drill	1
2.	Compressor	1
3.	Front End Loader	1
4.	Excavator	2
5.	Tippers	7

10.1.8.6 Employment Potential

The local labours shall be engaged for sizing of limestone and loading and handling of mineral in mining area, besides, watch and ward and plantation activity with proper maintenance. On assumption that one man on and average can size 1.5 tonnes of material per man-day. The total manpower required for material handling and loading works out to 150. Beside this, TCL shall engage skilled and managerial staff to meet the statutory requirement under MMR 1961 and MCDR 1988. At present, the mine is not functional. The following skilled / unskilled and semi-skilled workers besides managerial and administrative staff shall be employed at the time of re-opening of mine.

Employment Potential

S. No.	Designation	Number
Managerial and Supervisorial Personnel		
1.	Mine Manager (As per MMR – 1961)	1
2.	Mining Engineer (as per MCDR 1988)	1
3.	Mining Geologist	1
4.	Mining Mate/Supervisor	1
5.	Driller Cum Blaster	1
Skilled		
6.	Excavator Operator	2
7.	Tipper Operator	6
8.	Drill m/c Operator	2
9.	Driver Explosive Van	1
10.	Driver Water Tanker	1
11.	Driver Jeep	1
Semiskilled		
12.	Helpers	8
13.	Clerk cum Store Keeper	1
Un Skilled		
14.	Un Skilled	2
15.	Others	150
	Total	**179**

10.1.8.7 Site Facility

Following facilities will be provided to mine workers at the mines' office and in conformance with the Mines Rules, 1952.

- ✓ Mine office and rest room at the central area of all Aniali mine leases.
- ✓ Canteen cum Rest room
- ✓ Toilet
- ✓ First Aid
- ✓ Rest shelter
- ✓ Blasting shelter

10.1.8.8 Utilities required

Utility	Description
Power supply	Not required as the mine will be worked during day time only.
Workshop & Stores	Available at Adityana mine site
Fuel	0.08 MT/day of HSD is required for running mining machineries & equipment.

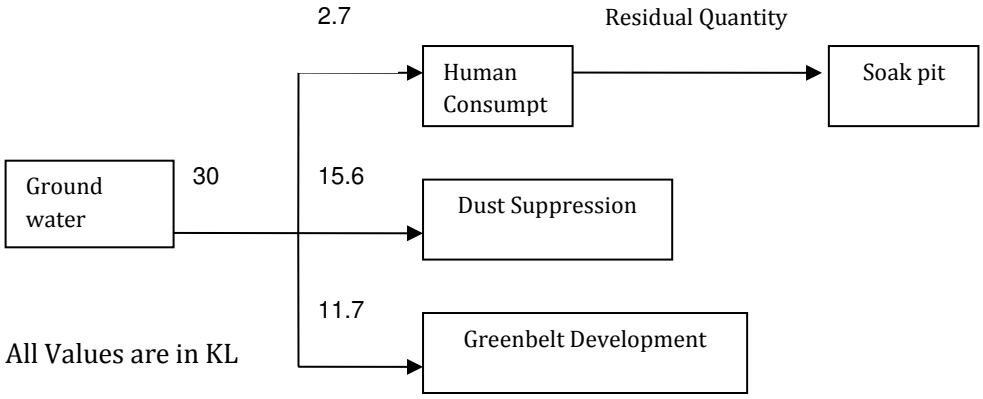
10.1.9 Water and Wastewater Management

10.1.9.1 Water Supply & Sanitation

The Aniali mine plans to abstract water from nearby privately owner dug well located near Aniali mine lease area.

10.1.9.2 Water Source & Requirement

The projected water requirements for the mine site are likely to be in the range of 30kld. It is to be noted that due to mechanical nature of mining in this lease the water requirement for the dust suppression will be optimal. Water balance diagram is given below:



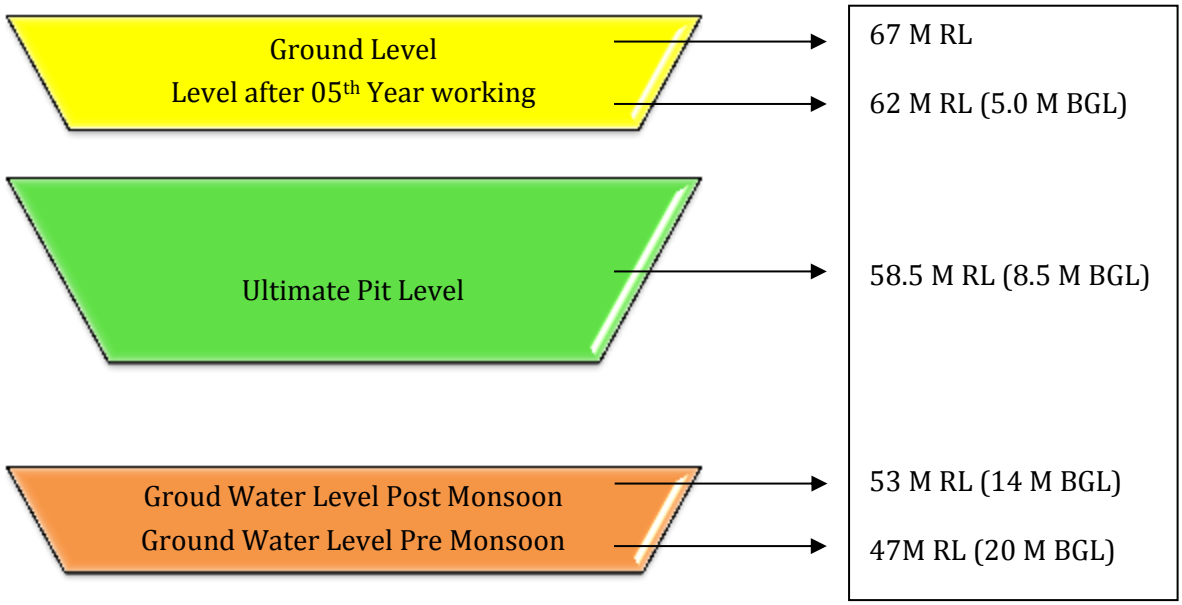
10.1.9.3 Wastewater Generation and Disposal

There will be no wastewater generation from limestone mining activities; however, marginal quantities of domestic wastewater will be generated, which will be disposed in soak pits.

10.1.9.4 Mine Drainage

10.1.9.5 Ground Water

The lime stone deposit is an elevated, above the ground and hence mining excavation will not go deeper down the ground level, will never touch the ground water table. The details of site levels and ground water table are given as below.



Hence, The Proposed Mining will not intersect ground water. The detailed quality of ground water in study area and impacts has been given in EIA Report Chapter 3.

10.1.9.6 Strom Water

The lease area is slightly sloppy hence no collection of surface water at site is envisaged during pre-operational stage. After commissioning of mining activities the rain water will get collected in the mined out pits and as a common practice is used for dust suppression and greenbelt development. After completion of mining activities, the site will cater 1,116,050 KL water storage in the region will create positive environment.

10.1.10 Post Mining Land use

A Forestation Programme Up To The End of Conceptual Plan

The proposed mining to be carried out with opencast mining method and rest of area will be developed as green belt for creation of aesthetic environment suitable to local conditions. At the

end of mining lease total 0.86 Ha area will be developed as green belt. The selection of species to be planted will be done with criteria like local, speedy growing & fruit bearing in nature.

Rain Water Storage/ Harvesting

The mine will be worked as opencast mechanised method and mining operations will generate rainwater storage pits at the end of mining. The total estimated area of pits will be 13.13 Hectare with ultimate depth of 8.5 meters. The shallow pit will cater water storage of 1,116,050 KL of water at site for green belt development and dust suppression.

10.2 Description of the environment

The baseline environment quality represents the background environmental scenario of various environmental components such as Land, Water, Air, Noise, Biological and Socio-economic status of the study area. Field monitoring studies to evaluate the base line status of the project site were carried out covering March, April & May 2013 with CPCB guidelines. Environmental data has been collected with reference to proposed mine for:-

a) Land
b) Water
c) Air
d) Noise
e) Biological
f) Socio-economic status

10.2.1 Land Environment

LAND USE/ LAND COVER

The existing land use pattern of the study area based on the latest satellite imagery is given below:

Land use pattern of the study area

S. No.	Land Category	Area (Sq Km)	% land cover
1.	Agricultural land	186.28	59.29
2.	Forest land	39.24	12.49
3.	Settlement	34.87	11.10
4.	Water bodies	11.74	3.74
5.	Waste land	17.85	5.68
6.	Barda Wild Life Sanctuary	24.18	7.70
TOTAL		**314.14**	**100**

10.2.1.1 Seismicity of the area

The project site as well as study area lies in Zone-III of Seismic Zoning Map, and thus can be said to be located in an area of moderate seismic hazard by national standards.

Soil Characteristics

From the above results it may be concluded that texture of the soil in the study area is sandy loam with conductivity ranging from 234.87 to 787.17 Micro mhos/cm at village Aniali and Bordi respectively. Soil has Water holding capacity in the range of 33.1 to 35.69. Nitrogen, Phosphorous & Potassium (NPK) level of soil ranges from 2.09, 40.15 & 0.3 mg/100gm to 4.40, 60.50 & 0.4 mg/100gm respectively.

10.2.2 Water Environment

10.2.2.1 Ground water Quality

The value of pH ranges from 7.54 to 7.78, indicating that water is alkaline in the study area. Maximum Conductivity observed is 3256 µmhos/cm at Bordi village, whereas minimum conductivity was observed at Aniali Village as 1352 µmhos/cm. Total hardness of ground water ranges from 402 to 1126 mg/l. Observed values of Chloride vary from 465 mg/l at Aniali village to 1077 mg/l at Bordi village. The ground water quality is in general poor (brackish to saline) at deeper levels at mostly all locations.

10.2.2.2 Surface water Quality

The surface water analysis data for the monitoring period i.e. March to May'2013. The physico-chemical characteristics of Surface water are found within the limits, prescribed by CPCB. The surface water quality is in general poor (brackish to saline) at mostly all locations.

10.2.3 Air Environment

SITE SPECIFIC METEOROLOGY

Site specific meteorology during the study period was recorded by an automated weather station. Site specific meteorological data of the study area reveals that predominantly wind is blowing from the west direction accounting approximately 34% of the total wind followed by SW and SSW contributing 16% to 11% respectively. Calm winds are only 0.63% of the total value. Average wind speed during the study period is 2.89 m/s.

10.2.3.1 Ambient Air Quality Results

The results of ambient air quality monitoring for the period (March to May 2013) are presented in the report. Data has been complied for three months.

PARTICULATE MATTER 10 (PM_{10}):

The maximum value for PM10 is observed, as 68 µg/m3 at Bordi village while 24 hours applicable limit is 100µg/m3 for industrial and mixed use areas. The area observes PM10 in the range of 42-68 µg/m3 with the lowest concentration recorded near Naliadhar RF.

PARTICULATE MATTER 2.5 ($PM_{2.5}$):

The maximum value for $PM_{2.5}$ observed is, 38 µg/m^3 at Bordi village while 24 hours applicable limit is 60 µg/m^3 for industrial and mixed use areas. The $PM_{2.5}$ value of 21 to 38 µg/m^3 is the lowest concentration recorded near Naliadhar RF.

SULPHUR DIOXIDE (SO_2):

The maximum value for SO_2 is observed, as 15 µg/m^3 at Bordi village, while 24 hours applicable limit is of 80 µg/m^3 for residential, industrial and other areas. Highest average value of SO_2 is 11.8µg/m3. All the villages have observed value well under the prescribed limit..

NITOROGEN OXIDES:

The maximum value for NO_X is observed, as 24 µg/m^3 at Bordi village, while 24 hours applicable limit is of 80 µg/m^3 for residential, industrial and other areas. Highest average value of NO_x is 22.3 at µg/m^3. The area observes NO_X well below the prescribed range.

10.2.4 Noise Environment

NOISE QUALITY

It can be observed from the monitored noise data that the noise levels ranges from 41.6 to 66.3 dB (A) during daytime and 36.6 to 58.9 dB (A) during night time.

Residential Area: In residential area, noise level are ranging between 47.6 dB (A) recorded at near mine site to 53.4 dB(A) recorded at Khirasra village during day time and 40.8 recorded at

Khirsara Village to 43.5 dB(A) recorded at Valotra village during night time. During daytime and night time noise level within the residential area are well within the prescribed limit.

Commercial Area: The noise level are ranging between 50.1 dB (A) to 63.7 dB (A) during the daytime and 38.5 dB (A) to 57.6 dB (A) during night time recorded at Vadwala-rana village and Jam Sakhpur Railway Station in the former & latter values. In commercial area noise level is less than the prescribed limit.

Sensitive Area: The noise level are ranging between 46.1 dB (A) to 49.3 dB (A) during the daytime and 37.2 dB (A) to 38.2 dB (A) during night time recorded at near reserve forest and near Barda WLS in the former & latter values as mentioned.

10.2.5 Biological Environment

STATUS OF FLORA

10.2.5.1 Taxonomic status of Plant species:

STUDY AREA:

The floral species in Aniali mine lease (16.21.ha) study area covering 10 km radius is reported as 133 species belonging to the 109 genera and 49 families.

CORE ZONE:

Core zone i.e. the mine lease area showed species richness of 24 species.

BUFFER ZONE:

The entire buffer zone covering areas of the Barda WLS, Naliyadhar Reserved Forest (NTF) and other outside habitats recorded 133 plant species of 109 genera and 49 families.

Overall taxonomic status of Flora in the study area

Taxa	Core Zone	Buffer Zone	Study area
Family	17	49	49
Genera	23	109	109
Species	24	133	133
Percentage (%)	14.35	100	100

10.2.5.2 Life form Status of Plant species:

STUDY AREA:

All the 133 plant species reported from the Aniali mine lease study area fall under 10 types of life forms. Among the life forms maximum of 49 herb species were identified and they formed 33.01% followed by tree species 20.57% with 30 species. The third level domination was observed from shrub (16 species) and grass (11 species) with the contribution 11.00% and 10.52% respectively. Sedges reported with four species.

BUFFER ZONE:

Buffer zone area showed the same trend as in case of the study area with the domination of herb (49 species) followed by tree (30 species). Shrub (14 species) and grass species dominated by 11 species at second level

Status of Life forms reported in mine lease area

Sl. No.	Life forms	Core Zone	Buffer Zone	Study Area	Relative %
1	Climber	0	1	1	2.39
2	Grass	4	11	11	10.53
3	Herb	7	49	49	33.01
4	Sedge	0	4	4	1.91
5	Shrub	4	14	14	11.03
6	Small trees	4	16	16	11.00
7	Straggling shrub	0	1	1	1.43
8	Tree	2	30	30	20.57
9	Twiner	0	1	1	2.39
10	Under Shrubs	3	6	6	5.74
TOTAL		24	133	133	100.00

STATUS OF CROP SPECIES:

Status of agriculture crops was assessed only in the buffer zone covering outside the sanctuary area. The list of species was prepared based on the casual observation while collecting data in and around the agriculture habitat. Based on the survey a total of 36 crop species were reported in the study area of Aniali mine lease area and based on their use value they have been grouped into four categories. Among the species list 8 species fall under grain crops, 10 species fruit crops, 11 vegetable crops and 6 commercial crops of the study area. Within the grain crops, Bajri, Juwar, Makai and Arenda were cultivated extensively. Though, 10 fruit yielding species were reported, they grown in small extent of areas along the agricultural hedges and mainly for local use and market. All the six commercial crops cultivate extensively and they for major income of the local agriculturalists

STATUS OF FAUNA

This section includes the discussion of major faunal groups like amphibians, reptiles, birds (terrestrial and aquatic) and mammals. Among the groups, due to taxa specific nature of life, direct sightings of herpetofauna and mammalian fauna are always lower than the avifauna which is comparatively more active. Therefore status of herpetofauna and mammals groups were discussed at species richness and abundance levels predominately based on indirect evidences for mammals reported within the sample area.

STATUS OF HERPETOFAUNA:

TAXONOMIC STATUS-AMPHIBIANS:

During the study period only three species of amphibians were reported from the study area. They belong to three genus under single family. Within buffer zone the area falling inside the sanctuary had these species. Due to the absence of perennial water resources within the core zone resulted no amphibian species within the proposed mine lease area. Below table represents the status of the Amphibian's in the study area.

Status of amphibian species in the study area

S.No	Zoological name	Common Name	WL Act, 1972 Schedule	Presence in Core Zone	Presence in Buffer Zone
1.	*Euphlictis cyanphylictis*	Indian skipping frog	IV	-	√
2.	*Fejevarya limnocharis*	Cricket frog	IV	-	√
3.	*Hoplobarahus tigerinus*	Indian bull frog	IV	-	√

TAXONOMICAL STATUS – REPTILES:

Status of Reptiles in the study area shows moderate species richness with overall 10 species belonging to 08 genera and 05 families. Core zone area identifies only two reptilian species. However all 10 species were reported from the buffer zone. *Hemidactylus flaviviridi, Calotes versicolar, Mabuya carinata, Mabuya macularia,* is some common reptiles of the area. Detailed status of the reptiles is given in the table below:

Status of reptiles in the study area

S. No.	Zoological name	Common Name	WL Act, 1972 Schedule	Presence in Core Zone	Presence in Buffer Zone
1.	*Calotes Sp.*	-	-	-	All around
2.	*Calotes versicolar*	Indian garden lizard *	-	√	BWLS
3.	*Cyrtopodion Sp.*	-	-	-	

4.	*Echis carinatus*	Indian saw scaled viper	IV	-	BWLS
5.	*Hemidactylus flaviviridis*	Yellow-green house gecko *	-	-	All around
6.	*Mabuya carinata*	Keeled grass skink *	-	√	All around
7.	*Mabuya macularia*	Common bronze-back skink	-	-	BWLS
8.	*Naja naja*	Spectacled cobra	II	-	BWLS
9.	*Ptyas mucosa*	Indian rat snake	II	-	BWLS
10.	*Sitana ponticeriana*	Fan-throated lizard		-	BWLS

(*)- Direct evidence during survey

STATUS OF AVIFAUNA

The study area of the Aniali limestone mine (16.21 ha) covering both the core and buffer zone represents a total of 21 bird species under 21 genera. Out of these 21 species, 05 were reported from the core area during the survey.

Status of avifauna reported from the study area

Sl. No	Zoological name	Common Name	WL Act 1972 Schedule	Presence in Core Zone	Presence in Buffer Zone
1	*Acridotheres tristis*	Common Myna	IV	√	√
2.	*Alcede atthis*	Small Blue Kingfisher	IV	-	√
3.	*Anas strepera*	Gadwall	IV	-	√
4.	*Columba livia*	Rock Pigeon	IV	√	√
5.	*Dendrocygna javanica*	Lesser Whistling Duck	IV	-	√
6.	*Eudynamys scolopacea*	Asian Koel	IV	-	√
7.	*Francolinus pondicerianus*	Grey Francolin	IV	-	√
8.	*Grus grus*	Common Crane	IV	-	√
9.	*Halcyon smyrensis*	White-throated Kingfisher	IV	-	√
10.	*Lanius schach*	Long-tailed Shrike	-	-	√
11.	*Lonchura malabarica*	Indian Silverbill	IV	-	√
12.	*Merops orientalis*	Green Bee-eater	-	√	√
13.	*Milvus migrans*	Black Kite	-	-	√
14.	*Nectarinia asiatica*	Purple Sunbird	IV	-	√
15.	*Passer domesticus*	House Sparrow	IV	√	√
16.	*Pavo cristatus*	Indian Peafowl	I	-	√
17.	*Ploceus philippinus*	Baya Weaver	IV	-	√
18.	*Pseudibis papillosa*	Black Ibis	IV	-	√
19.	*Psittacula krameri*	Parakeet	IV	-	√
20.	*Pycnonotus cafer*	Red-vented Bulbul	IV	-	√
21.	*Upupa epops*	Common Hoopoe	-	√	√

STATUS OF MAMMALS

Status of mammalian fauna in the study area shows moderate levelof species richness with overall 11 species under 11 genera and 10 families. The core zone shows comparatively less no of species richness than thebuffer area. It has six species under six genera and six families. The list of mammalian species is given in the following table.

Status of the mammalian species in the area

Sl. No	Zoological name	Common Name	WL Act, 1972 Schedule	Presence in Core Zone	Presence in Buffer Zone
1.	*Boselaphustragocamelus*	Nilgai *	III	-	BWLS + NFR
2.	*Canis aureus*	Jackal	II	-	BWLS+ NFR
3.	*Felis chaus*	Jungle Cat *	II	-	BWLS+ NFR
4.	*Funambulus pennant*	Five-striped Palm Squirrel *	IV	√	All around
5.	*Herpestes edwardsi*	Common mongoose*	IV	-	
6.	*Hyaena hyaena*	Striped Hyena	III	-	BWLS
7.	*Hystrix indica*	Porcupine	IV	-	BWLS + NFR
8.	*Lepus nigricollis*	Indian Hare *	IV	-	All around
9.	*Panthera pardus*	Leopard	I	-	BWLS
10.	*Rattus rattus*	House Rat *	IV	√	All around
11.	*Sus acrofa*	Wild boar *	III	-	BWLS + NFR

(*) Direct evidence during survey

BWLS- Barda Wildlife sanctuary, NFR- Naliyadhar Reserve Forests

STATUS OF THREATENED BIOTA

FLORA:

No rare, endangered or threatened (RET) plant species is reported from the study area.

FAUNA (AMPHIBIANS):

This group is very poorly reported from the study area. No RET species is reported from the area.

FAUNA (REPTILES):

No RET species belonging to reptiles is reported.

AVIFAUNA:

Indian Peafowl (*Pavo cristatus*) is the only species reported under Schedule-I of Wildlife (Protection) Act from the study area.

MAMMALIAN FAUNA:

Panthera pardus is the mammalian species reported from the sanctuary area, which is under Schedule-I of the Wildlife (Protection) Act, 1972.

WILDLIFE CORRIDORS/ ELEPHANT CORRIDORS:

The mine lease of Aniali (16.21 ha) is at the distance of 3.92 km from Barda WLS in South- east direction. Naliyadhar Forest reserve is in South- west to the lease area. The both Barda wild life sanctuary and Naliyadhar Reserve Forest are isolated from each other due to agricultural fields and human habitats and are not connected through any forest corridors. Hence no wildlife or elephant corridors are observed in the study area or passing through the lease area.

Location details of WLS & Reserve forest w.r.t. mine lease area

Sl. No	Name of the Reserved Forest	Location/direction	Distance from the mine lease
1	Barda wildlife sanctuary	North- West	3.92 Km
2	Naliyadhar Reserved Forest	South-West	0.11 Km

10.2.6 Socio-Economic Environment

An attempt has been made to assess the impact of the proposed Limestone mining project at village Aniali on Socio-economic aspect of the study area. The various attributes that have been taken into account are population composition, employment generation, occupational shift, household income, consumption pattern, ethnic issue and law & order problem.

Implementation of the Aniali Limestone Mine project will generate both direct and indirect employment. Besides, it will provide a check on existing system of mining operation. Mining operation will be legally valid and it will bring income to the state exchequer. The project will also provide impetus to industrialization of the area. At present agriculture is the main occupation of the people as more than half of the population depends on it. With the implementation of the proposed mining project the occupational pattern of the people in the area will change making more people engaged in mining based activities rather in agriculture.

10.3 Anticipated Impacts & Mitigation measures

S.No.	Aspect	Impact	Mitigation measure
A.	**Land Environment**		
i.	Land Use / Land Cover	At conceptual stage most of the waste land i.e. a will be converted into rain water harvesting pit and green belt Hence impact due to change in land use is positive.	--
ii.	Topography	--	--
iii.	Drainage	There are no prominent watercourses or nallas in the lease area. During rainy season the surface run-off flows in NW to SE direction. The drainage pattern will not get disturbed due to mining activity.	--
iv.	Geology	No impact is anticipated as the mine lease area lies in Seismic Zone-III and has practically no soil cover.	--
B.	**Water Environment**		
i.	Hydrological Regime	As there is no river or nallas passing through the mine site, hence no impact is anticipated on the hydrological regime of the area due to mining activity.	--
ii.	Diversion of Natural water course	No natural course of water stream is interrupted or diverted due to mining activity; hence no impact on natural drain is anticipated.	--
iii.	Contamination due to flow of waste generated	Practically there is no overburden or reject generating from the mining activity, moreover the excavated mineral itself is non-toxic and hence no effect due to water flow during rains following the contours of the area is expected.	--
iv.	Ground water abstraction	Impact on ground water is anticipated as there is provision of consuming ground water for the purpose of various mining activities. Total water demand to be met by ground water is 30 KLD. Tata chemicals Ltd. has already taken clearance from CGWA for the requisite amount of 30 KLD.	Permission has been taken for withdrawal of requisite amount of water. However measures will be taken for optimal use of ground water. At the end of mine life excavated pit will be converted into a water

S.No.	Aspect	Impact	Mitigation measure
			reservoir. This will help in recharging the ground water table.
v.	Ground water contamination	As the mineral is non-toxic so contamination of ground water due to leaching is not anticipated.	Ground water monitoring at regular intervals shall be carried out.
C.	**Air Environment**		
i.	Drilling	Fugitive dust	Wet drilling will be provided. Suitably designed dust extractor will be provided for dry drilling along with dust hood at the mouth of the drill-hole collar.
ii.	Blasting	Emission of noxious gases	Establish time of blasting to suit the local conditions. Avoid blasting i.e., when temperature inversion is likely to occur and strong wind blows towards residential areas.
iii.	Haul Road	Fugitive dust	The long life WBM (Water Bound Macadam) haul roads will be constructed and maintained for traffic movement. Regular water spraying shall be done
iv.	Transportation	Gases, such as, Sulphur Dioxide, Oxides of Nitrogen, Carbon Monoxide etc. from vehicular exhaust.	The speed of dumpers/ trucks on haul road will be controlled as increased speed increases dust emissions. Overloading of transport vehicles will be avoided. The trucks/ tippers will have sufficient free board. Spillage of ore on public roads will be cleared immediately and

S.No.	Aspect	Impact	Mitigation measure
			vehicles will play in safe speed.
D.	**Noise Environment**		
i.	Drilling & Blasting		Implement good working practices (equipment selection and siting) to minimize noise and also reduce its impacts on human health (ear muffs, safe distances and enclosures). Adopt good blasting practices to reduce impact on flora and fauna. Muffling will be done at the time of blasting
ii.	Mining machineries & Equipment	Noise generated from machineries & equipment	List of all noise generating machinery onsite along with age to be prepared. Equipment to be maintained in good working order.
iii.	Transportation	Generation of vehicular noise	Plantation of dense hedges on the boundary of lease area, these will reduce dust and noise in the vicinity area.
E.	**Ground vibration**		
i.	Blasting	Ground Vibrations due to Blasting	Good blasting layout must be adopted Adopting less number of holes per delay
F.	**Biological Environment**		
i.	Flora	There is no significant vegetation in the mine lease area, so no adverse impact on vegetation is anticipated. However at the conceptual stage Green belt shall be developed which will add to the aesthetics of the study area.	Phase wise plantation shall be carried out to improve the aesthetics of the study area.

S.No.	Aspect	Impact	Mitigation measure
ii.	Fauna	No major species are sited in the mine lease area. However due to presence of the Barda WLS and Naliyadhar RF some schedule-I species might be present.	Conservation plan have been submitted for approval and all the measures shall be taken to minimize any potential impact on the Scheduled fauna.
G.	Socio-Economic Environment	Practically there is positive impact on Socio-economic conditions of the study area	All the aspects covered shall be mitigated as per the CSR.
H.	Mine Waste Management	Undersize limestone Management	Undersized mineral sent to cement plant at Mithapur and nearby other cement plants.
		Hazardous waste management	Hazardous waste (Used oil and oil containers) will be managed as per Hazardous Wastes (Management and Handling) Rules, as amended till date
		Batteries of vehicles	Batteries will be managed as per Battery (Management & Handling) Rules; 2000.
		Non-routine events and accidental releases	Plan to be drawn up, considering likely emergencies and steps required to prevent/limit conse-quences.

10.4 Environment Monitoring Programme

Regular monitoring programme of the environmental parameters is essential to take into account the changes in the environmental quality. The objectives of monitoring are to:-

- Verify effectiveness of planning decisions;
- Measure effectiveness of operational procedures;
- Conform statutory and corporate compliance; and
- Identify unexpected changes.
- Details of the Environmental Monitoring schedule, which will be undertaken for various environmental components, are detailed below

Environmental Monitoring programme schedule

S.No.	Activity	Schedule
Air Pollution Monitoring		
1.	Ambient air monitoring of parameters specified by CPCB in their air consents from time to time within the TCL's mining lease	Once in every season except monsoon
2.	Ambient air monitoring of parameters specified by GPCB in their air consents from time to time at stations outside TCL mining lease	Once in every season except monsoon
Water Quality Monitoring		
3.	Monitoring water quality from rain water collected in mine pit area. Rain water will be used for plantation purpose.	During Monsoon
4.	Monitoring of one sample of tube well and open well at plant / nearby location. Parameters are essential parameters as per IS: 10500:1991.	Once in every season except monsoon
5.	Monitoring of water spray requirements	Log-sheet of water spray will be maintained on daily basis
Noise Quality Monitoring		
6.	Noise in the ambient atmosphere in TCL mining lease	Once in every season except monsoon
Greenbelt Maintenance		
7.	Monitor schedule for Greenbelt development as per approved mining plan	Yearly
Soil Quality Monitoring		
8.	Soil at two locations	Once in every year

10.5 Additional Studies

10.5.1 Public Consultation

As per the EIA notification, 2006 and its subsequent amendments later, Public hearing for Aniali Limestone Mine (16.21 ha) covered under "Category – A" was scheduled on 11/12/2013 at 10:30 a.m. at Panchayat ground, Near Panchayat Kacheri, Village- Aniali, Taluka – Ranavav & District – Porbandar, Gujarat.

As required under the Public Hearing process prior advertisements for the public hearing was published in the local language i.e. Gujarati in the daily newspaper "Divya Bhaskar" dated 7/11/2013 and English Newspaper namely "Indian Express" dated 07/11/2013. As per the new amendment in notification advertisement for the same was also telecasted by the local TV Channel GTPL Porbandar. Public hearing was conducted as scheduled on 11-12-2013 under supervision of Shri B L Maru, Regional Officer and Shri M A Gandhi, Collector and District Magistrate, Porbandar.

A statement showing participants present during the Public hearing is enclosed as Annexure-A in Public Hearing proceedings.

A statement showing salient points highlighting issues raised by the participants and responded by the representative of the applicant during Public hearing in English & Gujarati Languages are enclosed as Annexure B & B1 of Public Hearing Proceedings.

Written representations along with their responses are enclosed as Annexure C1, C2 & C3 & Annexure D1, D2 & D3 respectively in Public hearing Proceedings.

A time bound action plan has been made on the basis of issues raised during Public hearing process and commitments made by the project proponent.

10.5.2 Risk Analysis & Disaster Management Plan

The methodology for the risk assessment has been based on the specific risk assessment guidance issued by the Directorate General of Mine Safety (DGMS), Dhanbad, vide Circular No.13 of 2002, dated 31st December, 2002. The DGMS risk assessment process is intended to identify existing and probable hazards in the work environment and all operations and assess the risk levels of those hazards in order to prioritize those that need immediate attention.

Further, mechanisms responsible for these hazards are identified and their control measures, set to timetable are recorded along with pinpointed responsibilities.

In the unlikely event that a consequence has occurred, disaster management kicks in. This includes instituting procedures pertaining to a number of issues such as communication, rescue, and rehabilitation. These are addressed in the disaster management plan.

Both, the RA and DMP, are living documents and need to be updated whenever there are changes in operations, equipment, or procedures

Assessment is all about preventing accidents and taking necessary steps to prevent it from happening.

10.5.3 Mine disaster Management plan

The Disaster Management Plan (DMP) is a guide, giving general considerations, directions, and procedures for handling emergencies likely to arise from planned operations. The DMP has been prepared for the TCL on the basis of the Risk Assessment and related findings covered in the report.

10.5.3.1 DMP Audit, Non Conformance and Corrective Action and Preventive Action

Since this DMP has been designed as a dynamic document, it is required that its performance be audited at regular intervals. Ideally, persons auditing the DMP should be external auditors (i.e. not employed at the site being audited). The audit should result in a set of findings that are put before the site management for review.

Audits will be periodic, at intervals that are decided by the Head Office. Audit reports shall state the exact non-compliance with the particular clause of this DMP, and should include steps to be taken to attain compliance, through corrective and preventive actions.

10.5.3.2 Review of Emergency Performance

The site / head office management will review the findings of the audit and the non-compliances. It will consider whether the DMP is providing adequate safety assurance to the management, delivering performance as desired, and whether it continues to be in the spirit of

Environment, Health and Safety Policies, and changing requirements. On the basis of these, the management will record its decisions and consider modifying the DMP, as deemed appropriate.

10.5.4 Natural Resource Conservation

As far as possible, efforts shall be made to minimize the use of natural resources like fuel, mineral etc. A conservation strategy shall be followed according to which the use of energy will be minimized at all level of organization. All the machineries and equipments shall be properly maintained so as to reduce the green house gas emissions and to conserve the fuel & energy.

10.5.5 Rehabilitation & Resettlement

Mine lease area is free from habitation and settlements; hence no rehabilitation & resettlement (R & R) Plan is required.

10.6 Project Benefits

Various benefits are envisaged while planning for the mining of Limestone at village Aniali and a comprehensive description of various advantages and benefits anticipated from the proposed project to the locality, neighbourhood, region and nation as a whole.

- Improved road communication;
- Strengthening of existing community facilities through the Community Development Programme;
- Rain water reservoir to augment the water availability for irrigation and plantation;
- Creation of community assets (infrastructure) like school buildings, village roads/ linked roads, dispensary & health centre, community centre, market place etc.;
- Skill development & capacity building like vocational training of teachers
- Awareness program and community activities, like health camps, medical aids, family welfare programs, immunization camp sports & cultural activities, plantation etc.

10.7 Environmental Management Plan

As a part of its responsibility towards protection of environment, project proponent has allocated budget for Environment protection measures.

Proposed Cost of Environment Management

Particulars	Approximate recurring cost per annum (Rs. in lacs)	Approximate Capital cost (Rs. In lacs)	Basis for cost estimates
Air pollution monitoring	2	-	As in mining lease there are no any stacks hence capital cost is nil. Recurring cost would include cost of monitoring of ambient air environment at 5 locations in the mining lease season wise
Water pollution control	0.75	-	There are no treatment plants so capital cost for water pollution control is nil. While TCL will be monitoring tube well samples of 5 villages in each season.
Noise pollution control	0.1	-	Recurring cost includes monitoring cost of noise measure-ment at different locations.
Environment monitoring and management	1.0	-	The recurring cost would be incurred on hiring of consultants and payment of various statutory fees to regulatory agencies.
Green belt	0.5	1.5	Capital cost includes tree plantation cost and hedges on the boundary. And recurring cost includes cost of wire fencing and cost of post plantation care.
Total	**4.35**	**1.5**	

CHAPTER – 11: DISCLOSURE OF CONSULTANTS

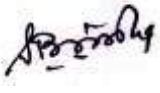
11 Disclosure of consultant Engaged

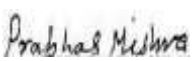
M/s Mantec consultants Pvt. Ltd, New Delhi was engaged as consultant for carrying out Environmental Impact Assessment Study. Brief Description of the organization is given below:

Name of the Firm	M/s Mantec Consultants Pvt. Ltd, New Delhi
Addresses	805, Vishal Bhavan 95, Nehru Place, New Delhi-110019
Services Rendered	Field Monitoring, Secondary Data Collection, Impact Assessment and Preparation of EIA documents
QCI Accreditation status	Accredited at S.No. 96 (as per List of Accredited Consultant Organizations/ Rev. 20/ May 5, 2014) attached as **Annexure-XIII.**
Duration	June 2012- till date
EIA Coordinator	Mr. Yamesh Sharma

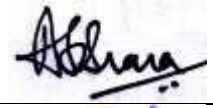
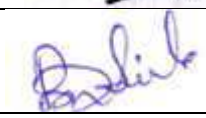
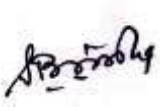
Names of the Functional Area Experts and other Team Member engaged with their brief resume and nature of consultancy rendered is provided below.

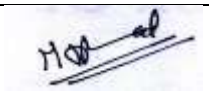
Functional Area Experts engaged in the project

S.No.	Name of the Consultant	Qualification & Year of Experience	Nature of Consultancy rendered	Signature
1.	Mr. Yamesh Sharma	B.Sc. (Civil Engg.), 42 Years	EIA Coordinator and provided consultancy in functional areas of Land Use (LU) and Hydrogeology (HG) and also provided inputs for Noise and Vibration (NV)	
2.	Mr. Sanjeev Sharma	M.Tech. (Env. Sc. & Engg.), 20 Years	Consultancy provided in functional areas of Air Pollution (AP), Air Quality & Meteorology (AQ), Noise & Vibrations (NV) and Solid & Hazardous Waste Management (SHW) and preparation of EIA report	
3.	Mr. S.B. Sinha	M.Sc. (Chemistry), 44 Years	Consultancy provided in functional area of Water Pollution (WP) and also provided input in the functional area of Solid & Hazardous Waste Management (SHW)	

S.No.	Name of the Consultant	Qualification & Year of Experience	Nature of Consultancy rendered	Signature
4.	Dr. Vivek N. Singh	PhD. (Botany), 11 Years	Consultancy provided in functional areas of Ecology & Biodiversity (EB) and Soil Conservation (SC)	
5.	Mr. Prabhash Mishra	M.A. (Sociology), 20 Years	Consultancy provided in functional area of Socioeconomic & CSR aspects (SE)	
6.	Mr. Soumya Dwivedi	B.E. (Chemical), 5 years	Consultancy provided in functional area of Risk & Hazard Management (RH)	

List of Team Members

S.No.	Name of the Consultant	Qualification & Year of Experience	Nature of Consultancy rendered	Signature
7.	Mr. A.S. Brara	B.Sc. Engg. (Mechanical), 48 Years	Overall quality management of EIA report	
8.	Mr. B.M. Sinha	M.Sc. (Applied Geophysics), 38 Years	Provided inputs on Geology aspects	
9.	Ms.S.B. Sinha	M.Sc. (Chemistry), 44 Years	Preparation of plan for handling and disposal of mineral rejects and domestic sewage under Solid & Hazardous Waste Management (SHW)..	
10.	Ms. Priyanka Singh	M.Sc. (Environment Management), 5 Years	Assisting Mr. Sanjeev Sharma in functional areas of Air Pollution (AP), Air Quality & Meteorology (AQ), and Solid & Hazardous Waste Management (SHW) Assisted Mr. S.B. Sinha in functional area of Water Pollution (WP)	
11.	Methun Biswas	M.Sc. (Environment Science), 3 Years	Assisting Mr. Sanjeev Sharma in functional areas of Air Pollution (AP), Air Quality & Meteorology (AQ), Assisted Mr. S.B. Sinha in functional area of Water Pollution (WP)	
12.	Mr. Gajanand Mallick	M.Sc. (Ecology and Environment Science), 4 Years	Assisted Dr. V. N. Singh in the functional area of Ecology & Biodiversity(EB)	
13.	Mr.	M.Sc.	Assisting Mr. Sanjeev Sharma in	

S.No.	Name of the Consultant	Qualification & Year of Experience	Nature of Consultancy rendered	Signature
	Muzaffar Ahmed	(Environment Science), 2 Years	functional areas of Air Pollution (AP), Assisted Mr. S.B. Sinha in functional area of Water Pollution (WP) and Assisted Dr. V. N. Singh in the functional area of Ecology & Biodiversity(EB)	
14.	Mr. Anil Kumar	M.A. (Sociology), 9 Years	Assisted Mr. Prabhas Mishra in functional area of Socio-Economics (SE)	
15.	Mr. Deepak Srivastava	M.Sc. Applied Geology & M.Sc.(Tech.) Remote Sensing (6 years)	Provided inputs on Geology aspects and assisted Mr. Yamesh Sharma In functional Area of Hydrogeology (HG) and Landuse (LU)	
16.	Mr Sumit Verma	MTech (Environmental Engg and Management), 3years	Assisting Mr. Sanjeev Sharma in functional areas of Air Pollution (AP), Assisted Mr. S.B. Sinha in functional area of Water Pollution (WP)	

Declaration by the Head of the Accredited Consultant Organization

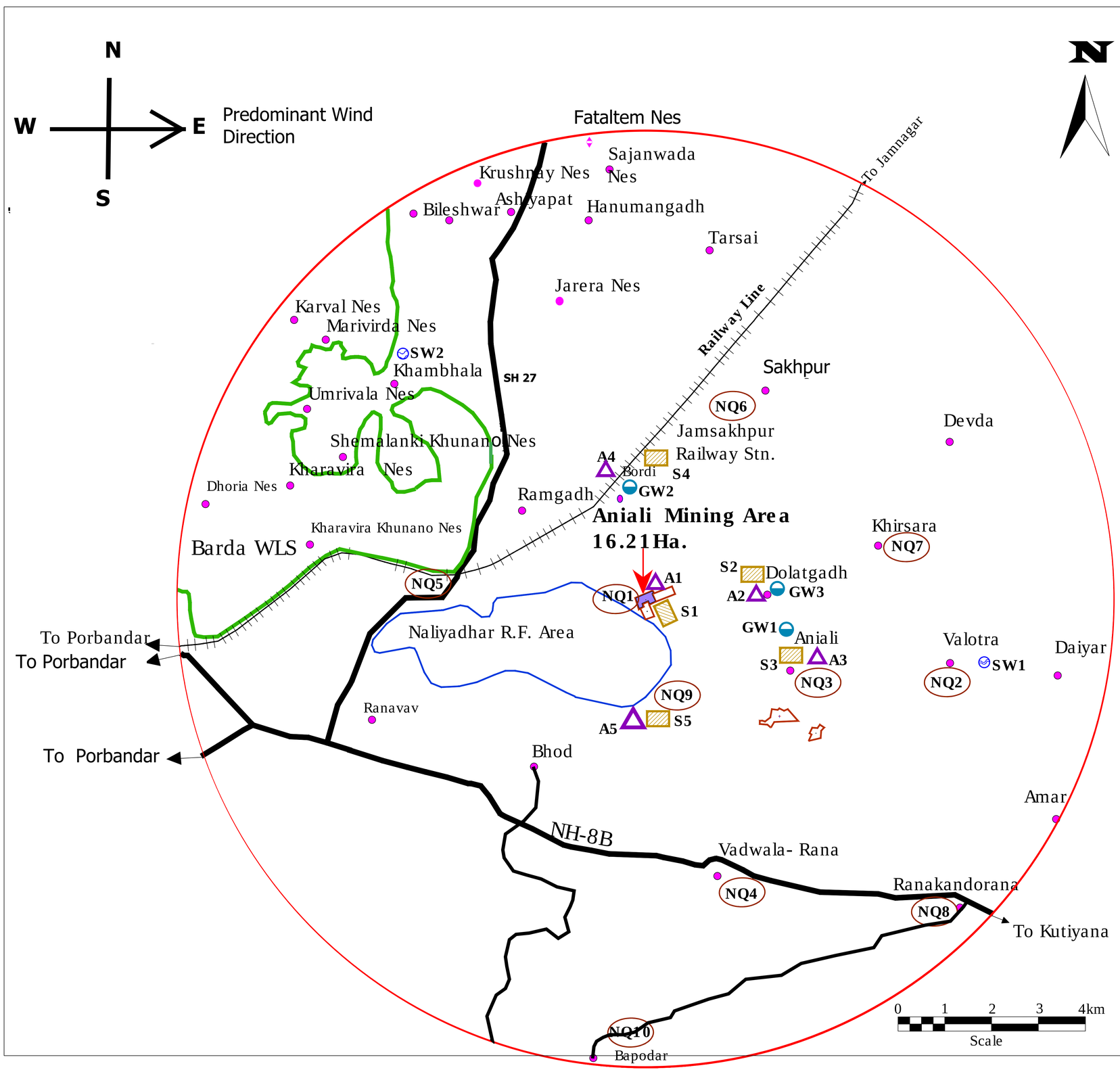
I, A.S. Brara, hereby, confirm and certify that the EIA team in the above capacity developed the EIA Report of Aniali Limestone Mine (16.21 ha).

Name : Mr. A. S. Brara
Designation : Chairman & Managing Director (CMD)
Signature & Date :

***List of Functional Areas**

1.	LU	:	Land Use
2.	AP	:	Air Pollution Monitoring, Prevention & Control
3.	AQ	:	Meteorology, Air Quality Modeling & Prediction
4.	WP	:	Water Pollution Monitoring, Prevention & Control
5.	EB	:	Ecology & Biodiversity
6.	NV	:	Noise & Vibration
7.	SE	:	Socio-Economics
8.	HG	:	Hydrology, Ground Water & Water Conservation
9.	GE	:	Geology
10.	SC	:	Soil Conservation
11.	RH	:	Risk Assessment & Hazard Management
12.	SHW	:	Solid & Hazardous Waste Management

ENVIRONMNTAL MONITORING LOCATIONS MAP



LEGEND

Figure No : 3-4

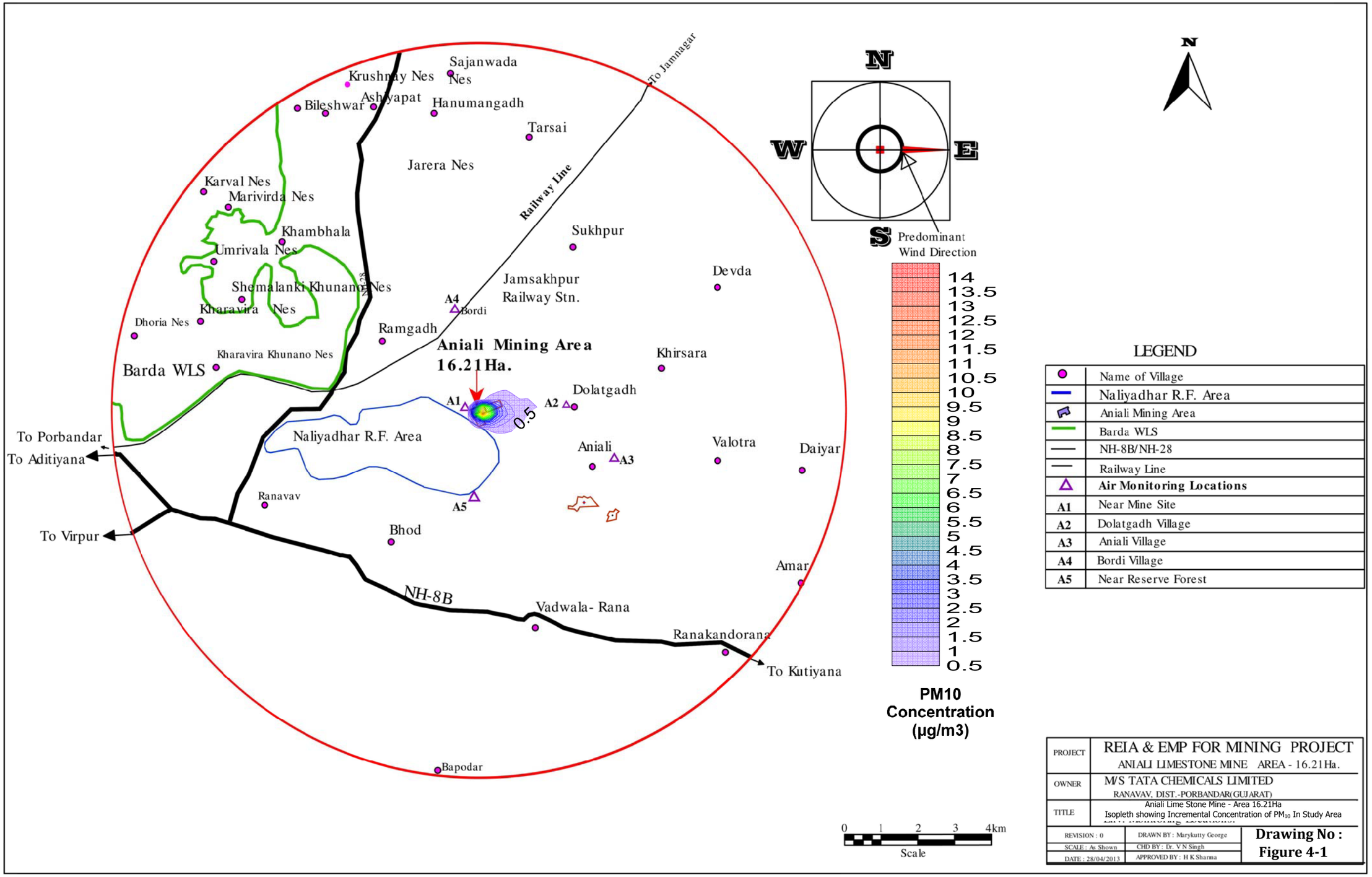
●	Name of Village
	Naliyadhar R.F. Area
	Aniali Mining Area
	Barda WLS
	NH-8B/SH-27
	Railway Line
△	**Air Monitoring Locations**
A1	Near Mine Site
A2	Dolatgadh Village
A3	Aniali Village
A4	Bordi Village
A5	Near Reserve Forest
▭	**Noise Monitoring Locations**
NQ1	Near Mine Site
NQ2	Valotra Village
NQ3	Aniali Village
NQ4	Vadwala -Rana Village
NQ5	Near Barda WLS
NQ6	Jamsakhpur Railway Station
NQ7	Khirsara Village
NQ8	Rana Kandorana Village
NQ9	Near Reserve Forest
NQ10	Bapodar Village
◒	**Ground Water Sampling Locations**
GW1	Aniali Village
GW2	Bordi Village
GW3	Dolat Gadh Village
◒	**Surface Water Sampling Locations**
SW1	Valotra Village
SW2	Khambhala Reservoir
▨	**Soil Sampling Locations**
S1	Mine Site
S2	Dolat Gadh Village
S3	Aniali Village
S4	Bordi Village
S5	Near Reserve Forest

PROJECT	REIA & EMP FOR MINING PROJECT ANIALI LIMESTONE MINE AREA - 16.21Ha.
OWNER	M/S TATA CHEMICALS LIMITED RANAVAV, DIST.-PORBANDAR(GUJARAT)
TITLE	Aniali Mining Area 16.21Ha. Env. Monitoring Locations.

REVISION : 0	DRAWN BY : Marykutty George	Drawing No : **Figure - 3-4**
SCALE : As Shown	CHD BY : Dr. V N Singh	
DATE : 28/04/2013	APPROVED BY : H K Sharma	

Isopleth showing Incremental Concentration of PM10 In Study Area

FIGURE 4-1



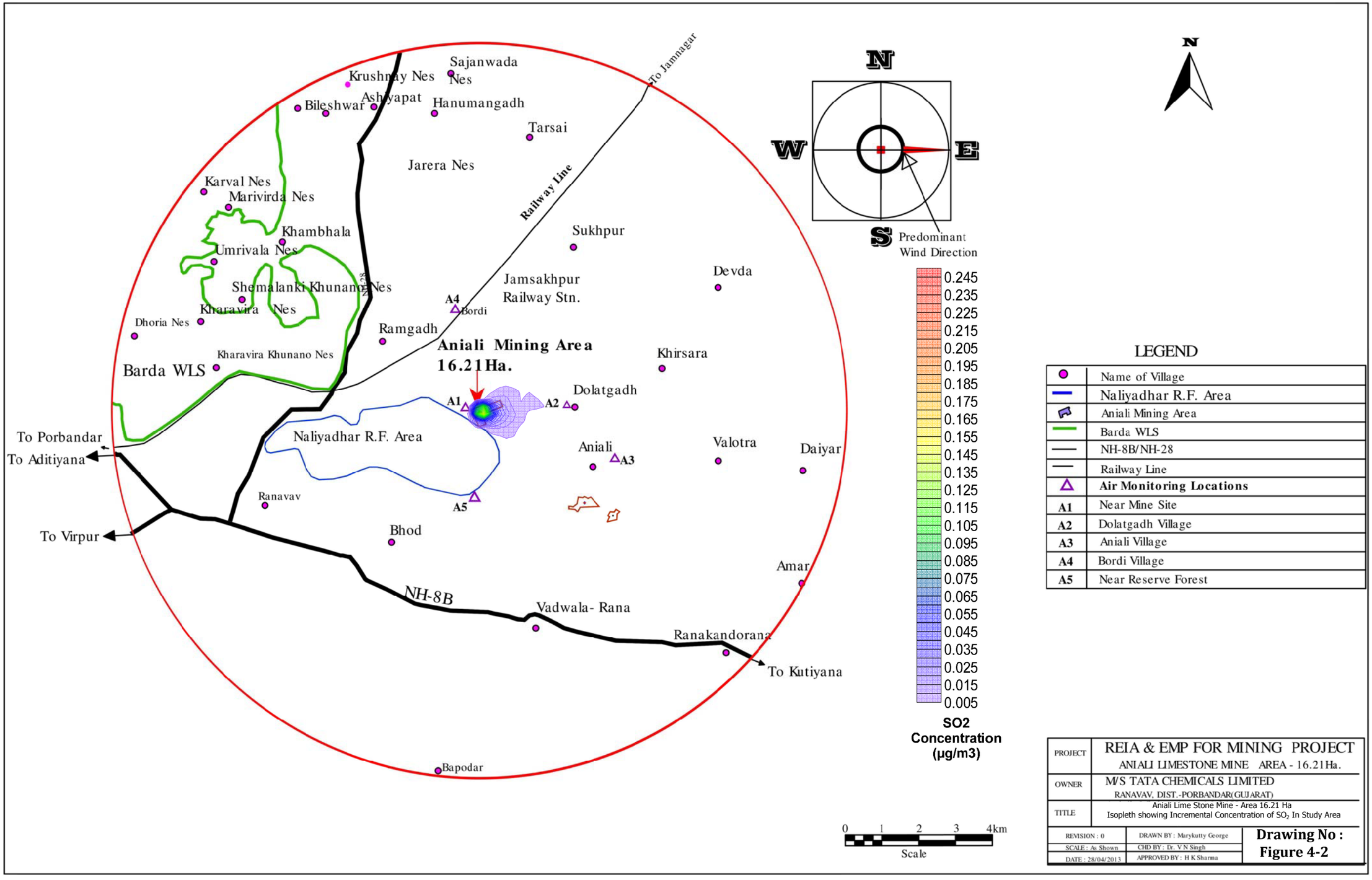
LEGEND

●	Name of Village
—	Naliyadhar R.F. Area
	Aniali Mining Area
—	Barda WLS
—	NH-8B/NH-28
—	Railway Line
△	**Air Monitoring Locations**
A1	Near Mine Site
A2	Dolatgadh Village
A3	Aniali Village
A4	Bordi Village
A5	Near Reserve Forest

PROJECT	REIA & EMP FOR MINING PROJECT ANIALI LIMESTONE MINE AREA - 16.21Ha.	
OWNER	M/S TATA CHEMICALS LIMITED RANAVAV, DIST.-PORBANDAR(GUJARAT)	
TITLE	Aniali Lime Stone Mine - Area 16.21Ha Isopleth showing Incremental Concentration of PM_{10} In Study Area	
REVISION : 0	DRAWN BY : Marykutty George	**Drawing No : Figure 4-1**
SCALE : As Shown	CHD BY : Dr. V N Singh	
DATE : 28/04/2013	APPROVED BY : H K Sharma	

Isopleth showing Incremental Concentration of SO_2 In Study Area

Figure 4-2



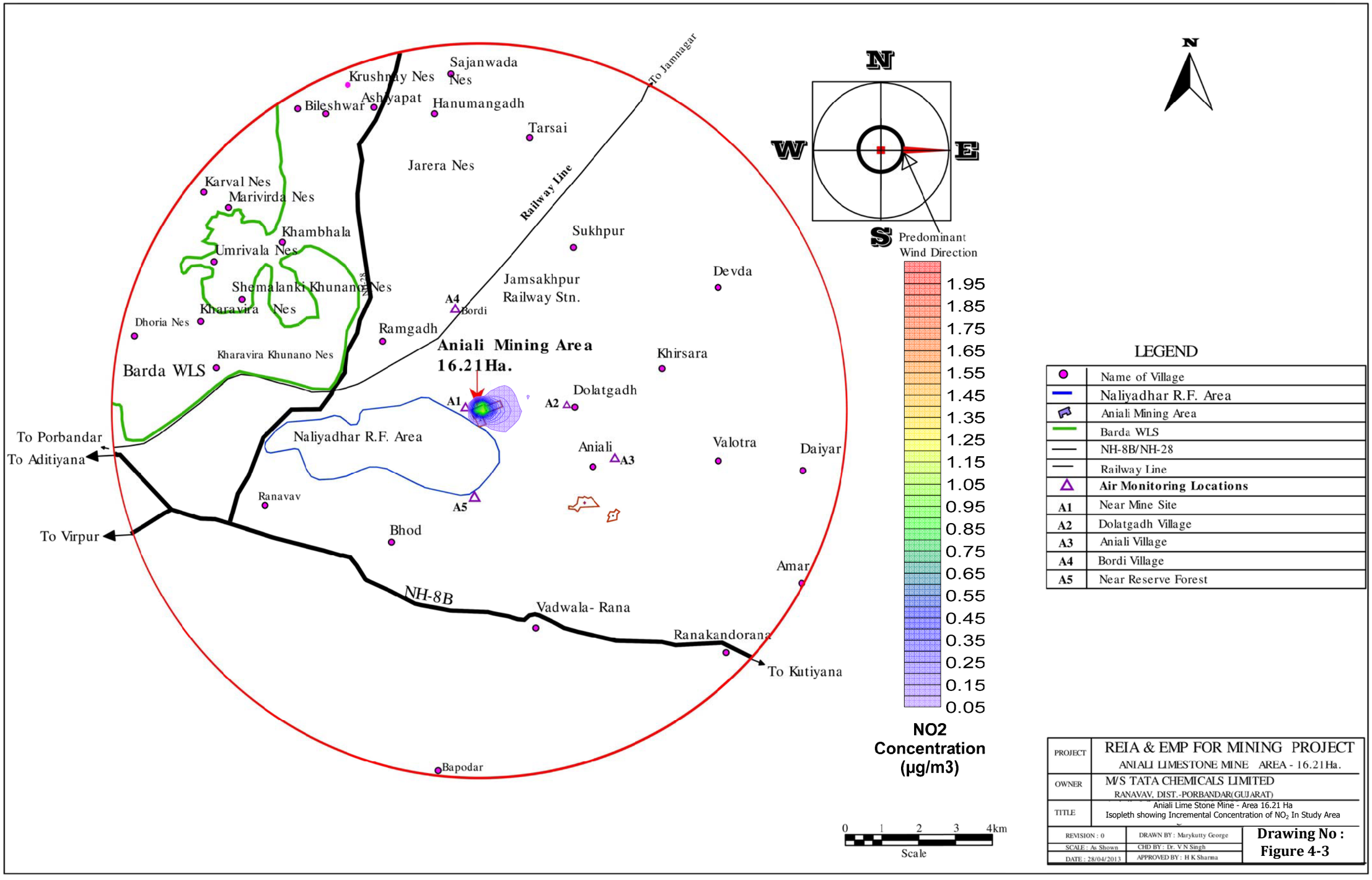
LEGEND

●	Name of Village
▬	Naliyadhar R.F. Area
▰	Aniali Mining Area
▬	Barda WLS
▬	NH-8B/NH-28
▬	Railway Line
△	**Air Monitoring Locations**
A1	Near Mine Site
A2	Dolatgadh Village
A3	Aniali Village
A4	Bordi Village
A5	Near Reserve Forest

PROJECT	REIA & EMP FOR MINING PROJECT ANIALI LIMESTONE MINE AREA - 16.21Ha.	
OWNER	M/S TATA CHEMICALS LIMITED RANAVAV, DIST.-PORBANDAR(GUJARAT)	
TITLE	Aniali Lime Stone Mine - Area 16.21 Ha Isopleth showing Incremental Concentration of SO_2 In Study Area	
REVISION : 0	DRAWN BY : Marykutty George	**Drawing No : Figure 4-2**
SCALE : As Shown	CHD BY : Dr. V N Singh	
DATE : 28/04/2013	APPROVED BY : H K Sharma	

Isopleth showing Incremental Concentration of NO_2 In Study Area

Figure 4-3

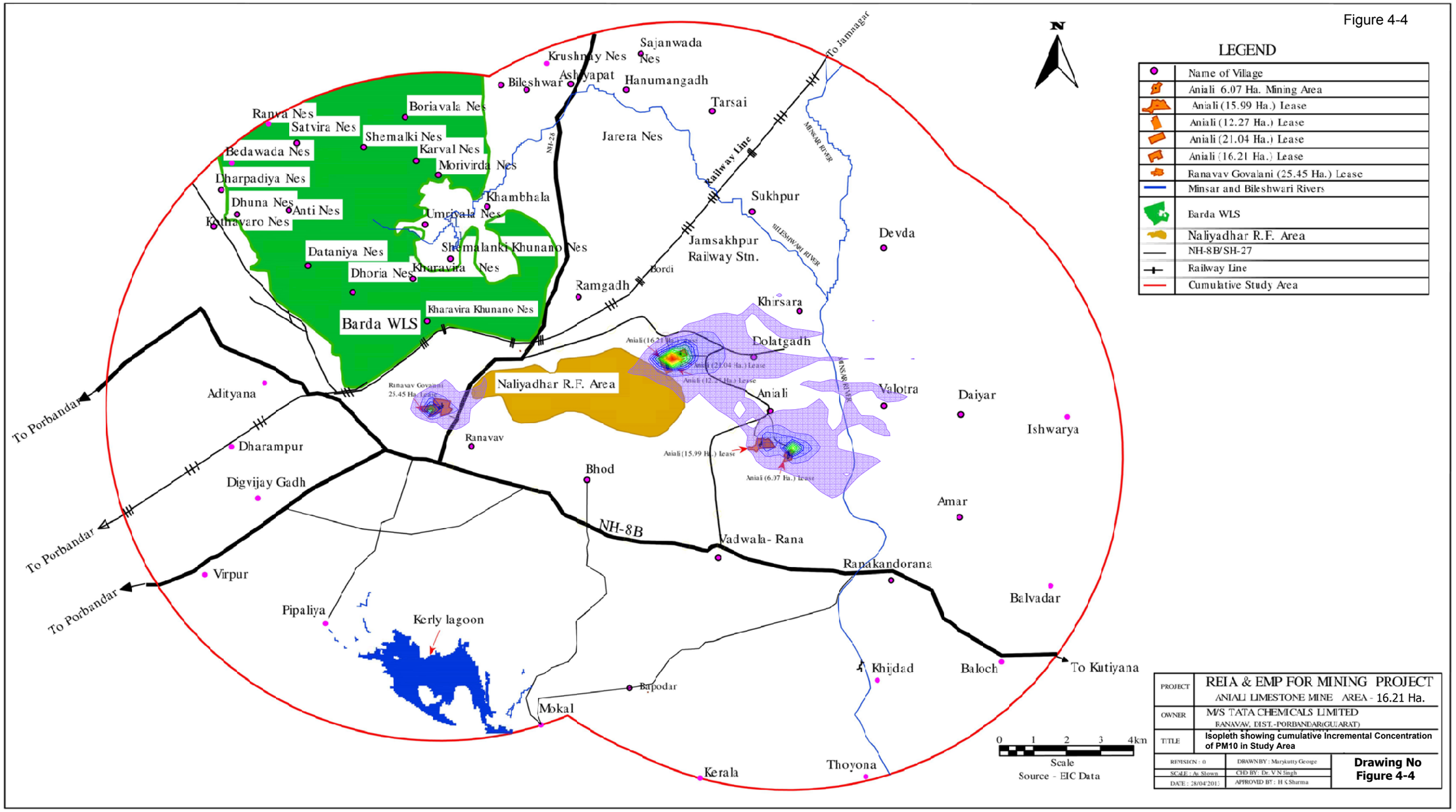


LEGEND

●	Name of Village
▬	Naliyadhar R.F. Area
▰	Aniali Mining Area
▬	Barda WLS
▬	NH-8B/NH-28
▬	Railway Line
△	**Air Monitoring Locations**
A1	Near Mine Site
A2	Dolatgadh Village
A3	Aniali Village
A4	Bordi Village
A5	Near Reserve Forest

PROJECT	REIA & EMP FOR MINING PROJECT ANIALI LIMESTONE MINE AREA - 16.21Ha.	
OWNER	M/S TATA CHEMICALS LIMITED RANAVAV, DIST.-PORBANDAR(GUJARAT)	
TITLE	Aniali Lime Stone Mine - Area 16.21 Ha Isopleth showing Incremental Concentration of NO_2 In Study Area	
REVISION : 0	DRAWN BY : Marykutty George	**Drawing No : Figure 4-3**
SCALE : As Shown	CHD BY : Dr. V N Singh	
DATE : 28/04/2013	APPROVED BY : H K Sharma	

Isopleth showing cumulative Incremental Concentration of PM10 in Study Area

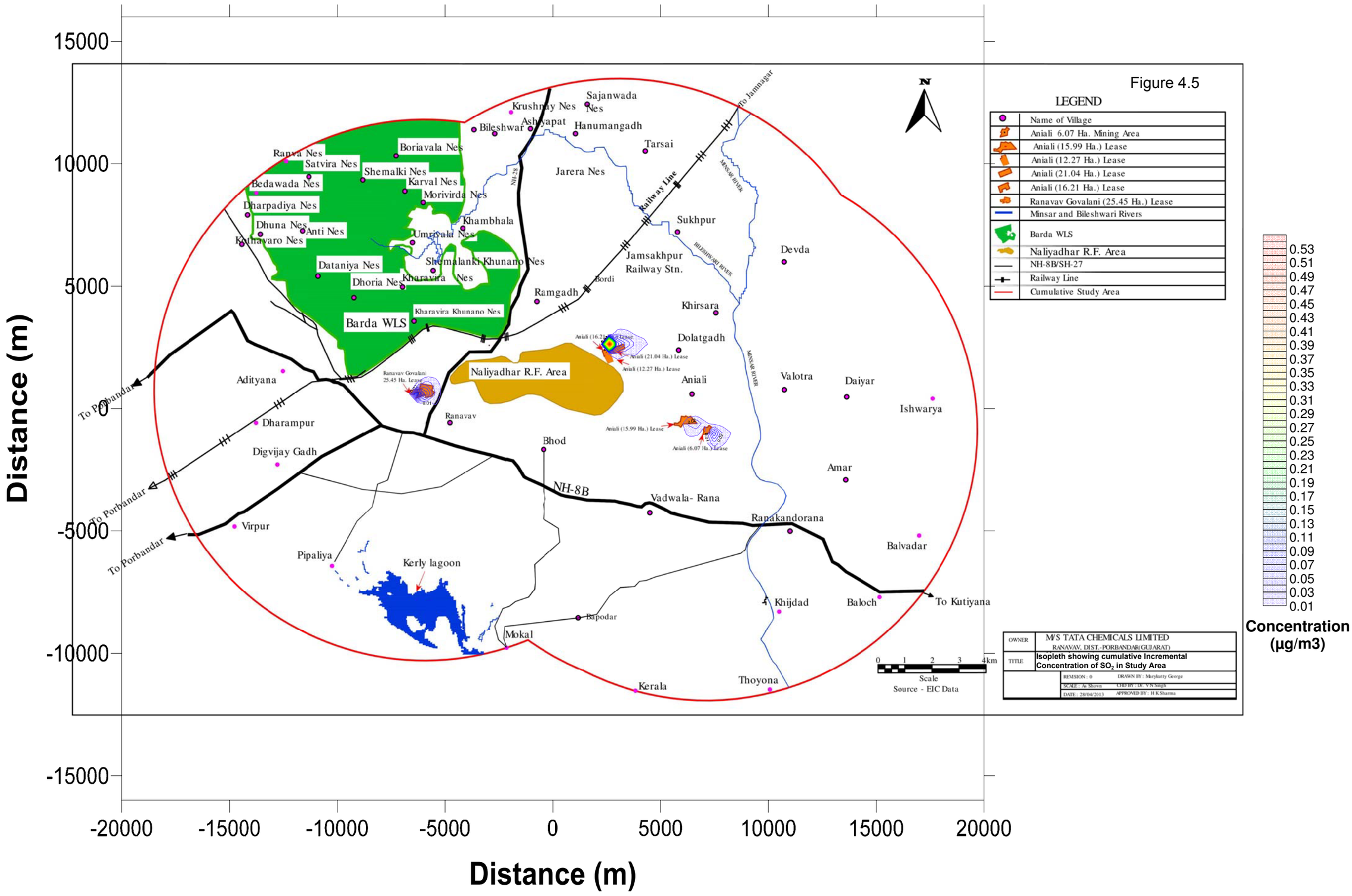


31 29 27 25 23 21 19 17 15 13 11 9 7 5 3 1

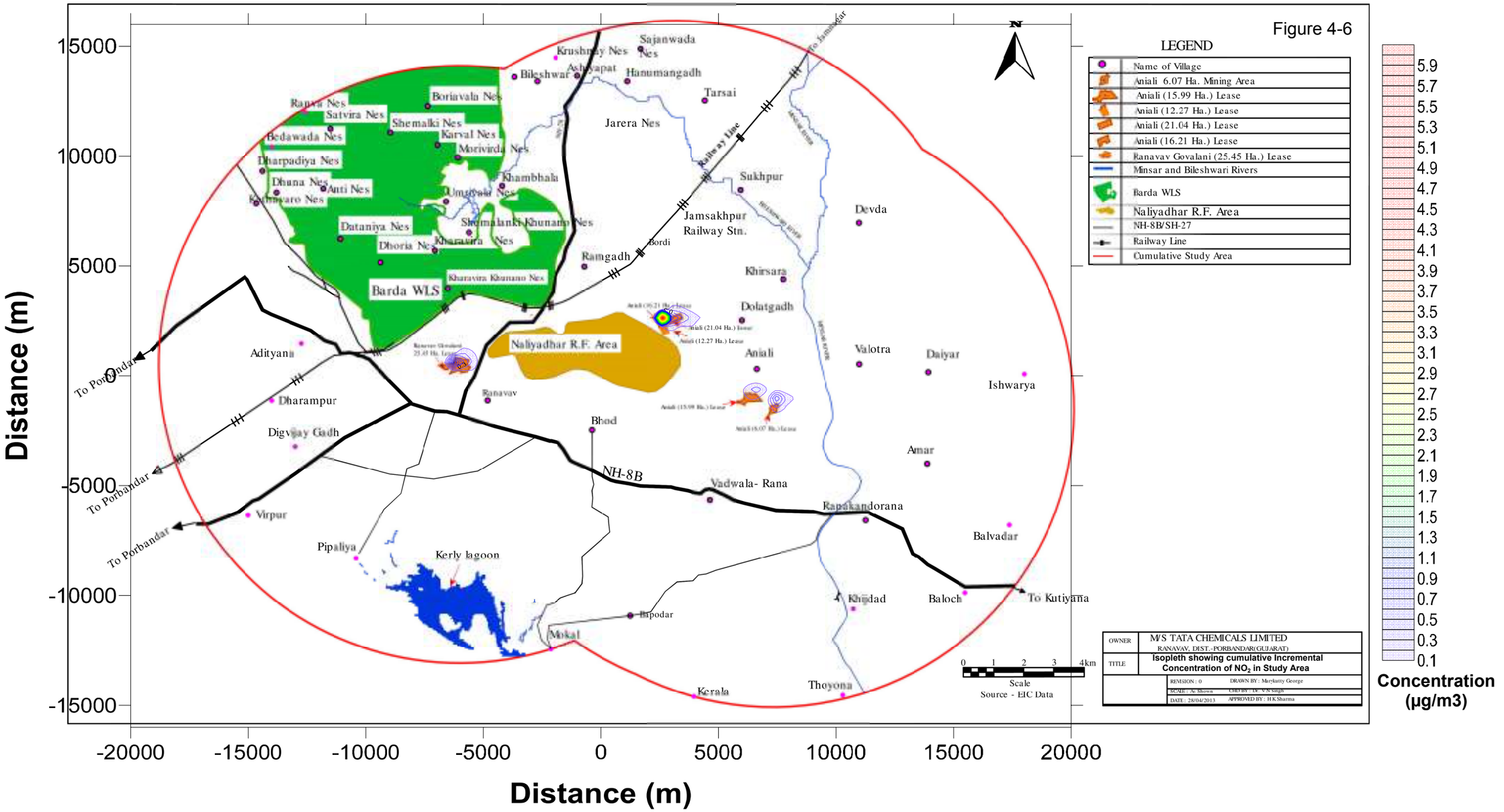
PM10 Concentration (µg/m3)

Isopleth showing cumulative Incremental Concentration of SO2 in Study Area

Figure 4.5



Isopleth showing cumulative Incremental Concentration of NO2 in Study Area



APPENDIX : QUESTIONNAIRE

PROFORMA FOR ENVIRONMENTAL APPRAISAL OF MINING PROJECTS (MINING SECTOR PROJECTS)

Note 1:	All information to be given in the form of Annex/s should be properly numbered and form part of reply to this proforma.
Note 2:	Please enter √ in appropriate box where answer is Yes / No
Note 3:	No abbreviation to be used - **Not available** or **Not applicable** should be clearly mentioned.
Note 4:	**Core zone** is the mining lease area. **Buffer zone** in case of ML area up to 25 ha is to be considered as **5 km** all around the periphery of the core zone and for ML area above 25 ha. an area **10 km** all around the periphery of the core zone.
Note 5:	Adopt **Scoping process** in carrying out EIA study.
Note 6:	Please indicate source of data.

1.	**General Information**				
a)	**Name of the project**	**Aniali Limestone Mine 16.21 Ha**			
i.	Name of the proponent	M/s TATA Chemicals Ltd.			
	Mailing Address	Rahul J. Buch General Manager (Safety, Health & Environment) Tata Chemicals Ltd., Mithapur, Jamnagar, Gujarat - 361345			
	E-mail	rjbuch@tatachemicals.com			
	Telephone	02892-665267, 665991-94 (Ext5267)			
	Fax No.	02892-223361			
b)	**Objective of the project**	**Mining of Limestone**			
c)	**Location of Mine (s)**	**Survey No. 207/p**			
	Village	Aniali			
	Tehsil	Ranavav			
	District	Porbandar			
	State	Gujarat			
d)	**Does the Proposal relate to**				
i.	New Mine	Yes		No	√ (Existing Mining Lease granted on 12.06.1964, and first renewal

TATA CHEMICALS LIMITED MITHAPUR 361 345

					granted on 09.09.1986. Applied first time for E.C and Not Operated since 1994-95.
ii.	Expansion	Yes		No	√
	• Increase in ML area	Yes		No	√
	• Increase in annual production	Yes		No	√
iii.	Renewal of ML	Yes	√ (Applied for 2nd Renewal to Government of Gujarat in 2003 for 20 years. Lease period is now under deemed renewal as provided under rule 24 A 6 of MCR 1960.)	No	
iv.	Modernization	Yes		No	√
e)	**Site Information**				
i.	Geographical location				
	• Latitude • Longitude				

Pillar No	Latitude	Longitude
1	21° 42' 20.15"	69°49'38.56"
2	21° 42' 17.62"	69°49'31.80"
3	21° 42' 23.13"	69°49'29.44"
4	21° 42' 21.73"	69°49'25.69"
5	21° 42' 19.84"	69°49'26.50"
6	21° 42' 18.43"	69°49'22.72"
7	21° 42' 27.06"	69°49'19.01"
8	21° 42' 35.11"	69°49'40.53"
9	21° 42' 32.82"	69°49'41.52"
10	21° 42' 30.11"	69°49'34.29"

	• Survey of India Toposheet Number	41 G /14 (Restricted)

	• Elevation above mean sea level	73 -61 AMSL			
	• Total mine lease area (in ha.)	16.21 ha			
ii.	Dominant nature of terrain				
	• Flat	Yes	√	No	
	• Undulated	Yes	√	No	
	• Hilly	Yes		No	√

2.	**Land usage of the mining lease area (in ha.)**	
a)	Agricultural	--
b)	Forest	--
c)	Waste land	16.21 ha (Government Waste Land)
d)	Grazing	--
e)	Surface water bodies	--
f)	Others (Specify)	--
	Total	**16.21 ha**

3.	**Indicate the seismic zone in which ML area falls. In case of zone IV & V, details of earth quakes in last 10 years.**				
a)	Severity (Richter scale)	Seismic zone-III (as per IS 1893:2002)			
b)	Impact i.e. Damage to				
	• Life	Yes		No	√
	• Property	Yes		No	√
	• Existing Mine	Yes		No	√

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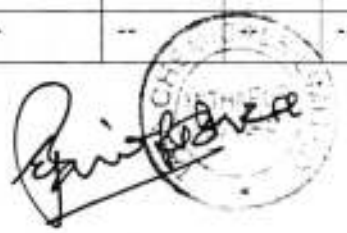
4. **Break-up of mining lease area (in ha.) as per approved conceptual plan:**

Purpose	Mining Lease Area				Total	Area acquired				Area to be acquired			
	Government		Private			Government		Private		Government		Private	
	Forest	Others	Agri.	Others		Forest	Others	Agri.	Others	Forest	Others	Agri.	Others
1. Area to be excavated	--	**13.13**	--	--	**13.13**	--	**13.13**	--	--	--	--	--	--
2. Storage for top soil	--	--	--	--	--	--	--	--	--	--	--	--	--
3. Overburden / Dumps	--	--	--	--	--	--	--	--	--	--	--	--	--
4. Mineral storage	--	--	--	--	--	--	--	--	--	--	--	--	--
5. Infrastructure (Workshop, Administrative Building)	--	-- --	--	--	-- --	--	--	--	--	--	--	--	--
6. Roads	--		--	--		--	--	--	--	--	--	--	--
7. Railways	--	--	--	--	--	--	--	--	--	--	--	--	--
8. Green Belt	--	**0.86**	--	--	**0.86**	--	**0.86**	--	--	--	--	--	--
9.Tailings pond	--	--	--	--	--	--	--	--	--	--	--	--	--
10.Effluent treatment plant	--	--	--	--	--	--	--	--	--	--	--	--	--
11.Coal handling plant / mineral separation plant	--	--	--	--	--	--	--	--	--	--	--	--	--
12. Township area	--	--	--	--	--	--	--	--	--	--	--	--	--
13.Other (Waste Land)	--	**2.22**	--	--	**2.22**	--	**2.22**	--	--	--	--	--	--
TOTAL	--	**16.21**	--	--	**16.21**	--	**16.21**	--	--	--	--	--	--



5.	Township (outside mining lease)	
a)	Total area (in ha)	--
b)	No. of dwelling units	--
c)	Distance from the mine site	--

6.	Distance of water bodies (in km)		
	Distance from	River Bank *	Other Water bodies * Sea / Creek / lake / nalla etc.(specify)
	Mining lease boundary	Minsar river- 5.60 Km	--
		Bileshwari river- 4.86 km	
	Ancillary facilities	--	--

[* From highest flood line / high tide line]

7.	For projects falling within the Coastal Regulation Zone (CRZ)				
	Whether the mineral to be mined is of rare nature and not available outside CRZ	Yes	--	No	--
	if yes, annex a scaled location map showing low tide line (LTL), high tide line (HTL) duly demarcated by one of the authorized agencies* [*Director, Space Application Centre, Ahmedabad: Centre for Earth Sciences Studies, Thiruvananthapuram: Institute of Remote Sensing, Anna University, Chennai: Institute of Wetland Management & Ecological Designs, Kolkata: Naval Hydrographers's Office, Dehradun: National Institute of Oceanography, Panjim, Goa: and National Institute of Ocean Technology, Chennai], boundary of mining lease area, distance of ML area from LTL and HTL CRZ boundary and CRZ classification of the project area as per the approved Coastal Zone Management Plan, and settlements, sand dunes, mangroves, forest land/patches, turtles breeding and nesting sites etc., if any, in the project area.				

8.	Indicate aerial distance from the periphery of core zone / area from the periphery of the buffer zone to the boundary of following (up to 10 km):			
S.No.	Areas	Name	Aerial distance from (in km.)	
			Core* Zone	Buffer* Zone
1	National Park / Sanctuary	Barda Wildlife Sanctuary	--	3.92 Km
2	Biosphere Reserve / Tiger Reserve / Elephant Reserve / any other Reserve	None	--	--
3	Forest (RF / PF / unclassified)	Naliyadhar R.F.	--	0.11 km
4	Habitat for migratory birds	None	--	--
5	Corridor for animals of schedule I & II of the Wildlife (Protection) Act, 1972	None	--	--
6	Archaeological sites	None	--	--
	* Notified	None	--	--
	* Others	None	--	--
7	Defence Installation	None	--	--
8	Industries / Thermal	None	--	--

	Power Plants			
9	Other Mines	Limestone Mine leases of Tata Chemicals and other owners Aniali 6.07 ha Aniali 21.04 ha Aniali 12.27 ha Aniali 15.99 ha		 4.27 km 0 km 0 km 3.35 km
10	Airport	None		
11	Railway Lines	Porbandar Ahmedabad		2.14 km
12	National / State Highways	NH-8B SH-27		5.23 km 4.06 km

[* Buffer zone in case of ML area up to 25 ha. is to be considered as **5 km** all around the periphery of the core zone and for ML area above 25 ha. an area **10 km** all around the periphery of the core zone].

9.	**Description of flora & fauna separately in the core and buffer zones.***

[* Consult the Wildlife (Protection) Act, 1972 as amended subsequently and list species with (1) Common name (2) Scientific name and (3) under which schedule of the Wildlife (Protection) Act the identified species fall. Get the list authenticated by an Expert in the field / credible scientific institute / University / Chief Wildlife Warden office. **Information to be based on field survey.**]

A.	Flora				**Core zone**	**Buffer zone**
1	Agricultural Crops				Common list is given below	Common list is given below
2	Commercial Crops					
3	Plantation					
Sl. No.	**Plant Species**	**Family**	**Local name**	**Life form**	**Core zone**	**Buffer zone**
1	*Andrographis paniculata* (Burm.f) Wall.	Acanthaceae	-	Herb	A	P
2	*Astrecantha longifolia* Nees	Acanthaceae	-	Herb	A	P
3	*Barleria prionitis* L. var. *prionitis*	Acanthaceae	Kantashelio	Shrub	A	P
4	*Dipteracanthus patulus* (Jacq.) Nees	Acanthaceae	-	Herb	A	P
5	*Elytraria acualis* (L.f.) Lindau	Acanthaceae	Pat Pathari	Herb	A	P
6	*Justicia procumbens* L.	Acanthaceae	-	Herb	P	P
7	*Justicia simplex* D.Don	Acanthaceae	Kari Andhedi, Kali Kariatu	Herb	A	P
8	*Lepidagathis trinervis* Wall.	Acanthaceae	Haran Cahro	Herb	P	P
9	*Neuracanthus trinervius* Wt.	Acanthaceae	Ganthera Kari Adhedi,	Herb	A	P
10	*Peristrophe bicalyculata* (Retz.) Nees	Acanthaceae	Adhedi, Lisi Adhedi	Herb	A	P
11	*Trianthema monogyna* L.	Aizoaceae	Satodo	Herb	A	P
12	*Achyranthes aspera* L. var. *argentea* Hook.f.	Amaranthaceae	Andhedi, Anghedo	Herb	A	P
13	*Aerva lanata* (L.) Juss.	Amaranthaceae	Gorakhganjo	Herb	A	P
14	*Amaranthus viridis* L.	Amaranthaceae	Tandaljo	Herb	A	P
15	*Digera muricata* (L.) Mart.	Amaranthaceae	Lolar	Herb	A	P
16	*Pupalia lappacea*(L.) Juss.	Amaranthaceae	Zipto Safed	Under Shrub	A	P
17	*Magnifera indica* L.	Ancardiaceae	Ambo	Tree	A	P
18	*Annona squamosa* L.	Annonaceae	Sitafal	Small Tree	A	P
Sl. No.	**Plant Species**	**Family**	**Local**	**Life form**	**Core**	**Buffer**

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			name		zone	zone
19	*Polyalthia longifolia* (Sonn.) Thw.	Annonaceae	Ashok	Tree	A	P
20	*Carissa congesta* Wt.	Apocynaceae	Karmada	Tree	A	P
21	*Holarrhena antidysenterica* (Heyne ex Roth) Wall.	Apocynaceae	Indrajav	Small Tree	A	P
22	*Thevetia Peruvian* (Pers.) Merr.	Apocynaceae	Pili Karen	Shrub	A	P
23	*Wrightia tinctoria* R.Br.	Apocynaceae	Dudhio	Tree	A	P
24	*Phoenix sylvestris* (L.) Roxb.	Arecaceae	Khejur	Tree	A	P
25	*Calotropis procera* (Ait.) R. Br.	Asclepiadaceae	Ankado	Shrub	P	P
26	*Pergularia daemia* (Forsk.) Chiov.	Asclepiadaceae	Chamar Dudheli	Twiner	A	P
27	*Blumea* sp.	Asteraceae	-	Herb	A	P
28	*Echinops echinatus* Roxb.	Asteraceae	Utkanto	Under Shrub	P	P
29	*Eclipta prostrata* (L.) L. Mant.	Asteraceae	Bhangaro	Herb	A	P
30	*Launaea resedifolia* (L.) Druce	Asteraceae	-	Herb	A	P
31	*Pulicaria wightiana* (DC.) Cl.	Asteraceae	Sonfulki, Sisoria	Herb	A	P
32	*Sonchus asper* Hill.	Asteraceae	Son chudi	Herb	A	P
33	*Tridax procumbens* L.	Asteraceae	Pardeshi Bhangro, Kaliyu Khor	Herb	P	P
34	*Vernonia cinerea* (L.) Less.	Asteraceae	Sahdevi	Herb	P	P
35	*Xanthium strumarium* L.	Asteraceae	Gadariyun	Herb	A	P
36	*Balanities aegyptia* L.	Balanitaceae	Hingor, Ingoriyo	Small Tree	A	P
37	*Heliotropium indicum* L.	Boraginaceae	Hathi Sundho	Herb	A	P
38	*Heliotropium ovalifolium* Forsk.	Boraginaceae	Velalun Hathi Sundho	Herb	A	P
39	*Farsetia jacquemontii* Hk.f. &Th.	Brassicaceae	-	Herb	A	P
40	*Commiphora wightii* (Arn.) Bhandari	Burseraceae	Gugal	Small Tree	A	P
41	*Bauhinia purpurea* L.	Caesalpiniaceae	Kanchner	Tree	A	P
42	*Bauhinia racemosa* L.	Caesalpiniaceae	Asundro	Small Tree	A	P
43	*Cassia auriculata* L.	Caesalpiniaceae	Aval Nani Chimed ,	Shrub	P	P
44	*Cassia pumilla* Lam.	Caesalpiniaceae	Bethi Chimed	Herb	A	P
45	*Cassia siamea* Lam.	Caesalpiniaceae	-	Small Tree	A	P
46	*Cassia tora* L.	Caesalpiniaceae	Kunwario	Herb	A	P
47	*Tamarindus indica* L.	Caesalpiniaceae	Ambali	Tree	A	P
48	*Capparis decidua* (Forsk.) Edgew.	Capparaceae	Kerdo,Kera	Shrub	P	P
49	*Capparis sepiaria* L.	Capparaceae	Kanther	Straggling Shrub	A	P
50	*Maerua oblongifolia* (Foeak.) A. Rich.	Capparaceae	Hemkand	Shrub	A	P
51	*Carica papaya* L.	Caricaceae	Pappaya	Tree	A	P
52	*Maytenus emarginata* (Willd.) D. Hou	Celastreceae	Vicklo	Shrub	A	P
53	*Terminalia belerica* (Gaertn.) Roxb.	Combretaceae	Behda	Tree	A	P
54	*Terminalia catappa* L.	Combretaceae	Deshi Badam	Tree	A	P
55	*Commelina benghalensis* L.	Commelinaceae	Moti	Herb	A	P

			shundiyu			
Sl. No.	Plant Species	Family	Local name	Life form	Core zone	Buffer zone
56	*Evolvulus alsinoides* L.	Convolvulaceae	Kari Sankhavail	Grass	A	P
57	*Merremia tridentate* (L.) Hall.f.	Convolvulaceae	Topriyal, Bhinigario	Herb	A	P
58	*Coccinia grandis* (L.) Voigt	Cucurbitaceae	Giloda	Climber	A	P
59	*Cyperus alopecuroides* Rottb.	Cyperaceae	-	Sedge	A	P
60	*Cyperus rotundus* L.	Cyperaceae	Moth, Chido	Sedge	A	P
61	*Scirpus lateriflorus* Gmel.	Cyperaceae	-	Sedge	A	P
62	*Diospyros melanoxylon* Roxb.	EbenaceaeS	Timbaru	Tree	A	P
63	*Cordia dichotoma* Forst.	Ehretiaceae	Vad Gundo	Tree	A	P
64	*Cordia gharaf* (Forsk.) E.&.A.	Ehretiaceae	Nana Gunda, Liar Gundi	Tree	A	P
65	*Ehretia aspera* Roxb.	Ehretiaceae	Nani vadhawrdi	Tree	A	P
66	*Bergia ammannioides* Roxb.ex Roth	Elatinaceae	Jal Ukharad	Herb	A	P
67	*Euphorbia hirta* L.	Euphorbiaceae	Vadi Dudheli, Kalu Ganthiu	Herb	A	P
68	*Euphorbia caducifolia* Hains.	Euphorbiaceae	Danda Thor	Shrub	A	P
69	*Euphorbia nerifolia* L.	Euphorbiaceae	Thor	Shrub	A	P
70	*Kirganelia reticulate* (Poir.) Baill.	Euphorbiaceae	Kamboi	Shrub	A	P
71	*Phyllanthus fraternus* Webst.	Euphorbiaceae	Kharedi, Bhonya Amli	Herb	A	P
72	*Abrus precatorius* L.	Fabaceae	Chanothi	Chanothi	A	P
73	*Alysicarpus monilifer* (L.) DC.	Fabaceae	Nano Sanervo,	Herb	A	P
74	*Butea monosperma* Lamk.	Fabaceae	Kesudo	Tree	A	P
75	*Delonix regia* (Boj.)	Fabaceae	Gulmohar	Tree	A	P
76	*Goniogyna hirta* (Willd.) Ali	Fabaceae	-	Herb	A	P
78	*Indigofera cordifolia* L.	Fabaceae	Pat Gari	Herb	P	P
79	*Enicostema axillare*(Lamk.) Roynal	Gentianaceae	Mamejavo	Herb	P	P
80	*Leucas aspera* (Willd.) Spr.	Lamiaceae	Kubo	Herb	A	P
81	*Ammannia baccifera* L.	Lythraceae	Jal Agio	Herb	A	P
82	*Abutilon indicum* (L.) Sw.	Malvaceae	Khapat	Under Shrub	A	P
83	*Sida cordata* (Burm. f.) Borss	Malvaceae	Bhoy Bala	Herb	P	P
84	*Thespesia populnea* (L.)Sol.ex. Corr.	Malvaceae	Paras Piplo	Tree	A	P
85	*Azadirachta indica* A. Juss.	Meliaceae	Limdo	Tree	A	P
86	*Acacia leucopholea* Willld.	Mimosaceae	Harmo baval	Tree	A	P
87	*Acacia jacquemontii* Bth.	Mimosaceae	Rato Baval	Small Tree	A	P
88	*Acacia nilotica* (L.) Del. Sub sp. *Indica* (Bth.) Brenan	Mimosaceae	Deshi Baval	Tree	P	P
89	*Acacia senegal* Willd.	Mimosaceae	Kher	Tree	A	P
90	*Albizia lebbeck* Benth.	Mimosaceae	Karo Sirish	Tree	A	P
91	*Dichrostachya cinerea* (L.)W.& A.	Mimosaceae	Madhad	Shrub	A	P
92	*Leucaena leucocephala* (Lam.)	Mimosaceae	Pardeshi Baval	Small Tree	A	P
93	*Pithecellobium dulce* (Roxb.) Bth.	Mimosaceae	Goras Amali	Tree	A	

94	*Prosopis cineraria* (L.) Druce	Mimosaceae	Khijado, Shami	Tree	A	P
95	*Prosopis* Druce *juliflora* (Sw.) DC.	Mimosaceae	Gando Baval	Small Tree	P	P
Sl. No.	**Plant Species**	**Family**	**Local name**	**Life form**	**Core zone**	**Buffer zone**
96	*Ficus benghalensis* L.	Moraceae	Vad	Tree	A	P
97	*Ficus racemosa* L.	Moraceae	Umaro	Tree	A	P
98	*Ficus microcarpa* L. f.	Moraceae	Pragvad	Tree	A	P
99	*Morus alba L.*	Moraceae	-	Shrub	A	P
100	*Moringa oleifera* Lam.	Moringaceae	Mitho Saragvo	Tree	A	P
101	*Musa paradisiaca* L.	Musaceae	Kera	Small Tree	A	P
102	*Boerhavia diffusa* L.	Nyctaginaceae	Satodi	Herb	A	P
103	*Dyerophytum indicum* (Gibs. Ex Wt.) O. Ktze.	Plumbaginaceae	Rato Chitro	Herb	A	P
104	*Plumbago Zeylanica* L.	Plumbaginaceae	Chitrak	Under Shrub	A	P
105	*Aeluropus lagopoides* (L.) Trin. ex Thw.	Poaceae	-	Grass	A	P
106	*Apluda mutica* L.	Poaceae	-	Grass	A	P
107	*Aristida adscensionis* L. subsp. *adscensionis*	Poaceae	Laso Lampdo	Grass	P	P
108	*Aristida funiculata* Trin. & Rupr.	Poaceae	Lampdu	Grass	A	P
109	*Cenchrus ciliaris* L.	Poaceae	Dhaman, Jhinu Dhamnu	Grass	A	P
110	*Cynodon dactylon* (L.) Pers.	Poaceae	Dhrab	Grass	A	P
111	*Dichanthium annulatum* Forsk.) Stapf	Poaceae	Jinjavo	Grass	P	P
112	*Eragrostis Poaeoides P. Beauv.*	Poaceae	-	Grass	P	P
113	*Melanocenchrus jacquemontii* J. & S.	Poaceae	-	Grass	A	P
114	*Sporobolus helvolus* (Trin.) Thw.	Poaceae	-	Grass	P	P
115	*Zizyphus nummularia* (Burm. F.) W. & A.	Rhamnaceae	Chani Bor	Under Shrub	P	P
116	*Borreria articularis* (L.f.) F.N. Will.	Rubiaceae	Ganthiyu	Herb	A	P
117	*Borreria stricta* (L.f.)	Rubiaceae	-	Herb	A	P
118	*Ixora arborea* Roxb.ex Sm.in Rees,	Rubiaceae	Naveri	Small Tree	P	P
119	*Mitragyna parvifolia* Korth.	Rubiaceae	Kadamb	Tree	A	P
120	*Morinda tomentosa* Heyne ex Roth.	Rubiaceae	Aal	Small Tree	A	P
121	*Aegle marmelos* (L.) Corr.	Rutaceae	Bili	Small Tree	A	P
122	*Murraya koenigii (L.)*	Rutaceae	Mitho Limbado, Kadi Patta	Small Tree	A	P
123	*Cardiospermum halicacabum* L.	Sapindaceae	-	Herb	A	P
124	*Lindenbergia muraria* (Roxb. Ex D. Don) P.	Scrophulariacea e	Pathar Chatti	Herb	A	P
125	*Physalis minima* L.	Solanaceae	Popti	Herb	A	P
126	*Helicteres isora* L.	Sterculiaceae	Maradsing	Tree	A	P
127	*Corchorus aestuans* L.	Tiliaceae	Chunch	Herb	A	P
128	*Corchorus capsularis* L.	Tiliaceae	Bor Chhunchi	Herb	A	P
129	*Grewia tenax* (Forsk.) Fiori	Tiliaceae	Gangeti	Under Shrub	P	P
130	*Grewia tiliaefolia* Vahlvar.tiliaefolia	Tiliaceae	Dhaman	Small Tree	A	P

Sl. No.	Plant Species	Family	Local name	Life form	Core zone	Buffer zone
131	*Typha angustata* Bory & Chaub	Typhaceae	Ga Bajriya	Herb	A	P
132	*Clerodendrum multiflorum* (Burm.f.)	Verbenaceae	Arni	Small Tree	A	P
133	*Clerodendrum phlomidis* L.	Verbenaceae	Arni	Shrub	A	P
4	Natural vegetation / forest type				--	Naliya dhar Reserved Forest within study area.
5	Grass lands				--	--
6	Endangered species				--	--
7	Endemic species				--	--
8	Others (Specify)				--	--
B.	**Fauna**					
1)	**Total listing of faunal elements**					

S.No.	Zoological name	Common Name	WL Act, 1972 Schedule	Presence	
				Core Zone	Buffer Zone
	Amphibians				
i.	*Euphlictis cyanphylictis*	Indian skipping frog	IV	-	√
ii.	*Fejevarya limnocharis*	Cricket frog	IV	-	√
iii.	*Hoplobarahus tigerinus*	Indian bull frog	IV	-	√
	Reptiles				
i.	*Calotes Sp.*	-	-	-	All around
ii.	*Calotes versicolar*	Indian garden lizard *	-	√	BWLS
iii.	*Cyrtopodion Sp.*	-	-	-	
iv.	*Echis carinatus*	Indian saw scaled viper	IV	-	BWLS
v.	*Hemidactylus flaviviridis*	Yellow-green house gecko *	-	-	All around
vi.	*Mabuya carinata*	Keeled grass skink *	-	√	All around
vii.	*Mabuya macularia*	Common bronze-back skink	-	-	BWLS
viii.	*Naja naja*	Spectacled cobra	II	-	BWLS
ix.	*Ptyas mucosa*	Indian rat snake	II	-	BWLS
x.	*Sitana ponticeriana*	Fan-throated lizard		-	BWLS
	(*)- Direct evidence during survey				
	Mammalia				
i.	*Boselaphus tragocamelus*	Nilgai *	III	-	BWLS + NFR

S.No.	Zoological name	Common Name	WL Act, 1972 Schedule	Core Zone	Buffer Zone
ii.	*Felis chaus*	Jungle Cat *	II	-	BWLS+ NFR
iii.	*Funambulus pennant*	Five-striped Palm Squirrel *	IV	√	All around
iv.	*Herpestes edwardsi*	Common mongoose*	IV	-	
v.	*Hyaena hyaena*	Striped Hyena	III	-	BWLS
vi.	*Hystrix indica*	Porcupine	IV	-	BWLS + NFR
vii.	*Lepus nigricollis*	Indian Hare *	IV	-	All around
viii.	*Panthera pardus*	Leopard	I	-	BWLS
ix.	*Rattus rattus*	House Rat *	IV	√	All around
x.	*Sus acrofa*	Wild boar *	III	-	BWLS + NFR
	(*) *Direct evidence during survey* BWLS- Barda Wildlife sanctuary, NFR- Naliyadhar Reserve Forests				
	Avifauna				

S.No.	Zoological name	Common Name	WL Act, 1972 Schedule	Presence	
				Core Zone	Buffer Zone
i.	*Acridotheres tristis*	Common Myna	IV	√	√
ii.	*Alcedo atthis*	Small Blue Kingfisher	IV	-	√
iii.	*Anas strepera*	Gadwall	IV	-	√
iv.	*Columba livia*	Rock Pigeon	IV	√	√
v.	*Dendrocygna javanica*	Lesser Whistling Duck	IV	-	√
vi.	*Eudynamys scolopacea*	Asian Koel	IV	-	√
vii.	*Francolinus pondicerianus*	Grey Francolin	IV	-	√
viii.	*Grus grus*	Common Crane	IV	-	√
ix.	*Halcyon smyrnensis*	White-throated Kingfisher	IV	-	√
x.	*Lanius schach*	Long-tailed Shrike	--	-	√
xi.	*Lonchura malabarica*	Indian Silverbill	IV	-	√
xii.	*Merops orientalis*	Green Bee-eater	--	√	√
xiii.	*Milvus migrans*	Black Kite	--	-	√
xiv.	*Nectarinia asiatica*	Purple Sunbird	IV	-	√
xv.	*Passer domesticus*	House Sparrow	IV	√	√
xvi.	*Pavo cristatus*	Indian Peafowl	I	-	√
xvii.	*Ploceus philippinus*	Baya Weaver	IV	-	√
xviii.	*Pseudibis papillosa*	Black Ibis	IV	-	√
xix.	*Psittacula krameri*	Parakeet	IV	-	√

S.No.	Zoological name	Common Name	WL Act, 1972 Schedule	Core Zone	Buffer Zone
xx.	*Pycnonotus cafer*	Red-vented Bulbul	IV	-	√
xxi.	*Upupa epops*	Common Hoopoe	--	√	√
2)	Endangered species			Core Zone	Buffer Zone
i.	***Pavo cristatus- Schedule I***			--	√
ii.	***Panthera pardus- Schedule I***			--	√
3)	Endemic species			--	--
4)	Migratory species			--	--
5)	Details of aquatic fauna, if applicable			--	--

10.	**Details of mineral reserves (as per approved Mining Plan)** **Quantity (in million tones)**	
a)	Proved	Detailed breakup of resources in UNFC system as given below:
b)	Indicated	
c)	Inferred	
d)	Mineable reserves	

Detailed breakup of resources in UNFC system as given below:

Category	UNFC Code	Quantity in Million MT.
Total Mineral Resources (A+B)		1.0176
A. Mineral Reserve		
1. Proved Mineral Reserves	111	0.4439
2. Probable Mineral Reserves	121 & 122	-
B. Remaining Resource		
1. Feasibility Mineral Resource	211	0.0598
2. Pre-Feasibility Mineral Resource	221 & 222	-
3. Measured Mineral Resource	331	0.5139
4. Indicated Mineral Resource	332	-
5. Inferred Mineral Resource	333	-
6. Inferred Mineral Resource	334	-

Source: Mining Plan - Page no. 24

11.	**Major geological formation / disturbances in the mining lease area**				
a)	Geological maps submitted	Yes	√ Plate No 4A & 4 B of Annexure XI.	No	--
b)	Geological sections submitted	Yes		No	--
c)	Contour map submitted	Yes	√ Plate No 3 of Annexure XI.	No	--
d)	Whether the presence, if any, noted of				
i.	Faults	Yes	--	No	√
ii.	Dykes	Yes	--	No	√

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iii.	Shear zone	Yes	--	No	√
iv.	Folds	Yes	--	No	√
v.	Other Weak zones	Yes	--	No	√
e)	Source of data (indicate)	Approved Mining Plan (Annexure XI)			

12.	**Production of mineral(s) and life of mine**	
a)	Rated capacity of mine mineral wise (Tonnes / annum)	0.088 million Tonnes/Annum
b)	Life of mine at proposed capacity (Years)	6
c)	Lease period (Years)	Limestone mine lease was granted vide grant order no MCR-1563/15740/-G-V-dated 12.06.1964 and same was executed on 31.10.1964. The First renewal was granted vide grant order no. MCR-1583(T-4) GOI-184-CHH dated 09.09.1986 and same was executed on 21.08.1987. Copies of lease deed and lease grant order are enclosed as **Annexure II.** TCL has applied for 2nd renewal vide letter No A/WG/2558/ 2003 dated 21.10.2003 for 20 years and the lease renewal is pending with the Gujarat Govt.
d)	Date of expiry of lease (D /M /Y)	The first lease renewal was expired on 31-10-2004. TCL has applied for 2nd renewal vide letter No A/WG/2558/ 2003 dated 21.10.2003 for 20 years and the lease renewal is pending with the Gujarat Govt. Lease period is now under deemed renewal as provided under rule 24 A 6 o MCR 1960.
e)	Indicate in case of existing mines	
i.	Date of opening of mine	31/10/1964
ii.	Production in the last 5 year from Year ..... to Year ..... In million tones	The mine lease has operated during 1985-86 to 1993-94; The lease is idle since 1994-95. The details of last operated three year production are given below:

Year	Production (Million Tons)
1985-86	0.028720
1986-87	0.031944
1987-88	0.055065
1988-89	0.027727

		1989-90	0.029643
		1990-91	0.042232
		1991-92	0.019959
		1992-93	0.018596
		1993-94	0.030157
iii.	Projected Production for the next 5 years from year ..... To year ..... in Million Tones	**Year**	**Production (in million Tones)**
		1st	0.087
		2nd	0.087
		3rd	0.088
		4th	0.087
		5th	0.084
iv.	Whether mining was suspended after opening of the mine?	Yes	√ / No
	If yes, details thereof, including last production figure and reason for the same.	The mine lease has operated during 1985-86 to 1993-94; The lease is idle since 1994-95. The details of last operated three year production are given below:
		Year	**Production (Million Tons)**
		1985-86	0.028720
		1986-87	0.031944
		1987-88	0.055065
		1988-89	0.027727
		1989-90	0.029643
		1990-91	0.042232
		1991-92	0.019959
		1992-93	0.018596
		1993-94	0.030157
		Notice of temporary closure of subject mine lease has been submitted in Form I. Copy of the same is enclosed as **Annexure – XV** of EIA Report.
v.	Whether plans & sections provided	Yes	√ (Plate 1 To Plate 9 of Annexure XI) / No / --

13.	**Type and method of mining operations**		
TYPE		**METHOD**	
Opencast	√	Manual	--
Underground	--	Semi-mechanized	--
Both	--	Mechanized	√

14.	**Details of ancillary operations for mineral processing**	
a)	Existing	--
b)	Additional	--

15.	**Mine Details**

a)	**Opencast Mine**	
i.	Stripping ratio (mineral in tonnes to over burden in m^3)	No overburden generation is anticipated from mining.
ii.	Ultimate working depth (in m bgl)	8.5 m BGL
iii.	Indicate present working depth in case of existing mine (in m bgl)	
iv.	Thickness of top soil (in m.)	
	• Minimum	As per approved mining plan, the mineable area is devoid of top soil, hence, no proposals are made for top soil management but efforts shall be made to recover even thin layer of soil (incidental soil), it shall be scrapped in separate slice and kept preserved for utilization in plantation work. Ref: Section 2.5.7 of EIA Report.
	• Maximum	
	• Average	
v.	Thickness of overburden (in m.)	
	• Minimum	As per approved mining plan the mineral limestone is exposed on the surface and stratified. There is no overburden to handle. Ref : Section 2.5.7 of EIA Report.
	• Maximum	
	• Average	
vi.	Mining plan	
	• Height and width of the bench in overburden / waste.	As per approved mining plan the mineral limestone is exposed on the surface and stratified. There is no overburden to handle. Ref : Section 2.5.7 of EIA Report.
	• Height & width of the bench in ore body/ coal seam	Height-4.0 m Width- 15 to 20 m
	• Proposed inclination / slope of the sides of the opencast mine (separately for overburden, coal / ore and overall slope of the pit sides) both while operating the mine as well as at the time of closure of the mine	Side of excavation will be adequately benched sloped and as per regulation 106 of The Metalliferous Mines Regulation 1961, Mines Act 1952, Mines Rules 1955 & M.C.D.R. 1988. Ref: Section 6.2.1.1 of EIA Report
	• Whether transverse sections across the opencast mine at the end of fifth year and at the end of the life of the mine have been submitted.	Yes , Enclosed as Plate 5 E (Proposed Development Plan & Sections of Vth Year) and Plate 8 (Conceptual Plan and Sections) of Annexure XI
vii.	Type of blasting, if any, to be adopted.	Down the Hole delay Detonators (DTH) & Trunk Line Delay Detonators (TLD) fitted with shock tube based non-electric initiation system will be used for primary blasting..
b)	**Underground Mine**	NA
i.	Seam/ Ore body	--

	Min. depth (m)	--			
	Max. depth (m)	--			
	Avg, thickness (m)	--			
	Rate of dip in degree	--			
	Direction of dip	--			
ii.	Mode of entry into the mine	--			
	• Shaft	--			
	• Adult	--			
	• Incline	--			
iii.	Details of machinery	--			
	• On surface	--			
	• At face	--			
	• For transportation	--			
	• Others	--			
iv.	Method of stoping	--			
	• Open	--			
	• Filled	--			
	• Shrinkage	--			
	• Caving	--			
	• Combination of the above	--			
	• Others (specify)	--			
v.	Extraction method	--			
	• Caving	--			
	• Stowing	--			
	• Partial extraction	--			
vi.	Subsidence	--			
	• Predicted max. subsidence (in m)	--			
	• Max. value of tensile strain (in mm/m)	--			
	• Max. slope change (in mm/m)	--			
	• Whether identified possible subsidence area(s) superimposed on Surface Plan has been submitted.	Yes	--	No	--
	• Major impacts on surface features like natural drainage pattern, houses, buildings, water bodies, roads, forest, etc.	--			
	• Salient features of subsidence management (monitoring and control).	--			

16.	**Surface drainage pattern at mine site**				
a)	Whether the pre-mining surface drainage plan submitted?	Yes	√Plate 3 of Annexure XI	No	--
b)	Do you propose any modification / diversion in the existing natural drainage pattern at any stage?	Yes	--	No	√

	If yes, when. Provide location map indicating contours, dimensions of water body to be diverted, direction of flow of water and proposed route / changes, if any i.e. realignment of river / nallah / any other water body falling within core zone and its impact.				

17.	**Embankment and / or weir construction**				
a)	Do you propose, at any stage, construction of				
i.	Embankment for protection against flood?	Yes	--	No	√
ii.	Weir for water storage for the mine?	Yes	--	No	√
b)	If so, provide details thereof.	NA			
c)	Impact of embankment on HFL and settlement around.	NA			
d)	Impact of weir on downstream users of water	NA			

18.	**Vehicular traffic density (outside the ML area)**	**Type of vehicles**		**No. of vehicles per day**	
a)	Existing	Trucks		320	
b)	After the proposed activity	Trucks		320 Existing + 15 Trucks /Day	
c)	Whether the existing road network is adequate? If no, provide details of alternative proposal?	Yes	√	No	

19.	**Loading, transportation and unloading of mineral and waste rocks on surface:**				
a)	Manual	Yes	√ (Loading from outside lease area)	No	√ (Within lease area)
b)	Tubs, mine cars etc.	Yes		No	√
c)	Scraper, shovels, dumpers/trucks	Yes	√ (Transport from mine lease to outside lease area)	No	
d)	Conveyors (belt/chain etc.)	Yes		No	√
e)	Others (specify)	--			

20.	**Mineral(s) transportation outside the ML area**			
		Qty. (in TPD)	Percentage (%)	Length (in Km)
a)	Road	320*	100	--
b)	Rail	--	--	--
c)	Conveyors	--	--	--
d)	Ropeway	--	--	--
e)	Waterways	--	--	--
f)	Pipeline	--	--	--
g)	Others (Specify)	--	--	--
	Total	320	100	--

*Considered 275 working days @ 0.088 Million Tons per Annum.

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21.	**Baseline Meteorological and Air Quality data**
(a)	**Micro-meteorological data**
[Continuous monitoring through autographic instrument for one full season other than monsoon]	
(i)	Wind rose pattern for one full season (16 points of compass i.e. N, NNE, NE, ---) based on 24-hourly data. For coastal area also furnish day-time and night time data.
• Day Time	NA
• Night Time	NA
• 24-hours period	Provided in chapter 3 of EIA report
(ii)	Site specific monitored data

Month	Wind Speed (kmph)			Temperature (°C)			Relative Humidity (%)			Rain Fall * (mm)			Cloud Cover** (Octas of sky)
	Mean	Max.	% of calm	Mean (Dry Bulb)	Highest	Lowest	Mean	Highest	Lowest	Total	24-hours Highest	No. of rainy days	Mean
March	13.5	38.9	16	22.6	36	15	66	70	51	0	0	0	1.8
April	13.7	35.2	7	26.3	36	21	72	77	60	0	0	0	1.4
May	15.4	24.1	2	28.8	35	22	81	85	75	0	0	0	1.0

*24-hour's rainfall should be reported from 08:30 hrs IST of previous day to 08:30 hrs. IST of the day.
*Rainy day is considered when 24 hrs. Rainfall is ≥ 2.5 mm.
**Visual observations of cloud cover should be recorded four times a day at regular intervals

(iii) Indicate name and distance of the nearest IMD meteorological Station from which climatological data have been obtained for reporting in the EIA report, if any.	Porbandar, 18 Km from the mine lease boundary

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(b) Ambient air quality data* (RPM, SPM, SO_2, and NOx)

[*Monitoring should be carried out covering one full season except monsoon – same season as in 21 (a) (i)]
[*Frequency of sampling: Sampling to be done twice a week for the entire season 24 hourly for SPM & RPM. For gaseous pollutants 24- hourly data be given irrespective of the sampling period.]

(i) Season and period for which monitoring has been carried out.

(ii) No. of samples collected at each monitoring station

Name of monitoring equipment used			PM_{10}			$PM_{2.5}$			SO_2			NO_x			Pb**		
Equipment sensitivity																	
Permissible AAQ standard (CPCB)		R	100 µg/m³			60 µg/m³			80 µg/m³			80 µg/m³					
		I	100 µg/m³			60 µg/m³			80 µg/m³			80 µg/m³					
		S	100 µg/m³			60 µg/m³			80 µg/m³			80 µg/m³					
Monitoring Location	No. of Samples Drawn	Category * (R, I, S)	Min.	Max.	98% tile	Min.	Max.	98% tile	Min.	Max.	98% tile	Min.	Max.	98% tile	Min.	Max.	98% tile
Mine Site (CA 1)	24	I	47	67	66.5	26	37	33.5	9	14	11.5	17	25	21.5	--	--	--
Dolatgadh Village (BA 1)	24	R	47	65	64.5	27	36	35.5	8	13	12.5	17	23	22.5	--	--	--
Aniali village (BA 2)	24	R	47	67	66.54	26	37	36.54	8	13	12.54	17	23	22.08	--	--	--
Bordi village (BA 3)	24	R	49	68	68.00	28	38	37.54	9	15	14.54	18	26	25.54	--	--	--
Near Naliyadhar R.F (BA 4)	24	S	42	55	54.08	21	29	29	7	11	10.54	16	22	21.08	--	--	--

*R = Residential; I = Industrial; S = Sensitive

**Pb for mineral specific sites only.

Annex a location map indicating location of AAQ stations, their direction and distance with respect to project site.

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ROBURN

22. Stack and emission details, if any* Not Applicable (see below*)

Sl. No.	Process / unit of operation (e.g. DG Set, Boiler)	Height of stack (m)	Internal top dia. (m)	Flue gas exit velocity (m/sec)	Emission rate (kg/hr)				Heat emission rate from top of stack (K.cal/hr)	Exhaust / Flue gas			
					SPM	SO_2	NO_x	CO		Temp ^0C	Density	Specific Heat	Volumetric flow rate (m^3/hr.)

23. Details of fugitive emissions during mining operations* Not Applicable (see below*)

24. Air Quality Impact Prediction (AQIP)* Not Applicable (see below*)

(a) Details of model(s) used for AQIP including grid Size, terrain features, and input meteorological data

(b) Maximum incremental GLC values of pollutants based on prediction exercise

(in $\mu g/m^3$)

S. No.	Pollutants	Incremental Value	Ambient Air Quality	Resultant Air Quality
1.	SPM			
2**.	SO_2			
3**.	NO_X			

[* Question Number 22, 23 & 24 need not be filled-in for mines having ML area of **25 ha. or less.**]

[**Information on item no. 2 & 3 to be provided in cases with captive power generation of 500 KVA and above]

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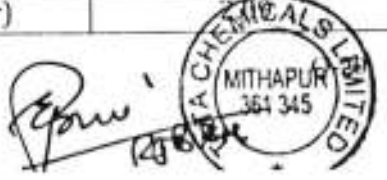
25.	Water requirement (m3/day)		
	Purpose	Avg. Demand	Peak Demand
A.	Mine site		
1.	Mine operation	--	--
2.	Land reclamation	--	--
3.	Dust suppression	15.6	15.6
4.	Drinking	2.7	2.7
5.	Green Belt	11.7	11.7
6.	Beneficiation	--	--
7.	Washeries	--	--
8.	Fire Service	--	--
9.	Others (specify)	--	--
B.	Township	--	--
1.	Green Belt	--	--
2.	Domestic	--	--
3.	Other (specify)	--	--
	Total	**30.0**	**30.0**

26.	Source of water supply*	
S.No.	Source	m^3/day
1.	River (name)	--
2.	Ground water	30 m^3/day (CGWA permission annexed as Annexure-X)
3.	Mine water (sump / pit)	--
4.	Other surface water bodies (specify)	--
[*Annex a copy of sanction letter / permission from the concerned authority (Central Ground Water Authority in case of ground water abstraction is from notified area / State Ground Water Board in case of non-notified area / State Irrigation Department for surface water pumping) for drawing water.]		

27.	Lean season flow in case of pumping from river / nalla (cumecs)	--

28.	Ground water potential of the study area	
28.1	Ground water availability	
a)	Range of water table (m bgl)	14-20 M BGL
i.	Pre-monsoon (April/May)	
	• Core Zone	20 M BGL
	• Buffer Zone	20 M BGL
ii.	Post-Monsoon (November)	
	• Core Zone	14 M BGL
	• Buffer Zone	14 M BGL
b)	Total annual replenishable recharge (million m^3/ year)	66.14
	• By ground water table fluctuation method	--
	• By rainfall infiltration factor method	--
c)	Annual draft excluding estimated draft through mine discharge (million m^3/ year)	42.09
d)	Estimated draft through mine discharge (million m^3/ year)	



e)	Net annual ground water availability (million m³/ year)					44.15	
f)	Stage of ground water development in %					70.26	
28.2	**Water demand - Competing users of the water source**						
S.No.	**Usage**	**Present Consumption (m^3/day)**		**Additional proposed as per local plan (m^3/day)**		**Total (m^3/day)**	
		Surface	**Ground**	**Surface**	**Ground**	**Surface**	**Ground**
1.	Domestic	--	--	--	--	--	--
2.	Irrigation	--	--	--	--	--	--
3.	Industry	--	--	--	--	--	--
4.	Mining	--	--	--	--	--	--
5.	Others (specify)	--	--	--	--	--	--
		--	--	--	--	--	--

29.	**Water quality***
a)	Annex physico -chemical analysis of water at intake point **
b)	In case of existing mine, annex report on quality of water discharge i.e. complete physico - chemical analysis** [*For non-discharging mines at least four ground water samples to be taken preferably from downstream direction of the mine in pre-monsoon and post-monsoon periods and analyzed. For discharging mines six samples are to be analyzed] **All parameters as per BIS 10500. Indicate name of Methodology, Equipment used for analysis, and Detection Level (DL) for each parameter. *** Wherever any analytical parameter is below detection level, "BDL" (Below Detection Level) should be written instead of 'NIL'.

30.	**Impact on ground water regime / stream / lake / springs due to mine dewatering ***				
a)	Radius of influence (in m) [To be estimated based on analysis of pumping test data and application of empirical formula]				
b)	Whether saline water ingress will take place? (applicable to coastal areas)	Yes	--	No	--
c)	Impact on stream / lake / springs				

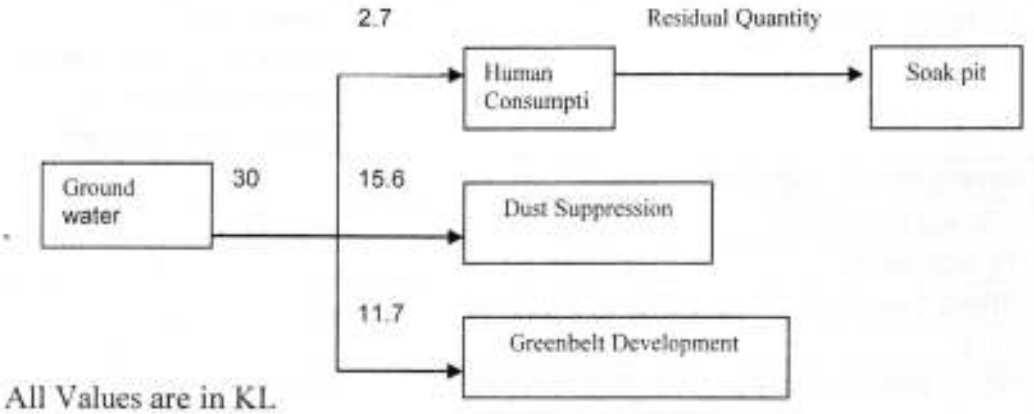
[* Provide a comprehensive hydro-geological assessment report if the average mine dewatering is more than 100 m3/day and or going below water table in non-monsoon period. The report should be based on preferably latest one year pre-monsoon and post-monsoon baseline data covering information on ground water situation, aquifer characteristics, water level conditions (April – May and November), estimate of ground water resources, predicted impact of the project on ground water regime and detailed remedial / conservation measures such as artificial recharge of ground water etc. The report should be based on actual field inventory out of existing wells, at least 30 observation wells in the buffer zone with supplementary information from secondary sources (mention name). For estimation** of ground water resource (refer question no. 28 above) be designated study area of the buffer zone may be sub-divided into command and non-command areas, watershed-wise (in case of hard rock / consolidated formations) / block-wise / mandal-wise in case of alluvial / unconsolidated formations)]

[**For estimating ground water resources in the area follow the Ground Water Estimation Committee recommendations of 1997]

31.	**Waste Water Management**				
	Mine				
a)	Daily average discharge (m^3/day) from different sources	No discharge			
i.	Mine water discharge during	--			
	• Lean period	--			
	• Monsoon period	--			
ii.	Workshop	--			
iii.	Domestic (mine site)	Residual quantity of water used for domestic purposes is discharged into the septic tank followed by soak pit.			
iv.	Beneficiation / washeries	--			
v.	Coal handling plant	--			
vi.	Tailing pond	--			
vii.	Others (Specify)	--			
	Total	--			
b)	Waste water treatment plant; flow sheet for treatment process attached.	Yes	--	No	√
c)	Quantity of water recycled/reused/to be recycled in				
i.	Percentage	--			
ii.	m^3/day	--			
d)	Point of final discharge				
	Final Point	Quantity discharged (in m^3/day)			
1.	Surface	--			
i.	Agricultural Land	--			
ii.	Waste Land	--			
iii.	Forest Land	--			
iv.	Green Belt	--			
2.	River / nallah	--			
3.	Lake	--			
4.	Sea	--			
5.	Others (specify)	--			
	Total	--			
e)	Users of Discharge water				
i.	Human	Yes	--	No	--
ii.	Livestock	Yes	--	No	--
iii.	Irrigation	Yes	--	No	--
iv.	Industry	Yes	--	No	--
v.	Others (specify)				
f)	Details of the river / nalla, if final effluent is / will be discharged (cumecs)				
i.	Average flow rate	NA			
ii.	Lean season flow rate	NA			
iii.	Aquatic Life	NA			
iv.	Analysis of river water 100m upstream and 100m	NA			

	downstream of discharge point submitted				
	Township				
a)	Waste water generation from Township (m^3/day)	NA			
b)	Are you planning to provide sewage treatment plant?	Yes	--	No	√
c)	Usage of treated water	NA			

32.	**Attach water balance statement in the form of a flow diagram indicating source (s), consumption (Section-wise) and output.**



33.	**Ambient noise level leq dB(A)**		
Code	Location of sampling station	Noise Level	
		Day Time	Night time
CN1	Near Mine site	47.6	43
BN1	Valotra	49.8	43.5
BN2	Aniali	49.6	43.3
BN3	Vadwala-rana	50.1	38.5
BN4	Near Barda wildlife sanctuary	49.3	38.2
BN5	Jam Sakhpur R.S.	63.7	57.6
BN6	Khirasara	53.4	40.8
BN7	Rana Kondorna	61.7	51.4
BN8	Near Reserve forest	46.0	37.2
BN9	Bapodar	51.2	44.7

34.	**Solid waste**			
a)	Top soil and Solid waste quantity and quality			
	Name (Lump/fines/slurry/ Sludge/others)	Composition	Quantity (m^3/month)	Method of disposal
	Mining activity*	--	Nil	No waste generation
	a. Top soil	--	Nil	No waste generation
	b. Overburden	--	Nil	No waste generation
	c. Others (specify)	--	Nil	No waste generation
	Effluent Treatment plant	--	Nil	No waste generation
	Total	--	Nil	No waste generation
	[* Annex layout plan indicating the dump sites.]			
b)	i. Does waste(s) contain any hazardous/toxic	Yes	--	√

	substance / radioactive materials or heavy metals?						
	ii. If yes, whether details or precautionary measures provided?			Yes	--	No	--
c)	Recovery & recycling possibilities			No waste generated			
d)	Possible user(s) of the solid waste.						
e)	i. Is the solid waste suitable for backfilling?			Yes	--	No	--
	ii. If yes, when do you propose to start backfilling			--			
	Solid waste (s)	**Already accumulated (A)**	**To be generated (B)**	**(in million m³)** **% of A & B to be backfilled**			
				A		**B**	
	Overburden	Nil	Nil	Nil		Nil	
	Others (specify)	Nil	Nil	Nil		Nil	
	Land reclamation Plan						
f)	In case waste is to be dumped on the ground, indicate			Not applicable as no waste is generated			
i.	Associated environmental problems			--			
ii.	Number & type of waste dumps			--			
	• No. of external dumps			--			
	• Max. projected height of dumps (m)			--			
	• No. of terraces & height of each stage			--			
	• Overall slope of the dump (degree)			--			
	• Proposed reclamation measures			--			
iii.	Section of waste dump in relation to the adjacent ground profile attached			Yes	NA	No	NA

35.	**Fuel/ Energy requirements***					
	[*To be furnished for mines having ML area more than 25 ha. or captive power generation of 500KVA and above]					
a)	Total power requirement			(In MW)		
S. No.	Particulars	Mine Site	Township	Others (specify)	Total	
1	Present	--	--	--	--	
2	Proposed / additional	--	--	--	--	
	Total	--	--	--	--	
b)	Source of power				(In MW)	
S. No.		SEB/Grid*	Captive power plant		DG Sets	
1	Present	--	--		--	
2	Proposed / additional	--	--		--	
	Total	--	--		--	
	[* Annex a copy of the sanction letter from the concerned authority]					
c)	Details of fuels					
S.No.	Fuel	Daily Consumption (TPD)		Calorific value (Kcals/kg)	% Ash	% Sulphur
		Existing	Proposed			
1	HSD	--	0.08	10,270	0.01	0.005

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2	LSHS	--	--	--	--	--
3	Other (specify)	--	--	--	--	--

36.	Storage of inflammable / explosive materials			
S.No.	Name	Number of Storages	Consumption (in MTPD)	Maximum Quantity at any point of time
1	Fuel		0.08	--
2	Explosives	No storage is proposed at Mining Site. Explosives are stored at Existing Adityana mine site of M/s TATA Chemicals Ltd. The Explosives will be transported from Magzine to Aniali 16.21 Ha mine through Explosive Van.	0.05	TCL has licensed magazine of 800 Kg Capacity.

37.	Human Settlement		
		Core Zone	Buffer Zone
	Population*	0	107241
	No. of villages	0	29
	Number of households village-wise	0	22890
	[* As per 2011 census record or actual survey]		

38.	Rehabilitation & Resettlement (R&R) Plan*		
	[*Provide a comprehensive rehabilitation plan, if more than 1000 people are likely to be displaced, other-wise a summary plan]		
a)	Villages falling within the study area		
		Villages	
		Number	Name
	Core zone	0	0
	500 m from the blasting site (s)	0	0
	Buffer zone	29	

S.No.	Village Name
1	Amar
2	Aniali
3	Bhod
4	Bileshwar
5	Bordi
6	Daiyar
7	Devda
8	Dhoria Nes
9	Dolatgadh
10	Fataltem Nes
11	Hanumangadh
12	Jarera Nes

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			13 Karval Nes 14 Kathiyo Nes 15 Khambhala 16 Kharavira Khunano Nes 17 Kharavira Nes 18 Khirsara 19 Krushnay Nes 20 Morivirda Nes 21 Ramgadh 22 Ranavav 23 Sajanwada Nes 24 Sakhpur 25 Shermlanki Khunano Nes 26 Tarsai 27 Bapodar 28 Vadwala-Rana 29 Valotra
	Township site	--	--

b)	Details of village(s) in the core zone			
S.No	Village Name	Population*		Average Annual Income
		Tribal	Others	
		--	--	--
	[*As per 2011 census / actual survey]			

c)	Population to be displaced and / or Land oustees			
	Name of village(s)falling within	Number of oustees		
		Land (only)	Homestead (only)	Land and Homestead (both)
	Mining Lease	--	--	--
	1	--	--	--
	2	--	--	--
	Township site	--	--	--
	1	--	--	--
	2	--	--	--

d)	Whether R&R package has been finalized? If yes, salient features of R&R plan for oustees.	
i.	Site details where the people are proposed to be resettled & facilities existing / to be created.	NA
ii.	Funds earmarked for compensation package.	NA
iii.	Agency /Authority responsible for their resettlement.	NA
iv.	Time of commencement of resettlement of Project Affected People (PAP).	NA
v.	Period by which resettlement of PAP will be over.	NA

39.	**Lease-wise plantation details**		
a)	Lease area (in ha)	Existing Mine	New Mine
i.	Area broken up	9.544 – Pre mining Stage	

ii.	To be broken up	13.13 – Conceptual Stage				
iii.	Area not to be broken up	3.08 Plantation area and area remaining for mining.				
b)	Township area (in ha.)					
c)	Area afforested and proposed (in ha.)	Peripheral	Dumps	Roads	Township	Others
i.	Existing	--	--	--	--	--
ii.	Proposed	0.3	--	--	--	0.56
d)	No. and type of trees planted and proposed					
i.	Existing					
	• When was plantation started?	Month		Year		
		--		--		
	No. of species planted	--				
	Number of saplings (per ha.)	--				
	Survival rate %	--				
	Average Height	--				
ii.	Proposed					
	No. of species planted	**Number of saplings (per ha.)**				
	As per Section 6.2.1.4. of EIA Report	Total 500 Saplings @ 1000 Saplings per Ha.				

40.	**Environmental health and safety**	
a)	What major health and safety hazards are anticipated?	As given below:
b)	What provisions have been made/ proposed to be made to conform to health and safety requirements?	

Hazard	Causes	Control	Procedure	Existing Procedure (Y/N)
Unintended explosions (exposure to overpressure) during storage of explosives in magazines	Defective explosives	Explosive used should be purchased only from approved and licensed authority. If deteriorated or unserviceable explosive is found, seek advice of licensing authority	If any defective explosive is found, it is returned back to the original supplier for disposal at their end as per Rule 16 of The Explosive Rules 1983	Y
	Outdated explosives	Records and accounts of explosive stock and issue is to be maintained. Stock should be drawn upon strict rotation Well planning for	Maintaining registers for Explosives receipt, issue and stock as per Reg. 154, 156 of MMR 1961.	Y

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		requirement of explosives shall be exercised. Disposal of outdated explosives as the chief controller or controller of explosive may issue		
	Improper storage of explosives	Detonators are to be stored separately. Explosives shall be stored in dry and well ventilated area. Protect explosives from extreme temperatures	Explosives and Detonators are stored separately as per approved design &licensed capacity of magazine under Explosive act, 1884	Y
	Force majeure conditions such as lightning strike	Lightning conductor are to be installed on the top of magazine Lightning conductor should not have resistance more than 10 ohms	Lightning arrestors are provided and maintained as per the requirement under Rule 116 the Explosive Rules 1983	Y
	Fire (can be caused by un safe practices or action)	Empty packages shall be removed immediately and destroyed. No smoking or any source of light or fire shall be allowed near explosives storage	Follow the instructions Specified in Rule 154, 156and 170 of MMR – 1961 for storage, and handling of Explosives. Rule 97and 101 of the ER 1983	Y
	Sabotage	Security shall be provided at the magazine. Shortage and theft of explosive shall be reported to the nearest police station and the licensing authority	Round the clock security guards provided and immediate reporting to nearest Police Station and Licensing Authority	Y

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			done in case of thefts or sabotage as per Rule -123 of ER 1983	
Rock falls or slide due to lack of bench face stability (bodily Injuries)	Improper design of bench	Proper catch bench design and proper blasting pattern reduces over break. Maintain the width to height ratio as per DGMS	Procedure for opencast working as per Reg. 106	Y
	Force Majeure (such as heavy floods or rainfall)	Dewatering or culverting the storm, water may reduces slides of bench	Following procedures as per Reg. 127 and 130 of MMR -1961 for Dewatering or and culverting the water	Y
	Improper blasting practices	Good design of blasting network is important to reduce rock fall and slides of bench face	Procedure for opencast working as per Reg. 106	Y
	Incompetent blasting personnel	Shot firer should have shot firer's permit granted under explosive rules	Appointment of Shot firer as provided in Reg. 160 of MMR 1961	Y
Vehicle accident (bodily injuries)	Head on collision between vehicle and another vehicle (due to poor visibility or incompetent drivers)	Haul road should be sprinkled Regularly. Driving at night shall be avoided. Driver should be RTO licensed holder for driving vehicle	Sprinkling of water in haul road as per Reg. 124MMR 1961 and appointment of RTO licensed drivers	Y
	Poor vehicle maintenance	Periodic servicing of vehicle, Brakes and steering apparatus should be in good condition. Headlight and tail light of the vehicle should be in good condition	Procedure for Maintenance of Vehicles under Reg. 176 of MMR - 1961	Y
Unintended	Poor access	Well planning is	Procedure for	

	explosion or exposure to overpressure, charging blast holes	control of blast area	required before and after charging of blast holes. Blast sites should be secured and warning signs posted before loading boreholes.	drilling charging stemming and firing of holes as per Reg.162	
		Incompetent blasting personnel.	Shot firer should have shot firer's permit granted under explosive rules	Appointment of Shot firer as per Reg. 160 as per MMR 1961	Y
		Poor blasting practices	Tamping rod of wood must be used; iron or steel rods should not be used. No smoking or any source of light or fire shall be allowed near explosives storage. Before loading the blast hole blaster should check the driller log. Blast sites should be secured and warning signs posted before loading boreholes.	Procedure for drilling charging stemming and Firing of holes as per Reg.161, Rule 14 of ER	Y
		Defective explosives	Explosive used should be purchased only from approved and licensed authority only. If deteriorated or unserviceable explosive is found, seek advice of licensing authority	Explosive are purchased from Approved manufactured or authorized license holder from CCE.	Y
		Outdated explosives	Stock should be drawn upon strict rotation	Issue of explosives on first come first Issue basis.	Y
	Hit by fly rock(bodily injuries)During blasting	Poor access control of blast area	Adequate blast area security must be provided. Blast sites should be secured and	Procedure for tacking shelter etc. during drilling and blasting Reg.	Y

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			warning signs posted before loading boreholes. Post guards at the access points to prevent unauthorized entry	164 of MMR 1961	
		Poor blasting practices (leading to excessive flyrock)	Burden, spacing, hole diameter, stemming, sub drilling, initiation system, and type of explosive used matched the characteristics of the rock formation. Adequate blasting Shelter must be used for the persons whose presence is required in blasting. Nobody should be present within 300 m radius of blasting site as per DGMS circular except blasting personnel. Practice for controlled blasting Technique with milli-second delay detonators/ electric shock tubes/ cord relays. Training of persons and their helpers engaged in such blasting operation.	Procedure for drilling and blasting, tacking shelter etc. as per Reg. 164 MMR1961, DGMS(SOMA) /(Tech) Cir.No.2of 2003	Y
	Hit by Machineries – Electrical Equipment (bodily injuries)	Poor machinery Maintenance	Periodic servicing of machineries. Periodic Inspection / Audit of Machineries and Structures Non Compliance to SOP.	Procedure laid under Section 174 Chapter XVI – Machinery and Plant of MMR 1961	Y

M.P. CHEMICALS LIMITED MITHAPUR 361 345

		Poor Cabling / Earthling To Rotating Equipments	Periodic servicing of electrical instruments. Periodic Inspection / Audit of Electrical equipments – cables and accessories Non Compliance to SOP.	Section VII – Works of Licensees of Indian Electricity Rules 2003	Y

c)	In case of existing mine				
i.	Comprehensive report on health status of the workers as under the Mines act annexed	Yes	NA	No	NA
ii.	Mineralogical composition of RPM (dust)				
	• Free silica	<0.1 µg/m^3			
	• Chromium* (Total as well as Hexavalent)	--			
	• Lead**	--			
	[* Only for Chromite mines]				
	[**Only for Base Metal mines]				
d)	Information on radiation protection measures, if applicable.	NA			

41.	**Environmental Management plan**		
	Salient features of environmental protection measures		
S.No.	Environmental issues*	Already practiced, if applicable	Proposed
1	Air pollution	Mine is Idle since 1994.	Wet drilling will be provided. Suitably designed dust extractor will be provided for dry drilling along with dust hood at the mouth of the drill-hole collar.
			Establish time of blasting to suit the local conditions. Avoid blasting i.e., when temperature inversion is likely to occur and strong wind blows towards residential areas.
			The long life WBM (Water Bound Macadam) haul roads will be constructed and maintained for traffic movement. Regular water spraying shall be done
			The speed of dumpers/ trucks on haul road will be controlled as increased speed increases dust emissions. Overloading of transport vehicles will be avoided. The trucks/ tippers will have sufficient free board. Spillage of ore on public roads will be cleared immediately and vehicles will ply in safe speed.
2	Water pollution		Ground water monitoring

			intervals shall be carried out.
3	Water conservation		At the end of mine life excavated pit will be converted into a water reservoir. This will help in recharging the ground water table.
4	Noise pollution		Implement good working practices (equipment selection and siting) to minimize noise and also reduce its impacts on human health (ear muffs, safe distances and enclo-sures). Adopt good blasting practices to reduce impact on flora and fauna. Muffling will be done at the time of blasting
			List of all noise generating machinery onsite along with age to be prepared. Equipment to be maintained in good working order.
			Plantation of dense hedges on the boundary of lease area, these will reduce dust and noise in the vicinity area.
			Good blasting layout must be adopted Adopting less number of holes per delay
5	Solid waste / Tailings		Undersized mineral sent to cement plant at Mithapur.
			Hazardous waste (Used oil and oil containers) will be managed as per Hazardous Wastes (Management and Handling) Rules 2008, as amended till date
			Batteries will be managed as per Battery (Management & Handling) Rules; 2000.
			Plan to be drawn up, considering likely emergencies and steps required to prevent/limit consequences.
6	Land degradation		At conceptual stage most of the waste land i.e. a will be converted into rain water harvesting pit and green belt Hence impact due to change in land use is positive.
7	Erosion & Sediment		Practically no topsoil or overburden is evident in the mine lease area which can get eroded. The soil is present in few pockets within lease area will be used in Plantation work.
8	Top soil		There is marginal topsoil in the mine lease area which will be used in plantation purpose.
9	Ground vibration		Good blasting layout must be adopted Adopting less number of holes per delay

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10	Wildlife conservation		Wildlife Conservation plan is attached (Annexure IX of EIA Report) and all the measures shall be taken to minimize any potential impact on the Scheduled fauna. Phase wise plantation shall be carried out to improve the aesthetics of the study area.
11	Forest protection		As per approved scheme of mining lease area is falls within government waste land, hence No forest is proposed to be degraded due to proposed mining project.
12	Others (specify)		--
	[*As applicable]		

42.	**Compliance with environmental safeguards (For existing units)**				
a)	Status of the compliance of conditions of environmental clearance issued by MoEF, if any, enclosed.	Yes	NA	No	--
b)	Status of the compliance of 'Consent to Operate' issued by SPCB, if any, enclosed.	Yes	NA	No	--
c)	Latest 'environmental statement' enclosed	Yes	NA	No	--

43.	**Scoping of EIA**				
a)	Whether environmental impact assessment of the project has been carried out by following scoping process?	Yes	√	No	--
b)	If yes, a copy of scoping of EIA annexed.	Yes	√ Annexure I of EIA Report	No	--
44.	**Mine closure**				
a)	Have you planned mine closure?	Yes	√ (Annexure XI)	No	--
b)	Submitted a conceptual mine plan	Yes	√ Plate No 8 of Annexure XI.	No	--
c)	If yes, indicate estimated amount for implementing the same (in Rs. Lakh)				

45.	**Capital cost of the project (in Rs. Lakh) Based on latest estimate**	**Rs. 0.39 Crores**

46.	**Cost of environmental protection measures**				
S.No.	Particulars	Capital Cost		Annual recurring cost	
		Existing	Proposed	Existing	Proposed
1	Pollution Control (Separately provide break-up)	0	0	0	0.85
2	Pollution Monitoring (Separately provide break-up)	0	0	0	2
3	Occupational Health	0	0	0	1.0

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4	Green Belt	0		0	0
	• Mine	0	1.5	0	0.5
	• Township	0		0	0
5	Reclamation / Rehabilitation of mined out area	0	0	0	0
6	Others (specify)	0	0	0	0
	Total	**0**	**1.5**	**0**	**4.35**

47.	**Amount earmarked for socio-economic welfare measures for the nearby villages other than R&R plans.**	TCL is proposing to spend Rs 25 lacs on CSR related activities in proximity of TCL mine leases in village Aniali and village Ranpur area during a period of five years" Five years action plan for CSR activities surrounding TCL six mine leases in Aniali and Ranavav area

S. No.	CSR Activities	Area	Budget allocation
1	Cattle camp development & cattle protection program –	Villages – Aniali, Daulatgarh, Ranabordi, wa dvala and Ranavav	5 Lac
2	Creation of drinking Water facility and check dam for water harvesting – by creating 5 bore wells with submersible pumps and participating in check dam construction	in Villages at Aniali, Daulatgarh, Ranabordi, Vadwala and Ranavav	10.00 Lac
3	Health & Medical camps for poors -. 10 camps will be arranged	Villages Aniali, DaulatGarh, Ranabordi, Vadwala and Ranavav	5.00 Lac
4	Village Road maintenance and children education facility	For village roads in Aniali, Wadvala & Ranavav villages	5.00 Lac

48.	**Public Hearing**	
a)	Date of Advertisement	07/11/2013
b)	Newspapers in which the advertisement appeared	Divya Bhaskar & Indian Express Newspaper Telecasted in GTPL, Local TV channel
c)	Date of public hearing (DD/MM/YYYY)	11/12/2013
d)	Public Hearing Panel chaired by & members present	1. Shri M. A. Gandhi (Collector & District Magistrate, Porbandar) 2. Shri B. L. Maru (Regional Officer & representative of Member Secretary of Gujarat Pollution Control Board

TATA CHEMICALS LIMITED MITHAPUR 361345

		3. Shri Paresh Tank (General Manager-Corporate Affairs, TCL)
e)	No. of people attended the public hearing meeting and number of people from the lease area.	List of all members participating in Public Hearing is enclosed as Annexure-A in Public Hearing Proceedings attached as **Annexure – XII.**
f)	Summary/details of public hearing in tabular form.	
Issues raised by the Public		**Response/Commitment of Project Proponents**
Please refer Table 7-1 & Annexure XII of EIA Report		Please refer Table 7-1 & Annexure XII of EIA Report

49.	**Whether the following approvals* (wherever applicable) have been obtained?**				
i.	Site clearance from MoEF	Yes	--	No	√
ii.	'Consent for Establishment' from the State Pollution Control Board	Yes	--	No	√
iii.	NOC from Atomic Mineral Division	Yes	N.A	No	N.A
iv.	Mining plan approval from IBM / Ministry of Coal	Yes	√	No	--
v.	In case of existing mines, mining scheme approval from IBM	Yes	√	No	--
vi.	Forestry clearance under FCA, 1980	Yes	N.A.	No	NA
vii.	NOC from Chief Controller of Explosives	Yes	√	No	--
viii.	Commitment regarding availability / pumping of water from the concerned Authorities	Yes	√ CGWA Approval (Annexure X)	No	--
ix.	In case of ML area falling in notified areas of the Central Ground Water Authority, NOC from them.	Yes	√ CGWA Approval (Annexure X)	No	--
	[* Annex copies of approvals and number them]				

50.	**Was / is there any court case relating to the project or related activities? If so, provide details present status.**	No, there has been no court case relating to the project or related activities.

Verification: The data and information given in this Performa are true to the best of my knowledge and belief.

Date: 14.06.2014
Place : Mithapur

Signature of the applicant with
Full Name & address

R J Buch
General Manager
(safety, Health & Environment)
Tata Chemicals Limited,
District Devbhumi Dwarka
Gujarat- 361345
Email: rjbuch@tatachemicals.com
Phone- 02892-665267, Mobile: 09227617010

TATA CHEMICALS LIMITED MITHAPUR 361 345

[authorized signatory]

Given under the seal of organization on behalf of whom the applicant is signing

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ANNEXURE I TO XI

OF

FINAL EIA REPORT

FOR

ANIALI 16.21 HA. LEASE

OF

M/S TATA CHEMICALS LTD

List of Annexure

ANNEXURE-I	-	TERMS OF REFERENCES FROM MOEF, NEW DELHI
ANNEXURE- II	-	LEASE DEED AND LEASE GRANT ORDER
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ANNEXURE-IV	-	SHE POLICY
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ANNEXURE-IX	-	WL APPLICATION AND WILD LIFE CONSERVATION PLAN
	A	APPLICATION FOR WILDLIFE CLEARANCE
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ANNEXURE-X	-	APPROVAL FROM CENTRAL GROUND WATER AUTHORITY FOR ABSTRACTION OF WATER
ANNEXURE-XI	-	APPROVED MINING PLAN DATED 01.04.2014
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MINE PLATE	2	KEY PLAN
MINE PLATE	3	SURFACE PLAN
MINE PLATE	4 A	GEOLOGICAL PLAN
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MINE PLATE	5 A	DEVELOPMENT PLAN AND SECTIONS OF 1ST YEAR
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MINE PLATE	6	LAYOUT PLAN
MINE PLATE	7	ENVIRONMENT PLAN
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MINE PLATE	9	PROGRESSIVE MINE CLOSURE PLAN
	10	APPROVED MINING SCHEME DATED 21.10.2008

Annexure - I

By Speed Post

No. J-11015/308/2012-IA.II (M)
Government of India
Ministry of Environment and Forests
***

751, Paryavaran Bhavan,
C.G.O. Complex, Lodi Road,
New Delhi-110 003
Telefax: 011-24364067

Dated: 19th March, 2013

To

M/s Tata Chemicals Ltd.
Mithapur, District-Jamnagar
Gujarat-361345
Tel. 02892-665267, Email-rbuch@tatachemicals.com

Subject: Limestone Mine of M/s Tata Chemicals Ltd., with production rate of 0.093 million tonnes/annum at Survey No. 207/ part, Village Aniali, Taluka Rananav, District Porbandar, Gujarat (16.21 ha)-TOR Regarding

This has reference to your letter no. A/WG/0584/2012, dated 07-07-2012, received in the Ministry on 12-07-2012. The Proposal is to determine the Terms of Reference (TOR) for undertaking detailed EIA study for the purpose of obtaining environmental clearance in accordance with the provisions of the EIA Notification, 2006. For this purpose, the Proponent had submitted information in the prescribed format (Form-1) along with a Pre-feasibility Report. The proposal was considered by the Reconstituted Expert Appraisal Committee in its 3rd meeting held during 16th -18th January, 2013.

2. The proposed Limestone Mine Lease Area is located at Survey No. 207/part, Village: Aniali, Taluk: Ranavav, District - Porbander in Gujarat State between 21° 42' 18" to 21° 42' 31" N 69° 49' 13" to 69°49' 29" E. The project activity falls under category 'A' (Activity 1 A - Mining of Minerals) because the lease area is located within 10 km from the boundary of Barda Wildlife Sanctuary, notified under the Wild Life (Protection) Act, 1972 as per General Condition 1 of the Environmental Clearance notification 2006, as amended from time to time. The land use of the mine lease area is government waste land (barren land). The original lease deed was executed on 29.10.1964 for a period of 20 years and thus, expired on 29.10.1984. The First renewal was executed on 21.08.1987 vide letter MCR-1583(T-4) GOI-184-CHH dated 09.09.1986 for 20 years and expired on 29.10.2004. The Tata Chemicals Ltd (TCL) TCL has applied for 2nd renewal vide letter No AW/G/2558/ 2003 dated 21.10.2003 for 20 years and the lease renewal is pending with the Gujarat Govt. This mine has been worked during the years 1985-1994, when the maximum production during year 1987-88 was 55,065 metric tonnes. The mining scheme with progressive mine closure plan was approved by Indian Bureau of Mines, Udaipur vide letter no. 682(23) MS-228/2003 MCCM (N) UDP dated 29.01.2004 for period of 2003-04 to 2007-08. This

Mining Scheme has expired on 31st March, 2008 without the mine being working and TCL has further submitted their next Mining scheme, which stands approved by the Regional Controller of Mines, Indian Bureau of Mines, Udaipur vide letter no. 682 (23) (MS-437/2008 MCCM (N) UDP Dated 21.10.2008 for period ending 2012-13. This mine is closed since 1994. The proposed rate of production is 0.093 million tonnes per annum. Total life of the mine is 5 years. The mine will be worked by fully mechanized opencast method. Water requirement for human consumption, plantation and dust suppression is 30 KLD, which shall be met from the ground water sources. Small amount of domestic waste water generation will be disposed in soak pits. The existing mine lease area is designated as government waste land and has no human settlements and hence, no R & R is envisaged.

3. Based on the information furnished, presentation made and discussions held, the Committee prescribed the TORs for undertaking detailed EIA study which are as follows:

1. Year-wise production details since 1994 onwards should be given clearly stating the highest production achieved in any one year prior to 1994. It may also be categorically informed whether there had been any increase in production after the EIA Notification, 1994 coming into force w.r.t. the highest production achieved prior to 1994.
2. A copy of the document in support of the fact that the proponent is the rightful lessee of the mine should be given.
3. All documents including approved mine plan, EIA and public hearing should be compatible with one another in terms of the mine lease area, production levels, waste generation and its management and mining technology and should be in the name of the lessee.
4. All corner coordinates of the mine lease area superimposed on High Resolution
5. Imagery/toposheet should be provided.
6. Does the company have a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.
7. Does the Environment Policy prescribe for standard operating process/procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / conditions? If so, it may be detailed in the EIA.
8. What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the EC conditions? Details of this system may be given.
9. Does the company have a 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? This reporting mechanism should be detailed in the EIA report.
10. Issues relating to mine safety based on subsidence study should be detailed. The proposed safeguard measure in this regard should also be provided.
11. The study area will comprise of 10 km zone around the mine lease from lease periphery and the data contained in the EIA such as waste generation etc should be for the life of the mine / lease period.

12. Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary and national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated.
13. Land use plan of the mine lease area should be prepared to encompass preoperational, operational and post operational phases and submitted.
14. Details of the land for OB dump outside the mine lease such as extent of land area, distance from mine lease, its land use, R&R issues, if any should be given.
15. High Resolution Satellite Imagery of the proposed area clearly showing the land use and other ecological features of the study area (core and buffer zone) should be furnished.
16. A Certificate from the Competent Authority in the State Forest Department should be provided, confirming the involvement of forest land, if any in the project area. In the event of any claim by the project proponent regarding the status of forests, the site may be inspected by the State Forest Department along with the Regional Office of the Ministry to ascertain the status of forests, based on which the Certificate in this regard as mentioned above be issued. In all such cases, it would be desirable for representative of the State Forest Department to assist the Expert Appraisal Committees.
17. Status of forestry clearance for the broken up area and virgin forestland involved in the project including deposition of net present value (NPV) and compensatory afforestation (CA). A copy of the forestry clearance should also be furnished.
18. Implementation of status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 should be indicated.
19. Impact of the project on the wildlife in the surrounding and any other protected area and accordingly detailed mitigative measures required should be worked out with cost implications and submitted.
20. The vegetation in the RF / PF area with necessary details should be given.
21. A study shall be got done to ascertain the impact of the mining project on wildlife of the area including on the elephant population and details furnished.
22. Location of National Parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, Tiger/Elephant Reserves (existing as well as proposed), if any, within 10 km of the mine lease should be clearly indicated supported by a location map duly authenticated by Chief Wildlife Warden. Necessary clearance, if any, as may be applicable to such projects due to proximity of the ecologically sensitive areas as mentioned above should be obtained from the State Wildlife Department/Chief Wildlife Warden under the Wildlife (Protection) Act, 1972 and copy furnished.
23. A detailed biological study for the study area [core zone and buffer zone (10 km radius of the periphery of the mine lease)] shall be carried out. Details of flora and fauna, duly authenticated, separately for core and buffer zone should be furnished based on primary field survey clearly indicating the Schedule of the fauna present. In case of any scheduled-I fauna found in the study area, the necessary plan for their conservation should be prepared in consultation with State Forest and Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost.
24. Impact, if any, of change of land use should be given.
25. R&R plan / compensation details for the project affected people should be furnished. While preparing the R&R plan, the National Rehabilitation

&Resettlement Policy should be kept in view. In respect of SCs / STs and other weaker sections, need based sample survey, family-wise, should be undertaken to assess their requirement and action programmes prepared accordingly integrating the sectoral programme of line departments of the State Government.

26. One season (non-monsoon) primary baseline data on ambient air quality (PM10, SO2 and NOx), water quality, noise level, soil and flora and fauna shall be collected and the AAQ data so collected presented date-wise in the EIA and EMP report. Site-specific meteorological data should also be collected. The location of the monitoring stations should be such as to represent whole of the study area and justified keeping in view the pre-dominant downwind direction and location of sensitive receptors. There should be at least one monitoring station within 500 m of the mine lease in the pre-dominant downwind direction.
27. The mineralogical composition of PM10 particularly for free silica should be given.
28. Air quality modelling should be carried out for prediction of impact of the project on the air quality of the area. It should also take into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input parameters used for modelling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any and the habitation. The wind roses showing pre-dominant wind direction may also be indicated on the map.
29. The water requirement for the project, its availability and source to be furnished. A detailed water balance should also be provided. Fresh water requirement for the project should be indicated.
30. Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the project should be provided.
31. Details of water conservation measures proposed to be adopted in the project should be given.
32. Impact of the project on the water quality both surface and groundwater should be assessed and necessary safeguard measures, if any required should be provided.
33. Based on actual monitored data, it may clearly be shown whether working will intersect groundwater. Necessary data and documentation in this regard may be provided. In case the working will intersect groundwater table, a detailed hydro geological study should be undertaken and report furnished. Necessary permission from Central Ground Water Authority for working below ground water and for pumping of ground water should also be obtained and copy furnished.
34. Details of any stream, seasonal or otherwise, passing through lease area and modification / diversion proposed, if any and the impact of the same on the hydrology should be brought out.
35. Details of rainwater harvesting proposed, if any, in the project should be provided.
36. Information on site elevation, working depth, groundwater table etc. should be provided both in AMSL and bgl. A schematic diagram may also be provided for the same.
37. Quantity of solid waste generation to be estimated and details for its disposal and management should be provided. The quantity, volumes and methodology

planned for removal and utilisation (preferably concurrently) of top soil should be indicated. Details of backfilling proposed, if any, should also be given. It may be clearly indicated that out of the total waste generated during the mine life, how much quantity would be backfilled and how much quantity would be disposed off in the form of external dump (number of dumps, their height, terraces etc. to be brought out).

38. The reclamation plan, post mine land use and progressive greenbelt development plan shall be prepared in tabular form (prescribed format) and submitted.
39. Impact on local transport infrastructure due to the project should be indicated.
40. Projected increase in truck traffic as a result of the project in the present road network (including those outside the project area) should be worked out, indicating whether it is capable of handling the increased load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered.
41. Details of the infrastructure facilities to be provided for the mine workers should be included in the EIA report.
42. Conceptual post mining land use and Reclamation and Rehabilitation of mined out area (with plans and with adequate number of sections) should be given in the EIA report.
43. Phase-wise plan of greenbelt development, plantation and compensatory afforestation should be charted clearly indicating the area to be covered under plantation and the species to be planted. The details of plantation already done should be given.
44. Occupational health impact of project should be anticipated and preventive measures initiated. Details in this regard should be provided. Details of pre placement medical examination and periodical medical examination schedules should be incorporated in the EMP.
45. Public health implication of the project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocation.
46. Measures of socio economic significance and influence to the local community proposed to be provided by project proponent should be indicated. As far as possible, quantitative dimensions may be given with time frame for implementation.
47. Detailed environmental management plan to mitigate the environmental impacts which, should inter-alia also include the impact due to change of land use, due to loss of agricultural land and grazing land, if any, occupational health impacts besides other impacts of the projects.
48. Public hearing points raised and commitment of the project proponent on the same along with time bound action plan to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project.
49. Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the project should be given.
50. The cost of the project (capital cost and recurring cost) as well as the cost towards implementation of EMP should clearly be spelt out.

Besides the above, the below mentioned general points should also be followed:-

a) A note confirming compliance of the TOR, with cross referencing of the relevant sections / pages of the EIA report should be provided.

b) All documents may be properly referenced with index and continuous page numbering.

c) Where data are presented in the report especially in tables, the period in which the data were collected and the sources should be indicated.

d) Where the documents provided are in a language other than English, an English translation should be provided.

e) The Questionnaire for environmental appraisal of mining projects as prescribed by the Ministry shall also be filled and submitted.

f) Approved mine plan along with copy of the approval letter for the proposed capacity should also be submitted.

g) While preparing the EIA report, the instructions for the proponents and instructions for the consultants issued by MoEF vide O.M. No. J-11013/41/2006-IA.II(I) dated 4th August, 2009, which are available on the website of this Ministry should also be followed.

h) Changes, if any made in the basic scope and project parameters (as submitted in Form-I and the F.R for securing the TOR) should be brought to the attention of MoEF with reasons for such changes and permission should be sought, as the TOR may also have to be altered. Post Public Hearing changes in structure and content of the draft EIA/EMP (other than modifications arising out of the P.H. process) will entail conducting the PH process again with the revised documentation.

4. The EIA report should also include (i) surface plan of the area indicating contours of main topographic features, drainage and mining area, (ii) geological maps and sections and (iii) sections of the mine pit and external dumps, if any, clearly showing the land features of the adjoining area.

5. The prescribed TORs would be valid for a period of two years for submission of the EIA/EMP reports, as per the O.M. No. J-11013/41/2006-IA.II(I) dated 22.3.2010.

6. After preparing the draft EIA (as per the generic structure prescribed in Appendix- III of the EIA Notification, 2006) covering the above mentioned issues, the proponent will get the public hearing conducted and take further necessary action for obtaining environmental clearance in accordance with the procedure prescribed under the EIA Notification, 2006.

(Dr. Saroj)
Director

Copy to:

1. The Secretary, Ministry of Mines, Government of India, Shastri Bhawan, New Delhi-110 001.
2. The Secretary, Department of Mines & Geology, Government of Gujarat, Secretariat, Gandhinagar.
3. The Secretary, Department of Environment, Government of Gujarat, Secretariat, Gandhinagar.

4. The Secretary, Department of Forests, Government of Gujarat, Secretariat, Gandhinagar.
5. The Chief Wildlife Warden, Government of Gujarat, Dr. Jivaji Mehta Bhavan, Block No. 14, 1st Floor, Old Sachivalaya, Gandhinagar-382 010.
6. The Chief Conservator of Forests, Regional Office (WZ), Kendriya Paryavaran Bhawan, Link Road No.3, Ravi Shankar Nagar, Bhopal - 462 016.
7. The Chairman, Central Pollution Control Board, Parivesh Bhavan, CBD-cum-Office complex, East Arjun Nagar, New Delhi-1100032.
8. The Member Secretary, Central Ground Water Authority, A-2, W3, Curzon Road Barracks, K.G. Marg, New Delhi-110001.
9. The Chairman, Gujarat State Pollution Control Board, Sector 10-A, Gandhi Nagar - 382043, Gujarat.
10. The Controller General, Indian Bureau of Mines, Indira Bhavan, Civil Lines, Nagpur-440 001.
11. The District Collector, Porbander District, Gujarat.
12. Guard File

(Dr. Saroj)
Director

Annexure II

O R D E R.

Health and Industries Deptt.,
Sachivalaya, Ahmedabad- 15
Dated the 12th June, 1964.

No. MCR 1563/ 15740 -G-V :- In exercise of the powers conferred by section 10 of the Mines and Minerals (Regulation and Development) Act,1957 Government is pleased to sanction the grant to M/s Tata Chemicals Limited at Mithapur of a mining lease for Limestone for twenty years in respect of the areas in the Junagadh district detailed below:-

Taluka	Village	Survey Numbers.	Area in Hectares
Ranavav	Aniyari	207 Part	16.21

2. The grant of the above lease is subject to the terms and conditions mentioned below:-

(a) Mining lease shall be in respect of Lime stone only. If any other minerals are found in association with this mineral they should be brought to the notice of Government and if the lessee desires to mine these minerals along with this mineral, he should do so only after the consent of the State Government is obtained in writing .

(b) Royalty at the rate of Seventy Five Naya Paise per tonne but subject to a rebate of thirty eight naya paise per tonne to be given on limestone beneficiated by forth flotation method or the dead rent at Rs. 25/- (Rupees Twenty Five) only per mineral per annum or part thereof per Hectare (2 acres and 2280 Sq. Yards) or part thereof, which ever is greater shall be charged ; provided that the dead rent shall not be payable for the first year of the lease.

(c) Surface rent and water rate at such rate not exceeding land revenue, water rate and cesses assessable in the land shall be charged.

(d) If beryl or any other substance prescribed under section 3 of the Atomic Energy Act, 1948(No. XXIX of 1948) is found to occur in the property under the lease, the lessee shall make available such mineral to the Govt. of India.

(P.T.O.)

(e) The lease shall be subject to the provisions of (i) the Mines and Minerals (Regulation and Development) Act, 1957 (67 of 1957), (ii) the Rules, in Chapter IV of the Mineral Concession Rules, 1960, and (iii) the Mineral Conservation and Development Rules, 1958.

(f) The lessee shall furnish to the Collector of Junagadh an accurate map of the area sanctioned duly attested by him. The Collector is authorised to get the map prepared after demarcation of the area, if the applicant so desires and recover the cost from the deposit of Rs.500/- paid for preliminary expenses.

(g) The lessee shall pay to the Collector of Junagadh necessary security deposit of Rs. 500/- for due observance of the terms and conditions of the lease in accordance with rule 32 of the Mineral Concession Rules, 1960, before the lease is issued to him.

(h) The lessee shall submit confidentially from time to time or when required progress reports to the Director of Geology and Mining, Ahmedabad, or an officer authorised by him alongwith the samples of the ores collected during the mining operations together with analysis report.

(i) The following conditions over and above standard preamtion clause in favour of the State Government containing clause 21 of part VII of the model form of Mining Lease Form 'K' shall be introduced in the Mining Lease.

Subject to the rights of the State Government and the obligations of the lessee under Clause 21 above, the lessee hereby undertakes that, in reppect of all flux or fettling grade Limestone/ Dolomite(that is, with acid insolubles of Alumina and Silica less that 15 percent) he shall win from the leased area, the lessee shall-

(a) offer the first option of purchase to the Hindustan Steel Limited, Ranchi, at such price and other terms as may be agreed upon between the lessee and the said Hindustan Steel Limited in advance from year to year (such price and terms being no less favourable than those prevalent in the particular year in the market), and

(P.T.O.)

(b) to the extent , the said Hindustant Steel Limited do not exercise that first option in the particular year , offer the second option of purchase to any other steel plant in the country at such price and other terms as may be agreed upon between the lessee and such other steel plant before other wise disposing of such limestone / Dolomite;

(c) in the event of any disagreement or dispute arising between the lessee and the said Hindustan Steel Limited (or other steel plant) relating to the price or any other terms or any other matters relating to the exercise of the options aforesaid, the point at dispute shall be referred to the State Government for decision provided further that in case the lessee or the said Hindustan Steel Limited (or other Steel Plant) is still agrrieved by the decisions of the State Government in such point, that matter shall be referred to the Secretary to the Government of India in the Ministry of Mines, Fuel and the decision of the said Secretary or of any officer nomiated by him for the purpose as the case may be, shall be final and binding on all concerned.

By Order and in the name of the Governor of Gujarat.

(P.P. SINGLA)
Deputy Secretary to the Government of Gujarat
Health and Industries Department.

K/12/6

(5)

JR-12

TATA CHEMICALS LTD.
MITHAPUR.
RECD. - 4 JAN 1965

(5)

2078 Plot

Mining lease Aniali (Ranavav)
Tata Chemicals Ltd.

original on Rs. 664 Stamp with the Collectors Office

COLLECTOR

INDIA GUJARAT JUNAGADH TREASURY

FORM K

MODEL FORM OF MINING LEASE

(See Rule 31)

THIS INDENTURE made this 2nd day of October 1964 between the Governor of Gujarat/the President of India(hereinafter referred to as "the State Government" which expression shall where the context so admits be deemed to include the successors and assigns) of the one part and

When the lessee is an individual

(Name of person with address and occupation) (hereinafter referred to as "the lessee" which expression shall where the context so admits be deemed to include his heirs, executors, administrators, representatives, and permitted assigns).

When the lessees are more than one individual.

(Name of person with address and occupation) and (Name of person with address and occupation)(hereinafter referred to as "the lessees" which expression shall where the context so admits be deemed to include their respective heirs, executors, administrators, representatives and their permitted assigns).

When the lessee is a registered firm

(Name and address of partners) son of of son of of son of of all carrying on business in partnership under the name and style of (name of the firm) registered under the Indian Partnership Act,1932 (9 of 1932), and having their registered office at in the town of (hereinafter referred to as "the lessees" which expression where the context so admits be deemed to include all the said partners, their respective heirs, executors, legal representatives and permitted assigns).

When the lessee is a registered company

Messrs. Tata Chemicals Limited (Name of company) a Company registered under Companies Act (Act under which incorporated) and having its registered office at 24 Bruce Street, Bombay-1 (Address)(hereinafter referred to as the lessee which expression shall where the context so admits be deemed to include its successors and permitted assigns) of the other part.

WHEREAS THE lessee/lessees have applied to the State Government in accordance with the Mineral Concession Rules, 1960 (hereinafter referred to as the said rules for a mining lease for **Limestone** in respect of the lands described in Part I of the Schedule hereunder written and has/have deposited with the State Government the sum of Rs. **Five hundred** as security and the sum of Rs. **Five hundred** for meeting the preliminary expenses for a mining lease and whereas the lessee is in possession of a valid certificate of approval and Income-tax Clearance Certificate (and WHEREAS the Central Government has approved the grant of the lease)*

WITNESSETH that in consideration of the rents and royalties covenants and agreements by and in these presents and the schedule hereunder written reserved and contained and on the part of the lessee/lessees to be paid observed and performed, the State Government (with the approval of the Central Government)* hereby grants and demises unto lessee/lessees. All those the mines beds/veins seams of **limestone** (here state the mineral or minerals) (hereinafter and in the schedule referred to as the said minerals) situated lying and being in or under the lands which are referred to in Part I of the said schedule together with the liberties, powers and privileges to be exercised or enjoyed in connection herewith which are mentioned in Part II of the said Schedule subject to the restrictions and conditions as to the exercise and enjoyment of such liberties, powers and privileges which are mentioned in Part III of the said Schedule

*In case of minerals included in the First Schedule of the Mines and Minerals (Regulation and Development) Act, 1957.

COLLECTOR JUNAGADH JUNAGADH DISTRICT

EXCEPT and reserving out of this demise unto the State Government the liberties, powers and privileges mentioned in Part IV of the said schedule TO HOLD the premises hereby granted and demised unto the lessees from the 31st day of October 1964 for the term of twenty years thence next ensuing YIELDING AND PAYING therefore unto the State Government the several rents and royalties mentioned in Part V of the said Schedule at the respective times therein specified subject to the provisions contained in Part VI of the said Schedule and the lessees hereby covenant with the State Government as in Part VII of the said Schedule is expressed and the State Government hereby covenants with the lessees as in Part VIII of the said Schedule as expressed AND it is hereby mutually agreed between the parties hereto as in Part IX of the said Schedule is expressed.

IN WITNESS WHEREOF these presents have been executed in manner hereunder appearing the day and year first above written.

The Schedule above referred to

Reference MCR,1563/15140-G.V. dated 12th June 1964

PART I

The Area of this lease

All that tract of lands situated at village Adyari (Description of area or areas) in (Pargana) in Ranavav the Registration District of Junagadh Sub-District Porbandar and Thana Ranavav bearing Cadastral Survey Nos. 207/Part containing an area of 16.21 hectares thereabouts delineated on the plan hereto annexed and thereon coloured and bounded as follows:

Location and area of the lease.

Industries, Mines and Energy Department,
Sachivalaya, Gandhinagar,
Dated the 9th September, 1986.

Reads:- Letter No. 4-(7)-85-MV, dated 26th August, 1986 of Government of India, Ministry of Steel & Mines Department of Mines, New Delhi.

O R D E R:-

No. MCR-1583-(T-4) COL-104-Ghh1 :- In exercise of the powers conferred by Section 8 of the Mines and Minerals (Regulation and Development) Act, 1957, Government of Gujarat is pleased to sanction the renewal to M/s. TATA CHEMICALS LTD., Mithapur of a Mining Lease for Lime Stone for twenty years with effect from 29th October 1984 in respect of the area in the Junagadh District detailed below:-

Taluka	Village	Survey Number		Area in Hect.
Ranavav	Aniyali	207 / Part	upto	16.21

2. The renewal of the above lease is subject to the terms and conditions mentioned below:-

(A) Mining Lease shall be in respect of Limestone only. If any other minerals are found in association with this mineral, they should be brought to the notice of Government and if the lessee desires to mine these minerals along with the mineral for which lease is granted, he should do so only, after the consent of the State Government is obtained in writing.

2....

(b) royalty at the rate specified for the mineral Lime stone in Schedule IInd of the Mines and Minerals (Regulation and Development) Act 1957 as amended from time to time and dead rent at the rates mentioned in the IIIrd Schedule of the said Act, as amended from time to time whichever is greater shall be charged provided that the dead rent shall not be payable for the first year of the lease.

(c) Surface rent and water rate at such rate not exceeding land revenue, water rate and cesses assessable in the land shall be charged.

(d) If beryl or any other substances prescribed under section 3 of the Atomic Energy Act, 1948 (XXIX of 1948) is found to occur in the property under the lease, the lessee shall make available such mineral to the Government.

(e) The lease shall be subject to the provisions of the Mines and Minerals (Regulation and Development) Act, 1957 (67 of 1957) the Mineral Concession Rules, 1960, and the Mineral Conservation and Development Rules, 1958, as amended from time to time.

(f) The lessee shall furnish to the Collector of [illegible] an accurate map of the area sanctioned under the lease together with the description giving the location and boundaries duly attested by the [illegible] Inspector of Land Records. The Collector [illegible] the area demarcated before

execution of the Mining Lease and recover the cost from the deposit of Rs. 500/- paid for preliminary expenses.

(g) The lessee shall pay to the Collector, necessary security deposit of Rs. 1000/- for the observance of the terms and conditions of the lease in accordance with rule 32 of the Mineral Concession Rules, 1968, before the lease is issued to him.

(h) The lessee shall submit confidentially from time to time or when required progress report to the Director of Geology and Mining, Gujarat State, Ahmedabad-16 or to an officer authorised by him along with the samples of the ores collected during mining operations together with the analysis report.

(i) The lessee shall not use or sell the said Mineral or deal with it in whatsoever manner or knowingly allow any one to use or sell the said mineral or deal with it in whatsoever manner as a minor mineral.

(j) The lessee also undertakes that if the limestone won from the lease area is not required for an industrial unit to be set up by himself, he shall deliver the limestone for utilisation in any industrial plant set up by any other party within Gujarat to whom the State Government (on notice of not less than six months) may direct the lessee to deliver the limestone and in su event the price and other terms of such supply arrange- ment on long term basis shall be mutually agreed upon.

4....

between the lessee and such other party, in the event of the Dispute arising between the lessee and such other party in regard to the said supply arrangements, the point at dispute shall be settled by the State Government and in case the lessee is still aggrieved by the decision of the State Govt. on such point, the lessee shall have the right to appeal to the Central Government.

(k) The lessee shall use all the Lime stone excavated from the said area for captive use in his existing/ proposed Soda Ash plant in Junagadh District in Gujarat State.

3. The following clause 21-A over and above pre-emption clause in favour of the State Government contained in the clause 21 of part VII of the model form of the Mining lease (Form K) shall be introduced in the mining lease deed.

"21-A: Subject to the rights of the State Government and the obligations of the lessee under clause-21, above the lessee hereby undertakes that in respect of all flux or fettling grade limestone" (that is with acid insolubles of Alumina and silica less than 15 percent) he shall win from the leased area, the lessee shall,

(a) Offer the first option of purchase to the [illegible] Steel Limited, Ranchi at such price [illegible] as may be agreed upon between the

5....

lessee and the said Hindustan Steel Limited, in advance from year to year (such price and terms being not less favourable than those prevalent in the particular year in the market) and

(b) To the extent, the said Hindustan Steel Limited do not exercise that first option in the particular year offer the second option of purchase to any other steel plant in the country, at such price and other terms as may be agreed upon between the lessee and such other steel plant before otherwise disposing of such limestone.

(c) In the event of any disagreement or dispute arising between the lessee and the said Hindustan Steel Limited (or other steel plant) relating to the price or any other terms or any other matters relating to the exercise of the options aforesaid, the point at dispute shall be referred to the State Government for decision provided further that, in case the lessee or the said Hindustan Steel Limited (or other Steel Plant), is still aggrieved by the decision of the State Government on such point the matter shall be referred to the Secretary to the Government of India in the Ministry of Steel and Mines, Department of Mines and the decision of the said Secretary or any officer nominated by him for the purpose, as the case may be shall be final and binding on all concerned.

6....

5. The State Government is also pleased to accord under Rule 27(3) of the M.C. Rules, 1960, for incorporation of the following conditions in the lease deed.

(i) The fines and silliceous limestone generated during mining has to be stacked separately for use in the other industries like cement plants. Alternatively, the Company should develop the requisite technology to use these fines (around 20% of the Run- of Mines ore) and also the siliceous limestone occuring below.

(ii) The excavation due to mining should be suitable reclaimed/rehabilitated for proper land use keeping in view of environment. A scheme of such reclamation should be submitted to the appropriate authority for approval.

(iii) Out of the 9 lease holders in Jamnagar District 8 lease holders are still virgin where no mining has been started. These areas should be thoroughly explored to augment the reserve.

6. This, and subsequent renewals, if any will be governed by the current Act and Rules and the terms of the lease deed should confirm to the Act and Rules.

By order and in the name of the Governor of Gujarat,

(R.U. Parmar,)
Under Secretary to the Government of Gujarat,
Industries, Mines and Energy Department.

To

M/s. Tata Chemicals Ltd., Mithapur.

With a request to approach the Collector of Junagadh District, Junagadh for execution of mining lease deed. If mining lease is not executed within six months of the date of order sanctioning it, the order sanctioned it may be revoked under the provision of rule 31 of the Mineral Concession Rules, 1960.

Copy to:-

*By Regd. A.D.

* 1. The Collector of Junagadh District, Junagadh, with a request to take further necessary action in the matter. The case papers are returned herewith.

2. The Director of Geology and Mining, Gujarat, Ahmedabad-16.

3. The Director, Government of India, Ministry of Steel and Mines, Department of Mines, New Delhi with reference to his letter No. 4(7)-85-MV, dated 26th August, 1986.

4. The Assistant Geologist, Director of Geology and Mining, Porbandar.

5. The Revenue Department.

6. The District Inspector of Land Records, Junagadh District, Junagadh.

7. The Accountant General, Gujarat, Ahmedabad.

8. The Accountant General, Gujarat, Rajkot.

9. The Controller General, Indian Bureau of Mines, New Secretariat Building, Nagpur-1.

10. The Director General of Mines Safety, Dhanbad.

11. The Director of Mines Safety, Udaipur Region 56, Shastri Marg, Udaipur-313001 (Rajasthan).

12. Copy for select file.

13. Copy for Personal file.

....

Annexure No. 4

Renew/37-83/3929

Mining Branch.
Junagadh District, Junagad

Date:- 1/9/1987

TATA CHEMICALS LTD.
7 SEP 1987
MITHAPUR.

To,
The Controller,
Indian Bureau of Mines,
N A G P U R .

Subject:- Grant of ~~Mining~~ Lease/Prospecting Licence for LIMESTONE to Shri M/s. Tata Chemicals Ltd.
Area Acre. — Guntha./H.6-2 Are.
Survey No. 207 f.p. ... Village. Bara
..... Taluka. Ranavav Junagadh District.

TATA CHEMICALS LTD.
7 SEP 1987
MITHAPUR.

Of Junagadh District vide Government of Gujarat, Industries, Mines and Energy Department order No.MCR-1583-T-1-H/Mci/
.....dated...9-9-86....

A copy of the lease deed alongwith a demarcated plan is submitted herewith for record.

For COLLECTOR
JUNAGADH DISTRICT JUNAGADH

Copy F. W. c.s. to:-
(with copy of lease deed and sketch)

1. The Under Secretary, Industries, Mines & Energy Dept., Sachivalaya, Gandhinagar.
2. The Director, Geology & Mining Deptt., New Mental Hospital Bldg. Asharwa, Ahmedabad.
3. The Mamlatdar. Ranavav. He is requested to handover the possession of the land to the party as per rules & regulations & immediate the date of giving possession to this office.
4. The Assistant Geologist/~~Royalty Inspector~~ ... Porbandar
5. The Mines Supervisor.....
6. The Mining Lease Statical File.
7. The Assistant Director, F.S. RAJKOT.

To,
Shri/M/s. Tata chemicals ltd.
.....Mith pur
.....

FORM K

MODEL FORM OF MINING LEASE

(*See* Rule 31)

THIS INDENTURE made this 21 st. day of August. 1987 19 between the Governor of Gujarat (hereinafter referred to as "the State Government" which expression shall where the context so admits be deemed to include the successors and assigns) of the one part and

When the lessee is an individual.

(Name of person with address and occupation) (hereinafter referred to as "the lessee" which expression shall where the context so admits be deemed to include his heirs, executors, administrators, representatives and permitted assigns).

When the lessee are more than one individual.

(Name of person with address and occupation) and

(Name of person with address and occupation) (hereinafter referred to as "the lessee" which expression shall where the context so admits be deemed to include their respective heirs, executors, administrators, representatives and their permited assigns).

When the lessee is a registered firm.

(Name and address of partner) son of of son of of all carrying on business in partnership under the name and style of

(Name of their firms) registered under the Indian Partnership Act, 1932 (9 of 1932), and having their registered office at in the town of (hereinafter referred to as "the lessees") which expres-on where the context so admits be deemed to include all the said partners, their respective heirs, executors, legal representatives and permitted assigns).

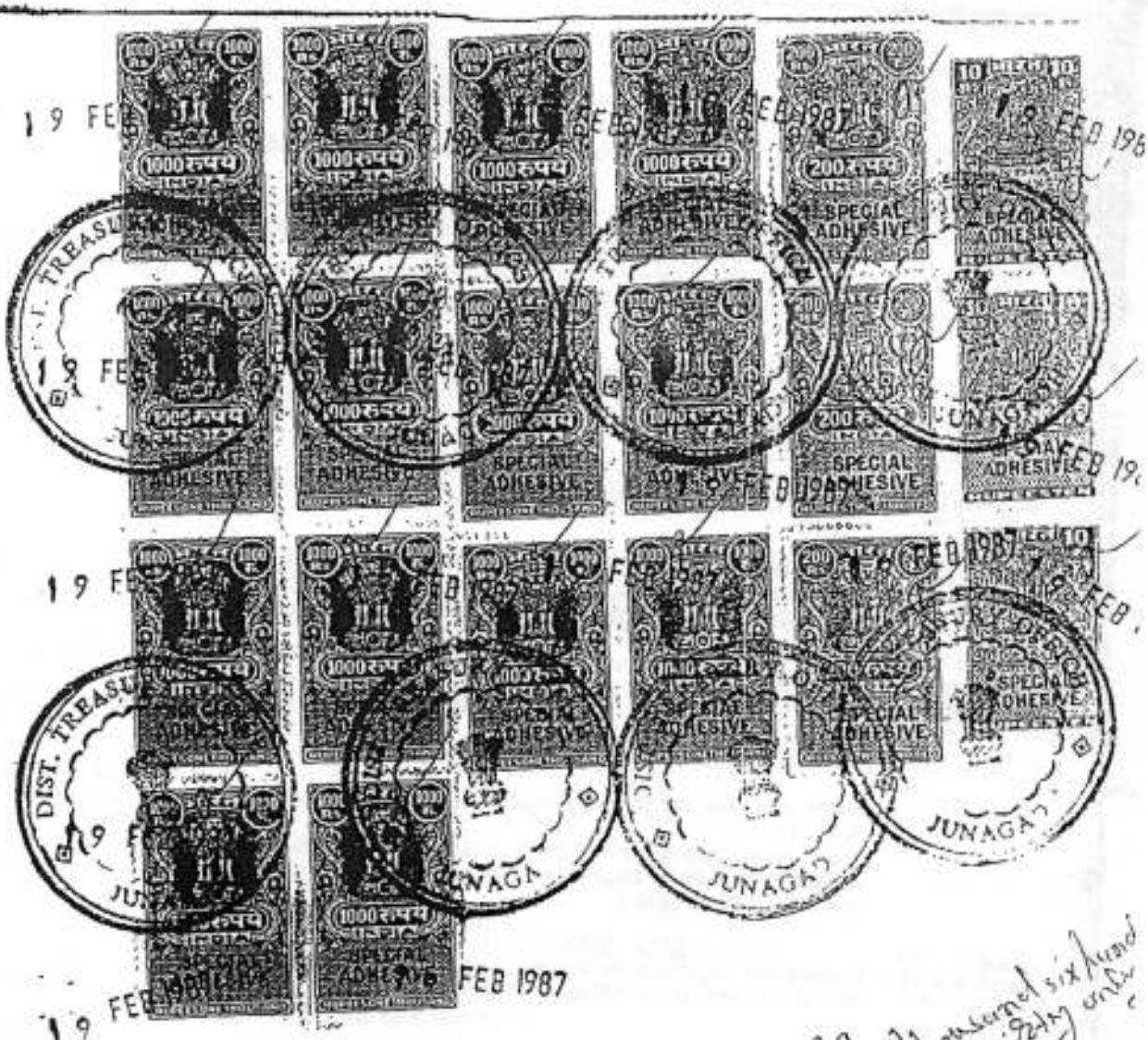
When the lessee is a registered company.

M/s. TATA CHEMICALS LIMITED., (Name of company) a company registered under Companies Act. (Act under which incorporated) and having its registered office at Bombay House, 24 Homi Mody Street, Fort, BOMBAY (400 023) (Address) (hereinafter referred to as the lessee which expression shall where the context so admit be deemed to include its successors and permitted assigns) of the other part.

WHEREAS THE lessee/lessees has/have applied to the State Government in accordance with the Mineral Concession Rule, 1960 (hereinafter referred to as the said rules), for a mininig lease for LIMESTONE in respect of the lands described in Part-I of the Schedule hereunder written and has/have deposited with the State Government the sum of Rs. 2000-00 as security and the sum of Rs. 500-00 for meeting the preliminary expenses for a mining lease (and WHEREAS the Central Government has approved the grant of the lease)* (No. M-II-152 (57) 61, dated 15th October 1963).

Lan No. 98
19.2.1987

WITNESSETH that in considerations of the rents and royalties convenants and agreements by and in these presents and the schedule hereunder written reserved and contained and on the part of the lessee/lessees to be paid observed and performed the State Government (with the approval of the Central Government)* hereby grants and demises into lessee/ lessees. All those the mines beds/veins seamas of LIMESTONE (herestate the mineral or minerals) (hereinafter and in the schedule referred to as the said minerals) situated lying and being in or under the lands which are referred to in Part-I of the said schedule together with the liberties, powers and privileges to be exercised or enjoyed in connection herewith which are mentioned in Part-II of the said schedule subject to the restrictions and conditions as to the exercise and enjoyment of such liberties powers, and privileges which are mentioned in Part-III of the said schedule EXCEPT and reserving out of this demise upto the State Government the liberties, powers and privileges mentioned in Part-IV of the said schedule TO HOLD the premises hereby granted and demised upto the lessee/lessees from the 29 th day of October 1984 for the term of 20 years thence next ensuring YIELDING AND PAYING therefore upto the State Government the serveral rents and royalties metioned in Part-V of the said Schedule at the respective times therein specified subject to the provisions contained in Part VI of the said Schedule and the lessee/lessees hereby convenants/convenant with the State Government as in Part-VII of the said schedule is expressed and the State Government hereby convenants with the lessee/lessees as in Part VIII of the said Schedule as expressed AND it is hereby mutually agreed between the parties hereto as in Part-IX of the said Schedule is expressed.



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FORM 'K'

MODEL FORM OF MINING LEASE

PART-V

Rate & Mode of payment of Dead Rent:

Subject to the provision of clause 1 of this part during the subsistance of the lease, the Leasee/Leasses shall pay to the following rate/rates or at such revised rate/rates which may be communicated in writing to the Leasee/Leasses by the State Government per mineral per hectares of the lands demised and described in part-1 of this schedule.

Name of Mineral	Dead rent fixed per Hects.	Area of demised land Hects.	Dead Rent payable Rs.	Total Dead rent payable Rs.
21st year upto 40th year.	90-00	16.21	1530-00	1530-00

(Here insert the manner in which and the time at which the Dead rent, Surface rent and water rent should be paid)

(Dead rent, Surface Rent, etc. will be paid at the State Bank of Ranavav, every year).

there after at all times during the continuance of this lease, shall work the said minerals without voluntary intermission in a skilful and workman like manner and prescribed under clause 12 hereinafter without doing or permitting to be done any unnecessary or avoidable damage to the surface of the said lands or the crops., buildings, structures or other property thereon. For the purposes of this clause operations shall include the erection of machinery laying of a tramways or construction of road in connection with the mine.

PART—I

The Area of this lease

Survey No.207/Part Village:Aniali

All that tract of lands situated at / (Description of area or areas) Location and area of the lease.
in (Pargana) in Ranavav the Registration District of
Junagadh Sub-District and Thana Ranavavbearing
Cadastral Survey Nos.207/Part containing an area of / or /16.21 Hects /Hect
thereabouts delineated on the plan hereto annexed and thereon coloured /and bounded as follows :

On the North by :
On the South by :
On the West by :
and
On the East by :

Bounded by Survey No.207
(As shown in enclosed plan)

hereinafter referred to as "the said Lands".

PART—II

Liberties, Powers and Privileges to be exercised and enjoyed by the lessee/lessees subject to the restrictions and conditions in Part-III

1. Liberty and power at all times during the term hereby demised to enter upon the said lands and to search for, mine, bore, dig, drill for, win, work, dress, process, convert, carry away and dispose of the said mineral/minerals. — To enter upon land and search for win work etc.,

2. Liberty and power for or in connection with any of the purposes mentioned in this part to sink, drive, make, maintain and use in the said lands and pits, shafts, inclines, drifts, levels, water-ways, air-ways and other works (and to use, maintain deepen or extend any existing work of the like nature in the said lands). — To sink drive and make pits shafts and inclines etc.

3. Liberty and power for or in connection with any of the purposes mentioned in this part of erect, construct, maintain and use in the said lands any engines, machinery plant, dressing floors, furnaces, coke, oven brickkilns, workshops, store-houses, bunglows, godowns, sheds and other building and other works and conveniences of the like nature on or under the said lands. — To bring and use machinery equipment etc.

4. Liberty and power or in connection with any of the purpose, mentioned in this part to make any tramways, railways, roads, aircraft landing grounds and other ways in or over the said lands and to use, maintain and go and repass with or without horses, cattle, wagon, aircrafts, locomotives or other vehicles over the same (or any existing tramways, railways, roads and other ways in on over the said lands) on such conditions as may be agreed to. — To make roads and ways etc., and use existing roads and ways.

5. Liberty and power for or in connection with any of the purposes mentioned in this part to quarry and get stone, gravel and other buildings and road materials and clay and to use and employ the same and to manufacture such clay in to bricks or tiles and to use such bricks or tiles but not to sell any such material, bricks or tiles. — To get building and road materials etc.

6. Liberty and power for or in connection with any of the purposes mentioned in this part but subject to the rights of any existing or future lesses and with the written permission of Collector to appropriate and use water from any streams, water-courses, springs or other sources in or upon the said lands and to divert, step up or dam any such stream or water course and collect or impound any such water and to make construct and maintain any water-course. culverts, drains or reservoirs but not as so to deprive any cultivated lands, villages, buildings, or watering place for livestock of a reasonable supply of water as before accustomed nor in any way to foul or pollute any streams or springs. Provided that the lessee/lessees shall not interfere with the navigation in any navigable stream nor shall divert such stream without the previous written permission of the State Government. — To use water from streams etc.

7. Liberty and power to enter upon and use a sufficient part of the surface of the said lands for the purpose of stacking, heaping, storing or depositing there in any produce of the mines or works carried on and any tools, equipment, earth and materials and substances dug or raised under the liberties and powers mentioned in this part. — To use land for stacking heaping depositing purposes.

8. (*a*) Liberty and power to enter upon and use a sufficient part of the said lands to beneficiate any or produced from the said lands and to carry away such beneficiated or. — Beneficiation and conveying away of production.

(*b*) Liberty and power upon the said lands to convert into coke any coal or coal dust produced from the said lands and to carry away such coke. — To make coke (To be used in case of coal only).

To clear b wood and fell and u trees etc.

No. buil etc., certain pl.

Permissio surface o tions in a not alrea use.

To cut tre unreserve lands.

To enter u Reserved f

Compensa for damag revenue fo

mi tion in Sch ma of po works etc.

Facilities joining Go ment la and le

To clear brushwood and to fell and utilise trees etc.

9. Liberty and power for or in connection with any of the purposes mentioned in this part and subject to the existing rights of others and save as provided in clause 3 of Part-III of this Schedule to clear under-growth and brushwood and to fell and utilise any trees or timber standing or found on the said lands provided that the State Government may ask the lessee/lessees to pay for any trees or timber felled and utilised by them/him at the rates specified by the Collector or the State Government.

PART—III

Restrictions and Conditions as to the Exercise of the liberties, Powers and Privileges Part-II.

No building etc., upon certain places.

1. No building or thing shall be erected, set up or placed and no surface operations shall be carried on in or upon any public pleasure ground, burial ground or burial place held sacred by any class of persons or any house or village site, public road or other place which the State Government may determine as public ground nor in such a manner as to injure or prejudicially affect any buildings, works, property or rights of other persons and no land shall be used for surface operations which is already occupied by persons other than the State Government for work or purposes not included in this lease. The lessee /lessees shall not also interfere with any right of way well or tank.

Permission for surface operations in a land not already in use.

2. Before using for surface operations any land which has not already been used for such operations, the lessee/lessees shall give to Collector of the District two calendar months previous notice in writing specifying the name or other description of the situation and the extent of the land proposed to be so used if objection is issued by the same is required and the said land shall not be so used if objection is issued by the Collector within two months after the receipt by him of such notice unless the objections so stated shall on reference to the State Government be annualled or waived.

To cut trees in unreserved lands.

3. The lessee/lesse shall not without the express sanction of the Collector cut down or injure any timber or trees on the said lands but may without such sanction clear away any brushwood or undergrowth which interferes with any operations authorised by these presents. The Collector or the State Government may require the lessee/lessees to pay for any trees or timber felled and utilised by him/them at the rates specified by the Collector of the District.

To enter upon Reserved forests

4. Notwithstanding anything in this schedule contained the lessee/lessees shall not enter upon any reserved forest included in the said lands without previous sanction in writting of the District Forest Officer nor fell cut and use any timber or trees without obtaining the sanctioned in writing of that Officer not otherwise than in accordance with such conditions as the State Government may prescribed.

Compensation for damage to reversed forest

4-A. The leasee/leasees shall pay such compensation as may be assessed by the Chief Conservator of Forest for damage caused to the land in any area of the reserved forest on account of the mining operation carried out in such area. The compensation for such damage shall be based on the value of the standing trees in the said area and twenty times the sum of annual revenue derived by the Government from such land immediately before the grant of lease.

No mining operation within 50 meters of public works etc.

5. The lessee/lessees shall not work or carry on or allow to be worked or carried on any mining operations at or to any point within a distance of 50 meters from any railway line except with the previous written permission of the Railway Administration "concerned or under or beneath any ropeway or any ropeway trestle or station, except, under and in accordance with the written permission of the authority owing the ropeway" or from any reservoir, canal or other public works such as public roads and buildings or inhabited site except with the previous written permission of the Collector or any other officer authorised by the State Government in this behalf and otherwise than in accordance with such instructions, restrictions and conditions either general or special which may be attached to such permission. The said distance of 50 meters shall be measured in the case of railway, reservoir or canal horizontally from the outer toe of the bank or the outer edge of the cutting as the case may be and in case of a building horizontally from the plinth thereof. In the case of village roads no working shall be carried out within a distance of 10 meters of the outer edge of the cutting except with the previous permission of the Collector or any other officer duly authorised by the State Government in this behalf and otherwise than in accordance with such directions, restrictions and additions, either general or special, which may be attached to such permission (No. 1 (51)/65-M-II, dated 26th February 1969).

Explanation.—For the purpose of this clause the expression "Railway Administration" shall have the same meaning as it is defined to have in the Indian Railway Act, 1980, by clause (6) of section 3 of that Act. "Public Road" shall mean a road which has been constructed by artificially surfaced as district from a track resulting from repreated use. Village road will include any track shown in the revenue record as village road.

Facilities of adjoining Government licences and lessees.

6. The lease/leassees shall allow existing the future holders of Government licences or leases over any land which is comprised in or adjoins or is reached by the land held by the lessee/lessees reasonable facilities of access thereto :

State Government may prescribe, royalty in respect of any mineral/minerals removed by him/them from the leased area at the rate for the time being specified in the Second Schedule to the Mines and Minerals (Regulation and Development) Act, 1957.

Payment of surface rent and water rate.

4. The lessee/lessees shall pay rent and water rate to the State Government in respect of all parts of the surface of the said lands which shall from time to time be occupied or used by the lessee/lessees under the authority of this presents at the rate that may be specified by the State Government, per annum per hectare of the area so occupied or used and so in proportion for any area less than a hectare during the period from the comencement of such occupation or use until areas shall cease to be so occupied or used and shall as far as possible restore and the surface so used to its original conditions. The surface rent in respect of the area actually under mining operation and area utilised for machinery labour quarters and office, shall be equal to non-agriculture assessment *i. e.* at the rent of Rs. 0.01 ps as per Sq. Meter per annum and in respect of the areas occupied but unused *i. e.* for the remaining areas shall be equal to the agriculture assessment should be paid at the rate of Rs. 1.38 ps per ~~hectare~~ acre or part thereof per annum from time to time :

PROVIDED THAT NO such rent/water rate shall be payable in respect of the occupation and use of the area comprised in any roads or ways to which the public have full right to acess.

PART—VI

Provisions relating to the Rent and Royalties

Rent and royalties to be free from deduction etc.,

1. The rent, water rate and royalties mentioned in part V of this Schedule shall be paid free from any deductions to the State Government at Ranaway and in such matter as the State Government may prescribed.

PROVIDED ALWAYS and it is hereby agreed that Rs. 500-00 the balance standing to the credit of the lessee/lessees on account of the deposit made by him/them as a licencee/licensees over an area which included the said lands shall be retained and accepted by the State Government in satisfaction of the rents and royalties mentioned in Part-V until they reach that amount.

Mode of Computation of royalties.

2. for the purposes of computing the said royalties the lessee/lessees shall keep a correct account of the mineral/minerals produced and despatched. The accounts as well as the weights of the mineral/minerals in stock or in the process of export may be checked by an officer authorised by the Central or State Government. The computation of royalties shall be decided by the Director of Geology and Mining of the State.

Courses of action if rents and royalties are not paid in time.

3. Should any rent, royalty or other sums due to the State Government together with simple interest due thereon at the rate of ~~ten~~ fifteen percent per annum under the terms and conditions of these presents be not paid by the lessee/lessees within the prescribed time, the same may be recovered on a certificate of such officer as may be specified by the State Government by general or special order, in the same manner as an arrear of land revenues.

PART—VII

The convenants of the Lessee/Lessees

Lessee to Pay rent and royalties taxes,

1. The lessee/lessees shall pay the rent, water rate and royalties reserved by this lease at such times and in the manner provided in PARTS V and VI of these presents and shall also pay and discharge all taxed, rates, assessments and impositions whatsoever being in the nature of public demands which shall from time to time be charged, assessed or imposed by the authority of the Central and State Government upon or in respect of the premises and works of the lessees/leasees in common with other permises and works of a like nature except demands for land revenue.

To maintain and keep boundary marks in good order.

2. The lessee/lessees shall at his/their own expense erct and at all times maintain and keep in repair boundary marks and pillars according to the demarcation to be shown in the plan annexed to this lease. Such marks and pillars shall be sufficiently clear of the shrubs and other obstructions as to allow easy identification.

Commence operation within a year and work in a workman like manner.

3. Unless the State Government for good cause permits otherwise, the lessee/lessees shall commance operation within one year from the date of execution of the lease and shall as there after at all times during the continuance of this lease search for, win work and develop the said minerals without voluntary intermission in a skilful and workman like manner and prescribed under clause 12 hereinafter without doing or permitting to be done any unnecessary or avoidable damage to the surface of the said lands or the crops., buildings, structures or other property thereon. For the purposes of this clause operations shall include the erection of machinery laying of a tramways or construction of road in connection with the

4. The lessee/lessees shall make and pay such reasonable satisfaction and compensation as may be assessed by lawful authority as in accordance with the law in force on the subject for all damage, injury or disturbance which may be done by him/them in exercise of the powers granted by this lease and shall iddemnify and keep indemnifies fully and completely the State Government against all claims which may be made by may person or persons in respect of any such damage, injury or disturbance and all costs and expenses in connection therewith.

To indemnify Government against all claims.

To maintain Plans etc.

5. The lessee/lessees shall during the subsistance of this lease well and sufficiently secure and keep open with timber or other durable means all pits, shafts and workings that may be made or used in the said lands and make and maintain sufficient fencesto the satisfaction of the State Government round every such pit, shifts or working whether the same is abandoned or not and shall during the same priod keep all working in the said lands and make and maintain sufficient fences to the satisfacion of the State Government round every such pit, shafts or working whether the same is abandoned or not and shall during the same period keep all working in the said lands except such as may be abandoned accessible free from water and foul air as for as possible,

To secure and keep in good condition pits, shafts, etc.

6. The lessee/lessees shall strengthen and support to the satisfaction of the Railway Administration concerned or the State Government, as the case may be any part of the mine which in its opinion fequired such strengthing or support for the safety of any railway, resorvoir canal, road and any other public works or structures.

To strengthen and support the mine to necessary extent.

7. The lessee/lessees shall allow any officer authorised by the Central Government or the State Government in that behalf to enter upon the premises including any in building, excavation or land comprised in the lease for the purpose of inspecting, examing, surveying, prospecting and making plans thereof sampling and collecting a data and the lessee/-lessees shall with proper person employed by the lessee/lessees and acquainted with the mines and work effectually assist the officer, agents, servants, and workmen in conslucting every such section and shall afford them all facilities, information, connected with them the working of the mines which they may reasonably require and also shall and will conform to and observe all orders and regulations which the Central and State Governments as the result of such inspection or otherwise may from time to time see fit to impose. (No. M-II(69)/44/61, dated 7th, September 1961).

To allow inspection of working.

8. The lessee/lessees shall without delays send to the Collector a report of any accident causing death or serious bodily injury or serious injury to property or seriously affecting or endangering life or property which may occur in the course of the operations under this lease.

To report accidents.

9. The lessee/lessees shall report to the State Government the discovery in the leased area of any mineral not specified in the lease within sixty days of such discovery along with full particulars of the nature and position of each such find. If any mineral not specified in the lease is discovered in the leased area, the lessee/lessees shall not win and dispose of such mineral unless such mineral is included in the lease or a separate lease is obtained therefore.

To report discovery of other minesals.

10. The lessee/lessees shall at time during the said term keep or cause to be kept at an office to be situated upon or near the said lands correct and intelligible books of accounts which shall contain accurate entries showing from time to time :—

(1) Quantity and quality of the said mineral/minerals realised from the said lands.

(2) Quantity of the various qualites of or beneficiated or converted (for example coal converted into coke).

(3) Quantities of the various qualities of the said mineral/minerals sold and exported separately.

(4) Quantities of the various qualities of the said mineral/minerals otherwise disposed of and the manner and purpose of such disposal.

(5) The prices and all other particulars of all sales of said mineral/minerals.

(6) The number of persons employed in the mines or work or upon the said lands specifying nationality, qualifications and pay of the technical personnel.

(7) Such other facts, particulars and circumstances as the Central or the State Government may from time to time require and shall also furnish free of charge to such officers and at such times as the central and State Government may oppoint true and correct abstract of all or any such books of accounts and such information and returns to all or any of the matters, aforesaid as thes tate Government may prescribed and shall at all reasonable time allow such officers as the Central Government or State Government shall in that behalf appoint to enter into and have free access to the said officers for the purpose of examining and inspecting the said books of accounts, plans and records and to make copies thereof and make extracts therefrom.

To pay compensation injury of th parties.

Not to struct work of other m rals.

FORM 'K' PART VII AFTER CLAUSE 11,

"11A The lessee shall pay a wage not less than the minimum wage prescribed by the Central or State Government from time to time.

11B The lessee shall comply with provisions of the Mines Act, 1952.

11C The lessee shall take measure for protection of environment like planting of trees, reclamation of land, use of pollution control devices; and such other measures as may be prescribed by the Central or State Government from time to time at his own expense.

11D The lessee shall pay compensation in the occupier of the land on the date and in the manner laid down in these rules."

To indemnify Government against all claims.

To maintain Plans etc.

11. The lessee/lessees shall at all times during the said term maintain at the mine office correct intelligible uptodate and complete plans and sections of the mines in the said lands. They shall show all the operations, and working and all the trenches pits and drillings made by him/them in the course of operations carried on by him/them under the lease, faults and other disturbances encountered and geological data and all such plans and sections shall be amended and filled up by and from actual surveys to be made for that purpose at the end of twelve months or any period specified from time to time and the lessee/lessees shall furnish free of charge to the Central and State Government true and correct copies of such plans and sections whenever required. Accurate records of all trenches, pits and drillings shall show:—

(*a*) The sub-soil and strata through which they pass:

(*b*) Any mineral encountered,

(*c*) Any other matter of interest and all data required by the Central and State Government from time to time.

To secure and keep in good condition pits, shafts, etc.

To strengthen and support

The lessee/lessees shall allow any officer of the Central or the State Government, authorised in this behalf by the Central Government, to inspect the same at all reasonable times. He/they shall also supply when asked for by the State Government/the Coal Controller/the Director, Geological Survey of India/the Director, Indian Bureaue Mines, a composite plan of the area showing thickness, dip, inclination etc., of all the seams as also the quantity of reserves quality-wise.

Act 67 of 1957.

12. The lessee/lessees shall be bound by such rules as may be issued from time to time by the Government of India under section 18 of the Mines and Minerals (Regulation and Development) Act, 1957 (Act 67 of 1957), and shall not carry on mining or other operations under the said lease in any way other than as prescribed under these rules.

To provide weighing machine.

13. Unless specifically exempted by the State Government the lessee/lessees shall provide and at all times keep at or near the pit head or each of the pit heads at which the said minerals shall be brought to bank a properly constructed and efficient weighing machine and shall weigh or cause to be weighed thereon all the said minerals from time to time brought to bank sold exported and converted and also the converted products and shall at the close of each day cause the total weights, ascertained by such means of the said minerals, ores products raise sold, exported and converted during the previous twenty-four hours to be present at the wighing of the said minerals as aforesaid and to keep accounts thereof and to check the accounts kept by the lessee/lessees. The lessee/lessees shall give seven days previous notice in writing to the Collector of every such measuring or weighing in order that he or some officer on his behalf may be present there at.

To allow test of weighing machine.

14. The lessee/lessees shall allow any person or persons appointed in that behalf by the State Government at any time or times during the said term to examine and test every weighing machine to be provided and kept as aforesaid and the weights used there with in order to ascertain whether the same respectively are correct and in good repair and order and if upon any such examination or testing any such weighing machine or weights shall be found incorrect or out of repair or order the State Government may require that the same be adjusted, repaired and put in order by and at the expenses of the lessee/lessees and if such requisition be not complied with within fourteen days after the same shall have been made, the State Government may cause such weighinig machine or weights to be adjusted, repaired and put in order by and the expense of so doing shall be paid by the lessee/lessees to the State Government on demand and if upon any such examination or testing as aforesaid any error shall be discovered in any weighing machine or weights to the prejudice of the State Government such error shall be regarded as having existed for three calendar months previous to the discovery thereof or from the last occassion of so examining and testing the same weghing machine and weight in case such occassion shall be within such period of three months and the said rent and royalty shall be paid and accounted for accordingly.

To pay compensation for injury of third parties.

15. The lessee/lessees shall make and pay reasonable a satisfaction and compensation for all damage, injury or disturbance of person or property which may be done by or on the the part of lessee/lessees in exercise of the liberties and power granted by these presents and shall at all times save harmless and keep indemnified the State Government from and against all suits, claims and demands which may be brought or made by any person or persons in respect of any such damage, injury or disturbance.

Not to obstruct working of other minerals.

16. The lessee/lessees will exercise the liberties and powers hereby granted in such a manner as to offer no unnecessary or reasonably avoidable obstruction or interruption to the development and working within the said lands of any minerals not included in this lease and shall at all times afford to the Central and State Government and to the holders of prospecting licence or mining lease in respect of any such minerals or any minerals within any land adjacent to the said lands as the case may be reasonable means of access and safe and convenient passage upon and across the said lands to such minerals for the purpose of getting working developing and carrying away the same provided that the lessee/lessees shall receive reasonable compensation for any damage or injury which he/they may sustain by reason or in consequence of the use of such passage by such lessees or holders of prospecting licences.

17. (1) The lessee/lessees shall not, without the previous consent in writing of the State Government : Transfer of lease.

(*a*) assign, sublet, mortgage, or in any other manner transfer the mining lease, or any right title or interest therein, or

(*b*) enter into or make any arragngement, contract or understainging whereby the lessee/lessees will or a may be directly or indirectly financed to a substantial extent, by or under which the lessee's operations or undertakings will or may be substantially controlled by any person or body of persons other than the lessee/lessees :

"Provided that he State Government shall not give its written consent unless.

(*a*) the lessee has furnished an affidavit alongwith his application for transfer of the mining lease specifying therein the amount that he has already taken or proposes to take as consideration from the transferee :

(*b*) the transfer of the mining lease is to be made to a person or body directly undertaking mining operaions [No.1 (33) 67-M-II dated 30th March 1968].

(2) Without prejudice to the above provisions, the lesses/lessees may, subject to the conditions specified in the proviso to rule 35, of the said rules transfer this lease or any right, title or interest therein, to a person holding a certificate of approval an income-tax clearance certificate from the Income-Tax Officer concerned, and the said valid clearance certificate on payment of a fee of rupees one hundred to the State Government. [No. 1 (25) 73 MVI dated 28th November 1974] :

Provided that the lesse/lessess shall make available to the transferee the original or certified copies of all plans off a bounded working in the area and in a belt 65 meters wide surrounding its :

Provided further that where the mortagee is an institution or a Bank or a corporation specified in Schedule V, it shall not be necessary for any such institution or Bank or Corporation to hold the said certificate of approval the said Income-Tax clearance certificate and said valid clearance certificate.

(3) The State Government may, by order in writing, determine the lease at any time if the lessee/lessees has/have in the opinion of the State Government, committed a breach of any of the above provisions or has/have transferred the lease of any right, title or interest therein otherwise than in accordance with clause (2) :

Provided that no such order shall be made without giving the lessee/lessees a reasonable opportunity of stating his/their c.

Not to be financed or controlled Trust, Corporation firm or person.

Employm foreign na

18. The lease shall not be controlled and the lessee/lessees shall not allow themselves to be controlled by any Trust, Syndicate Corporation, Firm or person except with the written consent of the Central Government. The lessee/lessees shall not enter into or marke any arrangement compact or understanding whereby the lessee/lessees' operations or undertaking will or may be carried on directly or indirectly by or for the benefit of or subject to the control of any Trust, Syndicate, Corporation Firm or person unless with the written sanction given prior to such arrangement compact or understanding being centered into or made of the Central Government and any or every such arrangement compact or understanding as aforesaid (Entered into or made with such sanction as aforesaid) shall only be entered into or made and shall always be subject to an express condition binding upon the other party or parties thereto that on the occasion of a state of emergency of which the President of India in his discretion shall be the sole judge it shall be terminable if so required in writing by the State Government and shall in the event of any such requisition being made be forthwith thereafter determined by the lessee/lessees accordingly.

Recovery expenses curred by the St Governmen

19. Whenever the security deposit of Rs. ~~1,000~~ 2000/- or any part thereof or any further sum hereafter deposited with the State Government in replenishment thereof shall be forfeited or applied by the Central or State Government pursuant to the power in hereinafter declared in that behalf the lessee/lessees shall deposit with the State Government such further sum as may be sufficient with the unappropriated part thereof to bring the amount in deposit with the State Government up to the sum of Rs. ~~1,000~~ 2000/-

Lessee shall deposit any additional amount necessary.

Furnishing geophysical

20. The lessee/lessees shall at the expiration or sooner determination of the said term or any renewal thereof deliver up to the State Government all mines, pits, shafts inclines, drifts, levels waterways, airways and other works now existing or hereafter to be sunk or made on or under the said lands except such as have been abandoned with the sanction of the State Government and in any ordinary and fair course of working all engines, machinery, plant, buildings, structures, other works and conviniences which at the commencement of the said term were upon or under the said lands and all such machinery set up by the lessee/lessees below ground which cannot be removed without

Delivery of workings in good order to State Government after determination of lease.

causing injury to the mines or works under the said lands (except such of the same as may with the sanction of the State Government have become disused) and all buildings and structures of bricks or stone erected by the lessee/lessees above ground level in good repair, order and condition and fit in all respectes for further working of the said mines and the said minerals.

Transfer of lease.

21. (a) The State Government shall from time to time and all times during the said term have the right (to be exercised by notice in writing to the lessee/lessees) of pre-emption of the said minerals (and all products thereof) lying in or upon the said lands hereby demised or elsewhere under the control of the lessee/lessees and the lessee/lessees shall with all possible expendition deliver all minerals or products or minerals purchased by the State Government under the power conferred by this provision in the quantities as the times in the manner and at the place specified in the notice exercising the said right.

(b) Should the right of pre-emption conferred by this present provision be exercised and a vessel chartered to carry the minerals or products thereof procured on behalf of the State Government or the Central Government be detained or demurrage at the port of loading the lessee/lessees shall pay the amount due for demurrage according to the terms of the charter party of such vessel unless the State Government shall be satisfied that the delay is due to causes beyond the control of the lessee/lessees.

(c) The price to be paid for all minerals or products of minerals taken in pre-emption by the State Government in exercise of the right hereby conferred shall be the fair market price prevailing a. the time of pre-emption PROVIDED THAT in order to assist in arriving at the said fair market price the lessee/lessees shall if so required furnish to the State Government for the confidential information of the Government particulars of the quantities descriptions and prices of the said minerals or products thereof sold to other customers and of charters entered into for freight for carriage of the same and shall produce to such officer or officers as may be directed by the State Government original or thernticated copies of contract and chatter parties entered into for the sale freightage of such minerals or products.

(d) In the event of the existence of a state of war or emergency (of which existence the President of India shall be the sole judge and a notification to this effect in the Gazette of India shall be conclusive proof), the State Government with the consent of the Central Governmet shall from time to time and all times during the said term have the right (to be exercised by a notice in writing to the lessee/lessees) forthwith take possession and control of the works, plan machinery and promises of the lessee/lessees on or in connection with the said lands or operations under this lease and during such possession or control the lessee/lessees shall conform to and obey all directions given by or on behalf of Central Government or State Government regarding the use or employment of such woks, plants premises and mineral PROVIDED THAT fair compensation which shall be determined in default of agreements by the State Government shall be paid to the leessee/lessees for all loss or damage sustained by him/them by reason or in consequence of the power conferred by this clause and PROVIDED ALSO that the exercise of the such power shall not determine the said term hereby granted or affect to terms and provisions of these presents further than may be necessary to give effect to the provisions of this clause

Not to be employment of foreign nationals.

22. The lessee/lessees shall not employ, in connection with the mining operation any person who is not an Indian national except with the previous approval of the Central Government.

Recovery of expenses incurred by the the State Government.

23. If any of the works or matters which in accordance with the convants in that behalf herein before contained are to be carried or performed by the lessee/lessee be not so carried out of performed within the time specified in that behalf, the State Government may cause the same to be carried out or performed and the lessee/lessee shall pay the State Government on demand all expenses which shall be incurred in such carrying out or performance of the same and the decision of the State Government as to such expenses shall be final.

Furnishing of geophsical data.

24. The lessee/lessees shall furnish

(a) all geophysical data relating to mining fields or engineering and ground water surveys, such as anomaly maps, section plans structures, contour maps, logging collected by him/the during the course of mining operations the Director Geological Survey of India, Calcutta,

(b) All information pertaining to investigations of radio active minerals collected by him/the during course of minning operations to the Secretary, Department of Atomic Energy, New Delhi.

The lessee shall submit from time to time or when required progress report to Director of Geology and Mining Gujarat State or to an officer authorised by him alongwith the samples of ores collected during Mining operation together with the analysis report

Lessee shall deposit any additional amount necessary.

Delivery of workings in good-order to State Government after determination of lease.

Data or information referred to above shall be furnished every year reckoned from the date of commencement of the period of the mining lease.

25. The lessee/lessees shall not use sell the said mineral or deal with it in whatsoever manner or knowingly allow any one to use or sell the said mineral or deal with it in whatsoever manner as minor mineral ;

Provided that on an application made to it in this behalf by the lessee/lessees the State Government is satisfied that having any regard to the inferior quality or such mineral, it cannot be used for any of the purposes by reasons of which it cannot be called a major mineral or that there is no market for such mineral as a major mineral, the State Government by order permit the leasse/lessees to dispose of the mineral in such quantity and on such terms and in such manner as may be specified therein as a minor mineral.

PART—VIII

The covenants of the State Government

1. The lessee/lessees paying the rents, water rate and royalties hereby served and observing and performing all the covenants and agreements here incontained and on the part of the lessee/lessees to be observed and performed shall and may quietly hold and enjoy the rights and premises hereby demised for and during the term hereby granted without any unlawful interruption from or by the State Government, or any person rightfully claiming under.

lessee/lessees may hold and enjoy rights quietly.

Refund of security deposit.

2. If in accordance with provisions of Clause 4 of Part VII of this Schedule the lessee/lessees shall offer to pay to an occupier of the surface of any part of the said lands compensation for any damage or injury which may arise for the proposed operations of the lessee/lessees and the said occupier shall refuse his consent to the exercise of the right and powers reserved to the State Government and demised to the lessee/lessees by these presents and the lessee/lessees shall report the matter to the State Government and shall deposit with it the amount offered as compensation and if the Central/State Government are satisfied that the amount of compensation offered is fair and reasonable or if it is not so satisfied and the lessee/lessees shall have deposited with it such further amount as the the State and Central Governments shall consider fair and reasonable the State Government shall order the occupier to allow the lessee/lessees to enter the land and to carry out such operations as may be necessary for the purpose of this lease. In assessing the amount of such compensation the State Government shall be guided by the principles of the Land Acquisition Act.

Acquisitional and of third parties and compensation thereof.

Obsruction inspecti

3. Where the mining lease relates to any mineral not specified in the First Schedule to the Act it shall be renewable for one period not exceeding the period specified in sub-section (2) of section 8, at the option of the lessee/lessees;

Provided that the State Government may for reasons to be recorded in writing reduce the area applied for.

If the lease is in respect of minerals specified in the First Schedule to the Act, renewal will be subject to the prior approval of the Central Government.

If the lessee/lessees be desirous of taking a renewed lease of the premises hereby demised or any part or parts of them for a further terms from the expiration of the term hereby granted and is otherwise eligible, he/they shall prior to the expiration of the last mentioned term give to the State Government Twelve calander months previous notice in writing and shall pay the rents, rates and royalties hereby reserved and shall observe and perform the several convenants and agreements herein contained and on the part of the lessee/lessees to be observed and performed upto the expiration of the term hereby granted. The State Government on receipt of application for renewal, shall consider it in accordance with rule 28 of the said rules and shall pass orders as it deems fit. In renewal is granted, the State Government will at the expense of the lessee/lessees and upon his executing and delivering to the State Government if required a counterpart thereof execute and deliver to the lessee/lessees a renewed lease of the said premises or thereof for the further term of 20 years at such rents, rates and royalties and on such terms and subject to such rents, rates and royalties and on such terms and subject to such convenants and agreements, including this present convenant to renew as shall be in accordance with the Mineral Concession Rules, 1960, applicable to LIMESTONE (Name of minerals) on the day next following the expiration of the terms hereby granted. (No.1 (19) 71 MVI, dated 9th September 1971)

To

Penalty of defa royalty breaches covenants.

Penalty repeated breaches covenants.

Failure fulfil the te of leases to "Force Majeuer".

Liberty determine th release.

Lessee/lesse to remove their prope on the exp of lease.

4. The lessee/lessees may at any time determine this lease by giving not less than 12 calandar months notice in writing to the State Government or to such officer, or authority as the State Government may specify in this behalf and upon the expiration of such notice

/provided that the lessee/lessees shall upon such expiration render and pay all rents, taxes, royalties, compensation for damages and other moneys which may then be due and payable under these presents to the lessor or any other person or persons and shall deliver, these presents to the State Government their this lease and the said term and the liberties powers and privileges hereby granted shall absolutely cease and determine but without prejudice to any right or remedy of the lessor in respect of any breach of any of the covenants or agreements contained in these present.

4.A. The State Government may on an application made by the lessee/lessees permit him them to surrender one or more minerals from his/their lease which is for a group of minerals on the ground that deposits of that mineral have since exhausted or depleted to such an extent that it is no longer possible to work the mineral economically, subject to the condition that the lessee.

(a) makes an application for such surrender of mineral at least six months before the intended date of surrender ; and

(b) gives an undertaking that he will not cause any hinderance in the working of the mineral so surrendered by any other person who is subsequently granted a mining lease for that mineral. (No. M-II-152(18)/61, dated 4th December, 1962).

Lessee/lessees may hold and enjoy rights quietly.

Refund of security deposit.

5. On such date as the State Government may elect within 12 calendar months after the determination of this lease or of any renewal thereof, the amount of the security deposit paid in respect of this lease and then remaining in deposit with the State Government and not required to be applied to any of the purpose mentioned in this lease shall be refunded to the lessee/lessees No interest shall run on the security deposit.

Additional rent of third parties and compensation thereof.

PART—IX

General Provisions

Obstructions to inspection.

In case the lessee / lessees of his / their transferee / assignee does / do not allow entry or inspection by the officers authority by the Central or State Government under clauses (*e*)-(*f*) of sub-rule (*1*) of rule 27 of said rule the State Government shall give notice in writing to the lessee/lessees requiring him/them to show cause within such times as may be specified in the notice why the lease should not be determined and his/their security deposit forfeited and if the lessee/lessees fails/fail to show cause within the aforesaid time to the satisfaction of the State Government, the State Government may determine the lease and forfeit the whole or part of the security deposit.

To case of default in royalty and of breaches of covenants.

2. If the lessee/lessees or his/their transferee or assignee makes/make any default in payment of rent or water rate or royalty as required by section 9 of the Act or commits a breach of any of the conditions and covenants other than those referred to in covenant above the State Government shall give notice to the lessee/lessees requiring him/them to pay the rent, water rate royalty or remedy the breach, as the case may be, within sixty days from the date of receipt of the notice and if the rent, water rate and royalty are not paid of or the breach is not remedied within such period, the State Government may without prejudice to any proceedings that may be taken against him/them, determine the lease and forfeit the whole or part of the security deposit.

Penalty for repeated breaches of covenants.

3. In case of repeated breaches of covenants and agreements by the lessees/lessees for which notice has been given by the State Government in accordance with clause (*1*) and (*2*) aforementioned on earlier occasion, the State Government without giving any further notice may impose such penalty not exceeding twice the amount of annual dead rent specified in clause 2 Part V.

Failure to fulfil the terms of leases due to "Force Majeure".

4. Failure on the part of the lessee/lessees to fulfil any of the terms and conditions of this lease shall not give the Central or State Government any claim against the lessee/lessees or be deemed a breach of this lease, in so far as such failure is considered by the said Government to arise from force majeure, and if through force majeure the fulfilment by the lessee/lessees of any of the terms and conditions of this lease be delayed, the period of such delay shall be added to the period fixed by this lease. In this clause the expression, "Force Majeure" means Act of God, war, insurrection, riot, civil commotion, strike, earthquake, tide, storm, tidal, wave, flood, lightening explosion, fire earthquake and any other happening which the lessee/lessees could not reasonably prevent or control.

Liberty to determine the lease.

Lessee/lessees to remove his/ their properties on the expiry of lease.

5. The lessee/lessees having first paid and discharged the rents, rates, and royalties payable by virtue of these present may at the expiration or sooner determination of the said term or within six calendar months thereafter (unless the lease shall be determined under clauses 1 and 2 of this part and in that case at any time not less than three calendar months nor more than six calendar months after such determination take down and removed for his/their own benefit all or any engines, machinery plants, buildings, structures, tramways railways, and other works erections and convenience which may have been erected, set up or placed by the

/essee/lessees in or upon the said lands and which the lessee/lessees is/are not bound to deliver to the State Government under clause 20 of part VII of this Schedule and which the State Government shall not desire to purchase.

Property left more than six months after determination of lease.

6. If at the end of six calendar months after the expiration or sooner determination of the said term under the provision contained in clause 4 of Part VII of this Schedule become effective there shall remain in or upon the said land any engines, machinery, plant buildings, structures, tramways, railways and other works, erection and conveniences or other property which are not required by the lessee/lessees in connection with operations in any other lands held by him/them under prospecting Licence or mining lease, the same shall, if not removed by the lessee/lessees within one calendar months after notice in writing requiring their removal has been given to the Lessee/lessees by the State Govenment be deemed to become the property of the State Government and may be sold or disposed of in such manner as the State Government shall deem fit without liablity to pay any compensation or to account to the lessee/lessees in respect thereof.

Notice.

7. Every notice by these presents required to be given to the lessee/lessees shall be given in writing to such person resident on the said lands as the lessee/lessees may appoint for the purpose of receiving such notice and if there shall have been no such appointment then every such notice shall be sent to the lessee/lessees by registered post addressed to the lessee/lessees at the address recorded in this lease or at such other address in India as the a lessee/lessees may from to time to time in writing to the State Government designate for their receipt of notices and every such service shall be deemed to be proper and valid service upon the lessee/lessees and shall not be questioned or challenged by him.

Immunity of State from Government liability to pay compensation.

8. If any event the order of the State Government are revised reviewed, or cancelled by the Central Government in pusuance of proceedings under chapter VII of the Mineral Concession Rules, 1960, the lessee/lessees shall not be entitled to compensation for any loss sustained by the lessee/lessees in exercise of the powers and privileges conferred upon him/ them by these present.

9. For the purpose of stamp duty the anticipation royalty from the demised land in Rs. 70,200-00 per year.

IN WITNESS WHEREOF these present have been executed in the manner hereunder appearing the day and year first above written.

Signed by Shri B.K. Shirke, Collector,

for and on behalf of the Governor of Gujarat.

COLLECTOR
Junagadh Dist. Junagadh

Asst. Director,
Geology and Mining
Junagadh

In the presence of

1. Shri H.R. Faldu ASST. DCOM-5710
2. N.D. P. Madlani Attender

Shri Tata Chemicals Ltd. Mithapur

for and on behalf of (Name of lessee/lessees)

FOR AND ON BEHALF OF
GUJARAT CHEMICALS LIMITED

In presence of

1. Shri K.L. Shukla Peon
2. Nathabhai Veerabhai Peon Junagadh

PRINTED AT THE GOVERNMENT PRESS, VADODARA.

"(P) the lessee shall, in the matter of employment give preference to the tribals and to the persons who become displaced because of the taking up of mining operations."

-(8A) The lease is executed at JUNAGADH the Capital town of the State of GUJARAT (name of the State) and subject to the provision of Article 226 of the Constitution of India, it is hereby agreed upon by the leasee and the lessor that in that event of any dispute in relation to the area under the lease, condition of lease the use realisation under the lease and in respect of all matter touching relationship of the lease and the lessor, the suits (or appeals) shall be filled in the Civil Courts at Junagadh (Name of the city) and it is hereby expressly agreed that neither party shall be competent to file a suit or bring any action or file any petition at any place other than the courts named above.

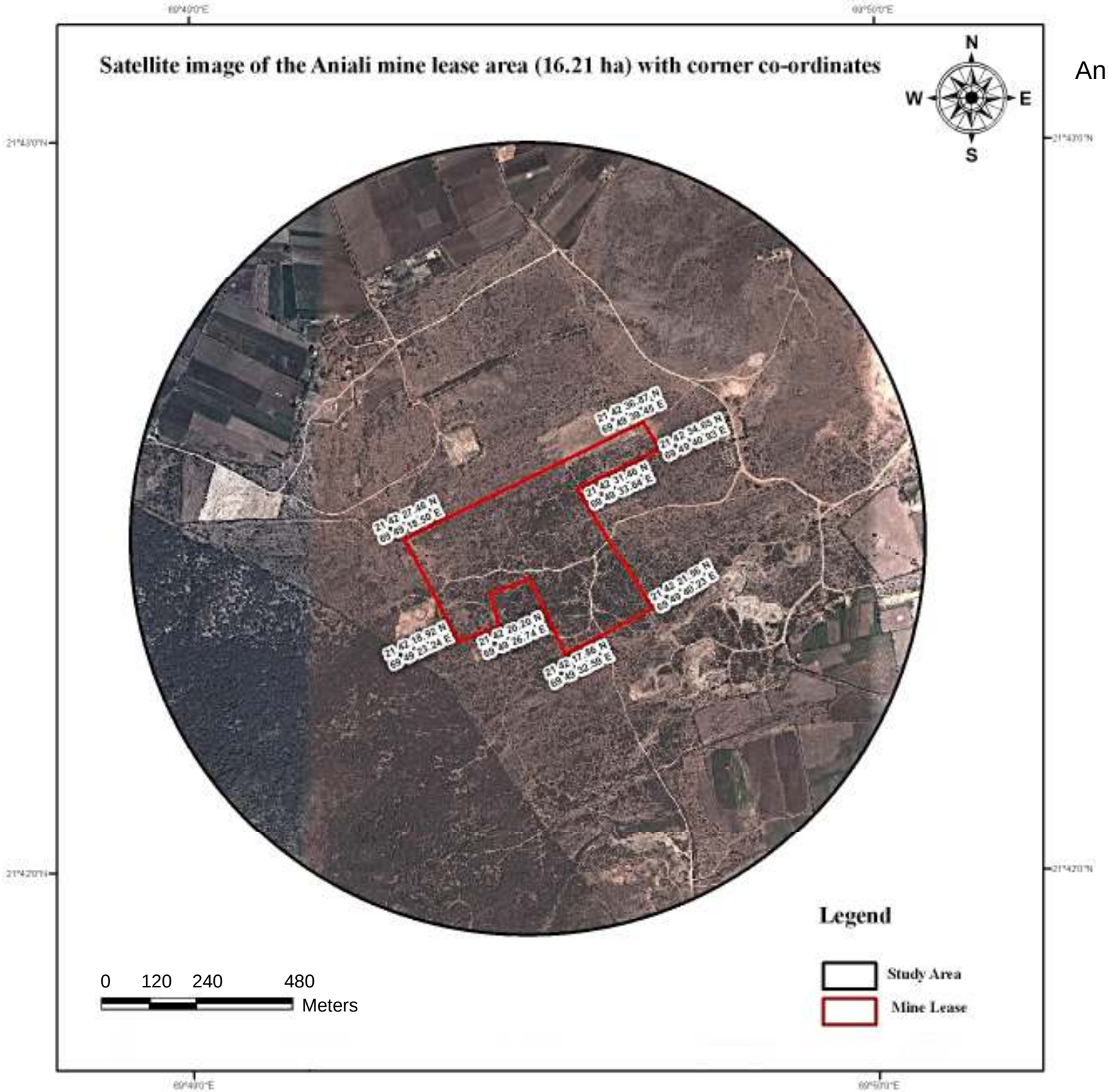
Property left more than six months after determination of lease.

Notice.

Immunity of State from Government liability to pay compensation.

Director,

Annexure - III



Annexure - IV

THE HUMAN TOUCH OF CHEMISTRY

TATA

Safety, Health and Environment Policy

Tata Chemicals shall uphold its position as a leader in the chemical industry by conducting all its operations in a manner that is protective of the environment and health and safety of employees, customers and the community.

In fulfillment of this commitment, we shall maintain a continuing effort to:

- Comply with all applicable safety, health and environment laws and regulations.
- Enhance Safety, Health and Environment (SHE) awareness among employees and associated stakeholders through effective communication and training.
- Investigate all workplace incidents and illnesses in order to promptly correct any unsafe conditions or practices.
- Integrate SHE considerations into business planning and decision making.
- Champion SHE responsibility among our employees in their practices, and promote and value their involvement in achieving the goals of this policy.
- Increase shareholder value through SHE excellence.

TATA CHEMICALS LIMITED

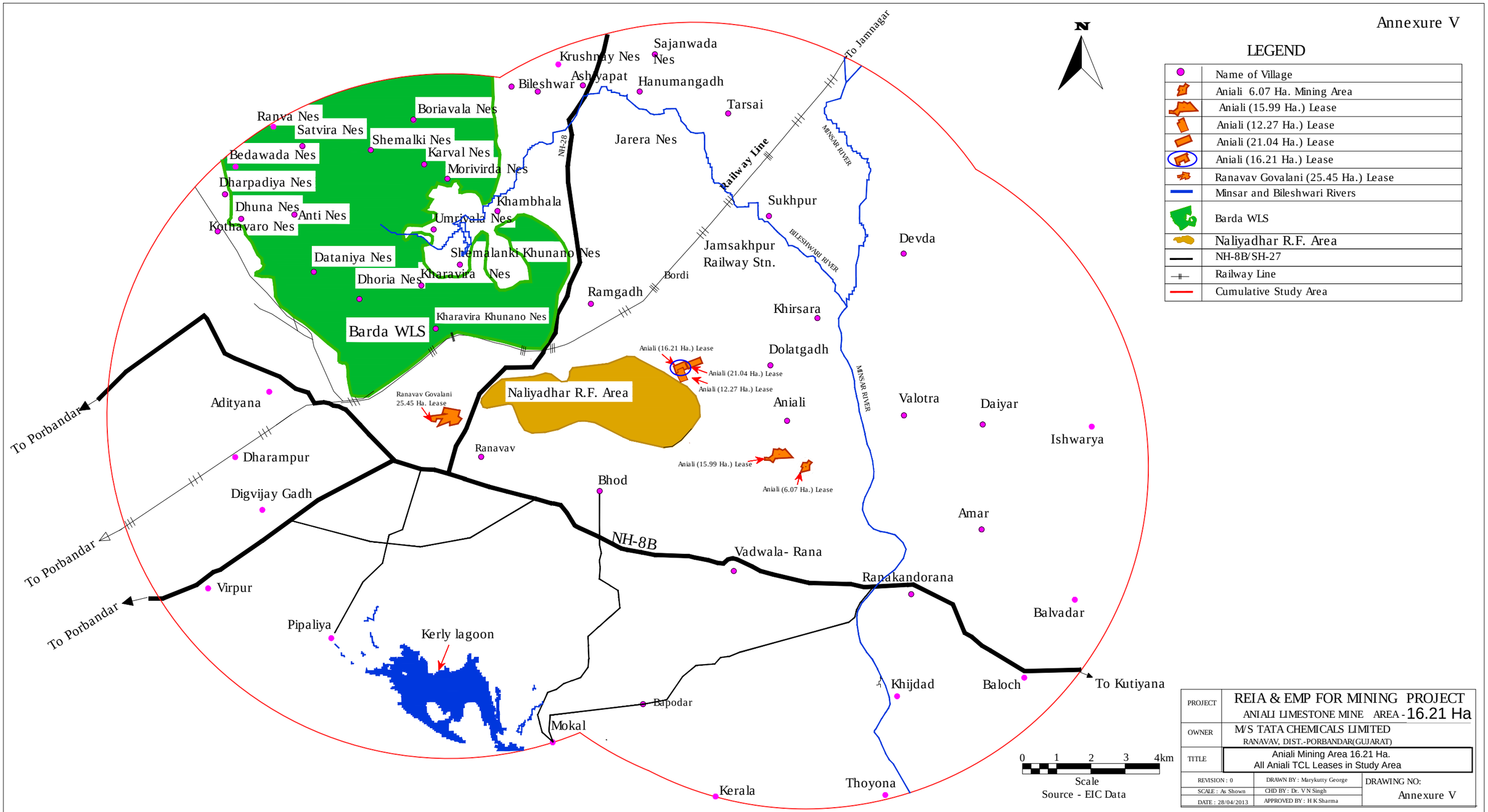
Date: 21st May 2009

Managing Director

Annexure V

LEGEND

	Name of Village
	Aniali 6.07 Ha. Mining Area
	Aniali (15.99 Ha.) Lease
	Aniali (12.27 Ha.) Lease
	Aniali (21.04 Ha.) Lease
	Aniali (16.21 Ha.) Lease
	Ranavav Govalani (25.45 Ha.) Lease
	Minsar and Bileshwari Rivers
	Barda WLS
	Naliyadhar R.F. Area
	NH-8B/SH-27
	Railway Line
	Cumulative Study Area



PROJECT	REIA & EMP FOR MINING PROJECT ANIALI LIMESTONE MINE AREA - 16.21 Ha	
OWNER	M/S TATA CHEMICALS LIMITED RANAVAV, DIST.-PORBANDAR(GUJARAT)	
TITLE	Aniali Mining Area 16.21 Ha. All Aniali TCL Leases in Study Area	
REVISION : 0	DRAWN BY : Marykutty George	DRAWING NO:
SCALE : As Shown	CHD BY : Dr. V N Singh	Annexure V
DATE : 28/04/2013	APPROVED BY : H K Sharma	

69°45'0"E 69°48'0"E 69°51'0"E 69°54'0"E

21°48'0"N 21°45'0"N 21°42'0"N 21°39'0"N 21°36'0"N

N W E S

Barda Wildlife Sanctuary
Area - 24.18 sqkm
(within studay area)

Mine site

Naliyadhar R.F

Ranavav

Kutiyana

Annexure - VI Landuse/Landcover Map

Annexure - VI

Legend

- Study Area
- Road
- Railway Line
- Barda Wildlife Sanctuary
- Mine Lease
- Agriculture Land
- Settlement
- Naliyadhar R.F
- Water Bodies
- Waste Land

LANDUSE/LANDCOVER MAP OF THE STUDY AREA WITH 10 KM RADIUS FROM MINE LEASE AREA - 16.21 HA AT ANIALI LIMESTONE MINE

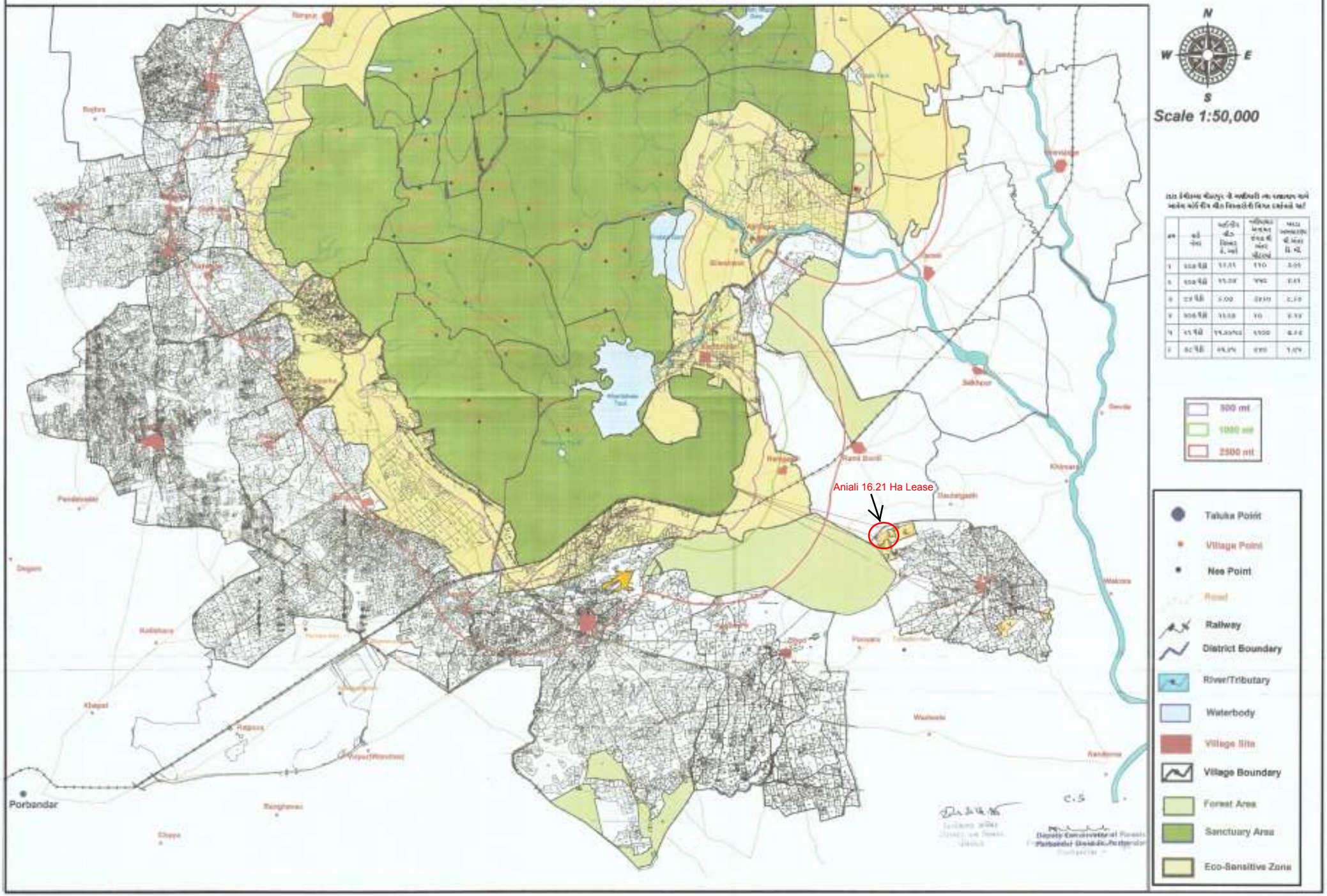
TATA CHEMICALS LTD

Village - Aniali
Taluka - Ranavav
District - Porbandar
State - Gujarat

0 1.25 2.5 5
Kilometers

Barda Wildlife Sanctuary, Porbandar Division
Porbandar District

Annexure VII



Annexure- VIII

Table: List of flora species:

Sl. No.	Plant Species	Family	Local name	Life form	Core zone	Buffer zone
1	Andrographis paniculata (Burn.f) Wall.	Acanthaceae	-	Herb	A	P
2	Astrecantha longifolia Nees	Acanthaceae	-	Herb	A	P
3	Barleria prionitis L. var. prionitis	Acanthaceae	Kantashelio	Shrub	A	P
4	Dipteracanthus patulus (Jacq.) Nees	Acanthaceae	-	Herb	A	P
5	Elytraria acualis (L.f.) Lindau	Acanthaceae	Pat Pathari	Herb	A	P
6	Justicia procumbens L.	Acanthaceae	-	Herb	P	P
7	Justicia simplex D.Don	Acanthaceae	Kari Andhedi, Kali Kariatu	Herb	A	P
8	Lepidagathis trinervis Wall.	Acanthaceae	Haran Cahro	Herb	P	P
9	Neuracanthus trinervius Wt.	Acanthaceae	Ganthera Kari Adhedi,	Herb	A	P
10	Peristrophe bicalyculata (Retz.) Nees	Acanthaceae	Adhedi, Lisi Adhedi	Herb	A	P
11	Trianthema monogyna L.	Aizoaceae	Satodo	Herb	A	P
12	Achyranthes aspera L. var. argentea Hook.f.	Amaranthaceae	Andhedi, Anghedo	Herb	A	P
13	Aerva lanata (L.) Juss.	Amaranthaceae	Gorakhganjo	Herb	A	P
14	Amaranthus viridis L.	Amaranthaceae	Tandaljo	Herb	A	P
15	Digera muricata (L.) Mart.	Amaranthaceae	Lolar	Herb	A	P
16	Pupalia lappacea(L.) Juss.	Amaranthaceae	Zipto Safed	Under Shrub	A	P
17	Magnifera indica L.	Ancardiaceae	Ambo	Tree	A	P
18	Annona squamosa L.	Annonaceae	Sitafal	Small Tree	A	P
19	Polyalthia longifolia (Sonn.) Thw.	Annonaceae	Ashok	Tree	A	P
20	Carissa congesta Wt.	Apocynaceae	Karmada	Tree	A	P
21	Holarrhena antidysenterica (Heyne ex Roth) Wall.	Apocynaceae	Indrajav	Small Tree	A	P
22	Thevetia Peruvian (Pers.) Merr.	Apocynaceae	Pili Karen	Shrub	A	P
23	Wrightia tinctoria R.Br.	Apocynaceae	Dudhio	Tree	A	P
24	Phoenix sylvestris (L.) Roxb.	Arecaceae	Khejur	Tree	A	P
25	Calotropis procera (Ait.) R. Br.	Asclepiadaceae	Ankado	Shrub	P	P
26	Pergularia daemia (Forsk.) Chiov.	Asclepiadaceae	Chamar Dudheli	Twiner	A	P
27	Blumea sp.	Asteraceae	-	Herb	A	P
28	Echinops echinatus Roxb.	Asteraceae	Utkanto	Under Shrub	P	P
29	Eclipta prostrata (L.) L. Mant.	Asteraceae	Bhangaro	Herb	A	P
30	Launaea resedifolia (L.) Druce	Asteraceae	-	Herb	A	P

Sl. No.	Plant Species	Family	Local name	Life form	Core zone	Buffer zone
31	Pulicaria wightiana (DC.) Cl.	Asteraceae	Sonfulki, Sisoria	Herb	A	P
32	Sonchus asper Hill.	Asteraceae	Son chudi	Herb	A	P
33	Tridax procumbens L.	Asteraceae	Pardeshi Bhangro, Kaliyu Khor	Herb	P	P
34	Vernonia cinerea (L.) Less.	Asteraceae	Sahdevi	Herb	P	P
35	Xanthium strumarium L.	Asteraceae	Gadariyun	Herb	A	P
36	Balanities aegyptia L.	Balanitaceae	Hingor, Ingoriyo	Small Tree	A	P
37	Heliotropium indicum L.	Boraginaceae	Hathi Sundho	Herb	A	P
38	Heliotropium ovalifolium Forsk.	Boraginaceae	Velalun Hathi Sundho	Herb	A	P
39	Farsetia jacquemontii Hk.f. &Th.	Brassicaceae	-	Herb	A	P
40	Commiphora wightii (Arn.) Bhandari	Burseraceae	Gugal	Small Tree	A	P
41	Bauhinia purpurea L.	Caesalpiniaceae	Kanchner	Tree	A	P
42	Bauhinia racemosa L.	Caesalpiniaceae	Asundro	Small Tree	A	P
43	Cassia auriculata L.	Caesalpiniaceae	Aval Nani Chimed ,	Shrub	P	P
44	Cassia pumilla Lam.	Caesalpiniaceae	Bethi Chimed	Herb	A	P
45	Cassia siamea Lam.	Caesalpiniaceae	-	Small Tree	A	P
46	Cassia tora L.	Caesalpiniaceae	Kunwario	Herb	A	P
47	Tamarindus indica L.	Caesalpiniaceae	Ambali	Tree	A	P
48	Capparis decidua (Forsk.) Edgew.	Capparaceae	Kerdo,Kera	Shrub	P	P
49	Capparis sepiaria L.	Capparaceae	Kanther	Straggling Shrub	A	P
50	Maerua oblongifolia (Foeak.) A. Rich.	Capparaceae	Hemkand	Shrub	A	P
51	Carica papaya L.	Caricaceae	Pappaya	Tree	A	P
52	Maytenus emarginata (Willd.) D. Hou	Celastreceae	Vicklo	Shrub	A	P
53	Terminalia belerica (Gaertn.) Roxb.	Combretaceae	Behda	Tree	A	P
54	Terminalia catappa L.	Combretaceae	Deshi Badam	Tree	A	P
55	Commelina benghalensis L.	Commelinaceae	Moti shumliyu	Herb	A	P
56	Evolvulus alsinoides L.	Convolvulaceae	Kari Sankhavail	Grass	A	P
57	Merremia tridentate (L.) Hall.f.	Convolvulaceae	Topriyal, Bhinigario	Herb	A	P
58	Coccinia grandis (L.) Voigt	Cucurbitaceae	Giloda	Climber	A	P
59	Cyperus alopecuroides Rottb.	Cyperaceae	-	Sedge	A	P
60	Cyperus rotundus L.	Cyperaceae	Moth, Chido	Sedge	A	P
61	Scirpus lateriflorus Gmel.	Cyperaceae	-	Sedge	A	P
62	Diospyros melanoxylon Roxb.	EbenaceaeS	Timbaru	Tree	A	P
63	Cordia dichotoma Forst.	Ehretiaceae	Vad Gundo	Tree	A	P

Sl. No.	Plant Species	Family	Local name	Life form	Core zone	Buffer zone
64	Cordia gharaf (Forsk.) E.&.A.	Ehretiaceae	Nana Gunda, Liar Gundi	Tree	A	P
65	Ehretia aspera Roxb.	Ehretiaceae	Nani vadhawrdi	Tree	A	P
66	Bergia ammannioides Roxb.ex Roth .	Elatinaceae	Jal Ukharad	Herb	A	P
67	Euphorbia hirta L.	Euphorbiaceae	Vadi Dudheli, Kalu Ganthiu	Herb	A	P
68	Euphorbia caducifolia Hains.	Euphorbiaceae	Danda Thor	Shrub	A	P
69	Euphorbia neriifolia L.	Euphorbiaceae	Thor	Shrub	A	P
70	Kirganelia reticulate (Poir.) Baill.	Euphorbiaceae	Kamboi	Shrub	A	P
71	Phyllanthus fraternus Webst.	Euphorbiaceae	Kharedi, Bhonya Amli	Herb	A	P
72	Abrus precatorius L.	Fabaceae	Chanothi	Chanothi	A	P
73	Alysicarpus monilifer (L.) DC.	Fabaceae	Nano Sanervo,	Herb	A	P
74	Butea monosperma Lamk.	Fabaceae	Kesudo	Tree	A	P
75	Delonix regia (Boj.)	Fabaceae	Gulmohar	Tree	A	P
76	Goniogyna hirta (Willd.) Ali	Fabaceae	-	Herb	A	P
78	Indigofera cordifolia L.	Fabaceae	Pat Gari	Herb	P	P
79	Enicostema axillare(Lamk.) Roynal	Gentianaceae	Mamejavo	Herb	P	P
80	Leucas aspera (Willd.) Spr.	Lamiaceae	Kubo	Herb	A	P
81	Ammannia baccifera L.	Lythraceae	Jal Agio	Herb	A	P
82	Abutilon indicum (L.) Sw.	Malvaceae	Khapat	Under Shrub	A	P
83	Sida cordata (Burm. f.) Borss	Malvaceae	Bhoy Bala	Herb	P	P
84	Thespesia populnea (L.)Sol.ex. Corr.	Malvaceae	Paras Piplo	Tree	A	P
85	Azadirachta indica A. Juss.	Meliaceae	Limdo	Tree	A	P
86	Acacia leucopholea Willld.	Mimosaceae	Harmo baval	Tree	A	P
87	Acacia jacquemontii Bth.	Mimosaceae	Rato Baval	Small Tree	A	P
88	Acacia nilotica (L.) Del. Sub sp. Indica (Bth.) Brenan	Mimosaceae	Deshi Baval	Tree	P	P
89	Acacia senegal Willd.	Mimosaceae	Kher	Tree	A	P
90	Albizia lebbeck Benth.	Mimosaceae	Karo Sirish	Tree	A	P
91	Dichrostachya cinerea (L.)W.& A.	Mimosaceae	Madhad	Shrub	A	P
92	Leucaena leucocephala (Lam.)	Mimosaceae	Pardeshi Baval	Small Tree	A	P
93	Pithecellobium dulce (Roxb.) Bth.	Mimosaceae	Goras Amali	Tree	A	P
94	Prosopis cineraria (L.) Druce	Mimosaceae	Khijado, Shami	Tree	A	P
95	Prosopis Druce juliflora (Sw.) DC.	Mimosaceae	Gando Baval	Small Tree	P	P
96	Ficus benghalensis L.	Moraceae	Vad	Tree	A	P
97	Ficus racemosa L.	Moraceae	Umaro	Tree	A	P

Sl. No.	Plant Species	Family	Local name	Life form	Core zone	Buffer zone
98	Ficus microcarpa L. f.	Moraceae	Pragvad	Tree	A	P
99	Morus alba L.	Moraceae	-	Shrub	A	P
100	Moringa oleifera Lam.	Moringaceae	Mitho Saragvo	Tree	A	P
101	Musa paradisiaca L.	Musaceae	Kera	Small Tree	A	P
102	Boerhavia diffusa L.	Nyctaginaceae	Satodi	Herb	A	P
103	Dyerophytum indicum (Gibs. Ex Wt.) O. Ktze.	Plumbaginaceae	Rato Chitro	Herb	A	P
104	Plumbago Zeylanica L.	Plumbaginaceae	Chitrak	Under Shrub	A	P
105	Aeluropus lagopoides (L.) Trin. ex Thw.	Poaceae	-	Grass	A	P
106	Apluda mutica L.	Poaceae	-	Grass	A	P
107	Aristida adscensionis L. subsp. adscensionis	Poaceae	Laso Lampdo	Grass	P	P
108	Aristida funiculata Trin. & Rupr.	Poaceae	Lampdu	Grass	A	P
109	Cenchrus ciliaris L.	Poaceae	Dhaman, Jhinu Dhamnu	Grass	A	P
110	Cynodon dactylon (L.) Pers.	Poaceae	Dhrab	Grass	A	P
111	Dichanthium annulatum Forak.) Stapf	Poaceae	Jinjavo	Grass	P	P
112	Eragrostis Poaeoides P. Beauv.	Poaceae	-	Grass	P	P
113	Melanocenchrus jacquemontii J. & S.	Poaceae	-	Grass	A	P
114	Sporobolus helvolus (Trin.) Thw.	Poaceae	-	Grass	P	P
115	Zizyphus nummularia (Burm. F.) W. & A.	Rhamnaceae	Chani Bor	Under Shrub	P	P
116	Borreria articularis (L.f.) F.N. Will.	Rubiaceae	Ganthiyu	Herb	A	P
117	Borreria stricta (L.f.)	Rubiaceae	-	Herb	A	P
118	Ixora arborea Roxb.ex Sm.in Rees,	Rubiaceae	Naveri	Small Tree	P	P
119	Mitragyna parvifolia Korth.	Rubiaceae	Kadamb	Tree	A	P
120	Morinda tomentosa Heyne ex Roth.	Rubiaceae	Aal	Small Tree	A	P
121	Aegle marmelos (L.) Corr.	Rutaceae	Bili	Small Tree	A	P
122	Murraya koenigii (L.)	Rutaceae	Mitho Limbado, Kadi Patta	Small Tree	A	P
123	Cardiospermum halicacabum L.	Sapindaceae	-	Herb	A	P
124	Lindenbergia muraria (Roxb. Ex D. Don) P.	Scrophulariaceae	Pathar Chatti	Herb	A	P
125	Physalis minima L.	Solanaceae	Popti	Herb	A	P
126	Helicteres isora L.	Sterculiaceae	Maradsing	Tree	A	P
127	Corchorus aestuans L.	Tiliaceae	Chunch	Herb	A	P
128	Corchorus capsularis L.	Tiliaceae	Bor Chhunchi	Herb	A	P
129	Grewia tenax (Forsk.) Fiori	Tiliaceae	Gangeti	Under Shrub	P	P

Sl. No.	Plant Species	Family	Local name	Life form	Core zone	Buffer zone
130	Grewia tiliaefolia Vahlvar.tiliaefolia	Tiliaceae	Dhaman	Small Tree	A	P
131	Typha angustata Bory & Chaub	Typhaceae	Ga Bajriyu	Herb	A	P
132	Clerodendrum multiflorum (Burm.f.)	Verbenaceae	Arni	Small Tree	A	P
133	Clerodendrum phlomidis L.	Verbenaceae	Arni	Shrub	A	P

ANNEXURE IX

WILD LIFE CLEARANCE APPLICATION AND WILD LIFE CONSERVATION PLAN

PART-III

(To be completed by the Officer-in-Charge of the National Park/ Sanctuary completed and submitted to the Chief Wild Life Warden or officer authorized by him in this behalf within 30 days of the receipt of PART - II)

1.	Date of receipt of the PART – II			
2.	Total Area (Ha.) of national park/sanctuary			
3.	Total area (Ha.) diverted form the NP/WLS so far for development purposes			
4.	List the past projects and the areas (Ha.) diverted			
Name of Project		Area Diverted		Year of Diversion
5.	Positive impact(s)due to the diversion of area for the projects referred			
Name of the Project(s)		Positive Impact		Scientific Basis of Assessment
(Attach separate sheet, if required)				
6.	Negative impact/s due to the diversion of area for the projects referred to in column 4 above			
Name of the Project(s)		Negative Impact		Scientific Basis of Assessment
(Attach separate sheet, if required)				
7.	Management Plan Period			
Attach copy of the Management Plan/Management Scheme/Recommendation of chief Wildlife Warden				
8.	List Management actions taken/proposed to be taken in the whole Block/ Zone in which the proposed area is located.			
9.	Type of forest in which the proposed area falls.			
10	Location of the proposed area w.r.t. the critical/intensive wildlife management areas/wildlife habitats(attach Map to scale).			
11	List the likely POSITIVE AND NEGATIVE impact/s of the proposed project giving scientific and technical justification for each impact.			
12	Provide COMPREHENSIVE details of the impact of the proposal in terms of Section 29 and/or section 35(6) of the Wild Life(Protection) Act, 1972 as the			

	case may be.	
13	Whether the project authorities have ever committed violation of the Wild Life(Protection) Act, 1972 or Forest Conservation Act,1980. If yes, provide the EXHAUSTIVE details of the offence and the present status of the case.(Concealing or misrepresenting the facts will lead to rejection of the case in addition to any other penalty as prescribed under Law)	
14	Have you examined the Project Appraisal document and the alternatives as provide in PART-II?	
15	Have you examined the Bio diversity Impact Assessment Report?	
16	If Yes, please give your comments on the recommendations given in the report?	
17	Dates and duration of your field visits to the proposed site.	
18	Do you agree that the present proposal of diversion of NP/WLS area is the best or the only option and is viable.	
19	Any other information that you would like to bring to the notice of the State Board for Wildlife, National Board for Wildlife or its Standing Committee that may be relevant and assist in decision making.	
20	Do you recommend the project.	

(Please provide full justification to support your recommendations)

Signed by

The Officer In Charge of the NP/WLS
Official Seal
Date of submission to the Chief Wild Life Warden or any other officer authorized by him in this regard

PART-IV

(To be completed by the Chief Wildlife Warden Within 15 days of the receipt of PART – II and PART - III)

1	Date of Receipt of Part-II and Part-III by the Chief Wild Life Warden or the officer authorized by him in this regard	
2	Do you agree with the information and recommendations provided by the Officer-in-charge in Part-III?	
3	If not, please provide the reasons	
4	Have you visited the site yourself and held discussions with the applicant?	
5	Do you agree that the present proposal for permitting use of NP/WLS area is the best option or the only option, and is viable?	
6	Please provide specific comments w.r.t. Section 29 of the Wild Life (Protection)Act, 1972	
7	Any other information that you would like to bring to the notice of the State Board for Wildlife, National Board for Wildlife or its Standing Committee that may be relevant and assist in decision making	
8	Do you recommend the project? (Please provide full justification to support your recommendations)	
9	Conditions, if any, to be ensured in the interest of protection and conservation of wildlife for allowing use of the area?	

Signed by

The Chief Wildlife Warden
Name
State
Official Seal

Date of submission to the State Government

PART - V

(To be completed by the Department in Charge of Forestry and Wilde Life in consultation with the State Board for Wild Life within 30 days of the receipt of Part – II, Part – III and Part – IV)

1	Date of Receipt of Part-II, Part-III and Part-IV by the Department	
2	Do you agree with the recommendation(s) of the Chief Wildlife Warden	
3	If not, please provide the reasons	
4	Did you provide Part-II, Part-III, and Part-IV to the members of the State Board for Wild Life?	
5	Attach copy of the opinion of the State Board for Wild Life	
6	Give details of the recommendations of the State Government	

Signed by

The Principal Secretary
Name
State
Official Seal

Date of submission to the Central Government

Annexure - 1

Location Map on scale of 1:50,000

Please Refer Annexure VII (EIA Report)

Annexure - 2

The Flora & Fauna Study Report

Flora and Fauna status, Impact on Sanctuary and Wild Life Assessment Report –Aniali Lime stone mine (16.21ha): Village Aniali, Taluka Ranavav, District Porbandar, Gujarat State.

Report Prepared By:

Gujarat Institute of Desert Ecology

October 2009

Flora and Fauna status, Impact on Sanctuary and Wild Life Assessment Report –Aniali Lime stone mine (16.21ha): Village Aniali, Taluka Ranavav, District Porbandar, Gujarat State.

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October 2009

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Figure 6.1: Concentration of PM due to emission from mineral winning (2 km)

Figure 6.2: Concentration of PM due to emission from DG set (2 km)

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Plate 2: Faunal Species of the Study area

FORWARD

Tata Chemicals Limited (TCL) was established in 1939 and has been operating a Soda ash plant since 1943 at Mithapur village, Okhamandal Taluka of Jamnagar District Gujarat. The TCL complex consists of various plants include; manufacturing of Soda ash, Sodium Bicarbonate, Caustic Soda, Liquid Chlorine, Hydrochloric acid, Bromine,Vacuum Evaporated Salt and Cement. As part of its backward integration plans, TCL has been mining limestone, to cater the need of the raw material for its soda ash and plant, for more than 45 years from its captive mine leases in Porbandar and Jamnagar districts of Gujarat, located 150 km from the Mithapur facility.

Aniali - limestone mining lease (16.21 ha) of TCL, fall within the survey no. 207/p of Aniali village in Ranavav Taluka, Porbandar district, is proposed to cater the need of limestone. The subject mine has been worked during the years 1985-1994, with the peak production of 55,065 metric tons per annum. The latest mining plan, approved by the Indian Bureau of Mines (IBM), envisages a maximum production quantity of 0.0889 Million TPA (ROM). Thus, the mine is now due for renewal, as well as increasing its pre-1994 capacity, i.e. is carrying out expansion. Therefore Environmental Clearance is required. In this context, Gujarat Institute of Desert Ecology – GUIDE, Bhuj was assigned a study to assess: "Floral and faunal status with special reference to Impact on Sanctuary and Wildlife Assessment Report –ISWAR" for obtaining environmental clearance from the MoEF and No objection Certificate from Department of Environment & Forest, Government of Gujarat.

Study report discusses the status of flora (Tree, Shrub, Climber, Herb and Grass) and major faunal groups (Amphibian, Reptiles, Birds and Mammals) specific to Core zone (mine lease area) and Buffer zone (10 km radius from the core zone) of the proposed mine. In addition, status of threatened / schedule I floral and faunal species was also assessed. With the understanding of the proposed mine project and associated activities, the existing status of flora and fauna including threatened biota were correlated to identify and evaluated the likely impacts with the special emphasis on the Barda Sanctuary. Based on the impacts visualized, appropriate mitigatory measures have been suggested under Environmental Management plan and Conservation Plan for threatened species to regain and maintain the ecological integrity of the proposed mining site and its adjacent areas.

V.Vijay Kumar
Director In-charge
GUIDE – Bhuj

CHAPTER 1: INTRODUCTION AND PROJECT SCENARIO

1.1 M/S TATA CHEMICALS LIMITED

Tata Chemicals Limited (TCL) was established in 1939 and has been operating a Soda ash plant since 1943. The plant site is located close to the Arabian Sea as well as the Gulf of Kutch on the western coast of Gujarat State. The industrial unit at Mithapur village, which is situated 20 km north of Dwarka and 9 km South of the port of Okha on State Highway 25-A and administratively fall under Okhamandal Taluka of Jamnagar District. The chemical complex uses solar evaporated salt from its captive salt works (located 12 to 43 km away from each other) and the sea- water from Arabian Sea 3 km away from the factory site.

The complex consists of various plants include; manufacturing of Soda ash (875,000 TPA) and Sodium Bicarbonate (55,000 TPA- various grades), Caustic Soda (50% lye 36,000 TPA) – Liquid Chlorine (18,000 TPA) – Hydrochloric acid (33% 64,800 TPA), Bromine (1,200 TPA), Vacuum Evaporated Salt (525,000 TPA) and Clinker (825,000 TPA) / Cement. Other supporting infrastructure facilities like; a 85 MW power plant (Petcoke/Coal and Lignite based), a fabrication - machining shop and foundry, facilities to handle materials (Limestone, Coal, Petcoke, Coke, Lignite, and Salt) storage godowns and product packing unit, laboratories other maintenance shops are established within the premises with well connected communication systems. Administrative offices for different department are also located within the TCL industrial complex.

As part of its backward integration plans, TCL has been mining limestone, to cater the need of the raw material for its soda ash plant, for more than 45 years from its captive mine leases in Jamnagar and Porbandar district of Gujarat, located ~130-150 km, south-south east of the Mithapur facility. Tata Chemicals Limited, (including its mining operation) is certified to ISO 9001:2000, ISO 14001:2004 and OHSAS 18001:2007.

1.2 PROJECT BACKGROUND

The focus of this study report, namely the *Aniali Limestone* mining lease, admeasuring 16.21 hectares (ha.) is a captive mine of TCL, and is in survey no. 207 part, of Aniali village in Ranavav Taluka of Porbandar district, Gujarat.

The original lease deed was executed by TCL on 31.10.1964 (Grant Order No. MCR-1563/15140-GV Dated: 12.6.1964). First lease renewal was executed on 21.08.1987 (Grant Order No. MCR- 1583 (T-4)-1962-CHH dated 28.05.1987). TCL applied for the 2nd lease renewal vide TCL letter No. A/WG/2558/2003 dated 21.10.2003 and the lease renewal is pending with the Gujarat Govt.

1.3 RATIONALE OF THE STUDY

The Ministry of Environment and Forests (MoEF) issued the revised Environmental Impact Assessment (EIA) Notification on September 14, 2006. Under the Activity 1(a) of the Schedule attached to this Notification, mining of minerals (including expansion in capacity or area) for mines having lease area >5 ha requires prior Environmental Clearance (EC) from the MoEF/SEAC. As per the General conditions of the Notification, projects located within the 10 km radius of ecologically sensitive area need to take EC from MoEF Delhi. Since the subject mine leases are located 3.92 km distance from Barda Wildlife Sanctuary, clearance for this project applied MoEF, Delhi.

The subject mine has been worked during the year 1985-1994, at which time the production peaked at 55,065 metric tons per annum Run Off Mines (ROM)[1]. The latest mining plan, approved by the Indian Bureau of Mines (IBM), Government of India, envisages a maximum production quantity of 0.0889 Million TPA (ROM).

Thus, the mine is now due for renewal, as well as increasing its pre-1993 capacity, i.e. carrying out an expansion. Therefore, Environmental Clearance is required.

[1] Run of Mines means total production of sized and unsized limestone. These figures are based on historic production records.

Tata Chemicals approached Ministry of Environment and Forests for Environmental clearance Ministry issued Terms of Reference (TOR) vide letter no. J-110015/471/2007-IA.II (M) dated 15.10.2007. Gujarat state dept of Forest and environment issued a Resolution No. VPS- 102008- 399- C(1) dated 02.04.2008. It requires an 'Impact on Sanctuary and Wildlife Assessment Report- (ISWAR). To meet both the requirements a common scope of work was proposed - In this context, **floral and faunal status with special reference to Impact on Sanctuary and Wildlife Assessment Report – ISWAR** has been prepared for obtaining environmental clearance from the MoEF for the Aniali Limestone mines for the quantity of 0.0889 Million TPA ROM.

1.4 IMPORTANCE OF PROJECT TO COUNTRY AND REGION

Limestone Mining is a very important economic activity in Saurashtra region of Gujarat. Chemical Grade Limestone is mainly found in this region, is essential for Soda Ash Manufacturing. This region practically supplies limestone for all Soda Ash production of India. The Soda Ash based limestone mining industry contributes significantly to the State Gross Domestic Product and provides direct employment to about 7500 laborers. Additional jobs are created by way of transportation and related jobs, ancillary to mining. Subject mine lease aims to augment the limestone supply to TCL, Mithapur.

The products of TCL's Mithapur plant, especially soda ash, are a vital input for a number of basic industries such as glass, pulp and paper, chemicals and detergents, besides others. Consequently, this project aims at keeping many of the key industries within the country well supplied with an essential raw material. Cement, another product of TCL, also dependent on limestone inputs, is a key input to the infrastructure development of India.

1.5 SCOPE OF WORK

The following scope of works has been formulated to prepare Flora & Fauna status report (MoEF requirements) and ISWAR (Gujarat State Forest Department requirement) document for Limestone Mining Project, Aniali (16.21 Ha) mine lease of TCL.

S.No.	Scope term	Ref
1	Give details of Mining method, machinery to be used.	Section-2.5.1
	Details of planning and arrangements of leveling the land after the mining is completed ;	Section-2.12
	Details of abundance or the rarity of the minerals to be mined and whether this mineral is connected to high purpose of national security etc. If the proposal is for an industry then an explanation of the unavoidable reasons for citing the industry near the sanctuary and a study and conclusion of the suitability or otherwise of alternative site.	Section-1.4
2	*Identify the existing different habitat types (terrestrial and aquatic) and land use patterns in and around the project area.*	Chapter-5, Sec 3.1
3	*Indicate the distance of land applied for from the Protected area ,height , the natural barrier between the Two (ex River , Nallah , clump of trees).*	3.3
4	*Indicate land use of the study area delineating forest area , agricultural land , grazing land , wild life sanctuary and national park , migratory routes of fauna , water bodies , human settlements and other ecological features*	3.1.1
5	*Indicate location of national parks, sanctuaries, biosphere reserves, wildlife corridors, Tiger/ Elephant reserves (existing as well as proposed), if any, within 10 km of mine lease*	3.3
6	*A location map duly authenticated by the chief wild life warden should also be furnished in this regard.*	Applied
7	*Assess the status of floral components: grass, herbs, shrubs and tree forms of different habitats within core and buffer zones of the mining sites*	5.1
8	*Details of flora duly authenticated, separately for core and buffer zone should be furnished based on field survey clearly indicating the schedule of the fauna present.*	5.1
9	*Assess the status of major faunal components (herpetofauna, birds and mammals) of different habitats within core and buffer zones of the mining sites.*	5.4.1, 5.4.2, 5.4.3
10	*Details of fauna duly authenticated, separately for core and buffer zone should be furnished based on field survey clearly indicating the schedule of the fauna present.*	5.4.1, 5.4.2, 5.5
11	*within the sanctuary area , the area being used actively by the Tigers and their concentration zone should be demarcated in consultation with the Chief Wild Life Warden and shown on a map vis a vis the mine lease.*	5.5
12	*Identify and evaluate the status of threatened species and habitat of conservation significance within the project area.*	5.5
13	*Asses the status of wildlife of the Sanctuary/National park/ conservation reserves in the vicinity of mine lease areas. Understand the movements and habitat use of wildlife (considering these aspects to be studied so that the proposed area should not fall*	6.3.12

S.No.	Scope term	Ref
	in the movement roots of the wildlife, the area not being on the shores of the rivers entering/ leaving the protected area or not being on the shores of other water bodies/ water sources/ reservoirs not being a part of the grazing lands of the people living nearby.)	
14	*Identify and evaluate the potential / likely impacts (ex. : Noise, Air , Water pollution , spreading of dust , accumulation of unusable material / waste , weight and velocity of particles , spread into the atmosphere due to blasting , operation of conveyor belts) on wildlife values of the protected areas, natural boundary.*	6.3.6, 6.3.4, 6.3.7
15	*Material flow: The wind velocity during the year in the storage area of unusable material/ waste the flow of polluted water from the mining area to the protected area, the slope of the mining area and the impact of drainage line on the protected area length, width and depth of the pits in case of the open cast mining area Various methods of reducing the side effects of the mining in the area between the protected area and the proposed sight for eg. the width of the green belt spraying water on unpaved roads and other non usable material storage sight, the alternative of mineral transportation roads to be sited out of the protected area.*	6.3.5
16	*In case of any scheduled-I flora found in the study area, the necessary plan for their conservation should prepared in consultation with State Forest and Wildlife Department and details furnished.*	5.5/7.0
17	*In case of any scheduled-I fauna found in the study area, the necessary plan for their conservation should prepared in consultation with State Forest and Wildlife Department and details furnished.*	5.5/7.0
18	*Suggest management strategies for the conservation of wildlife and maintain ecological integrity of the protected areas in the vicinity of the project sites.*	7.0
19	*Necessary allocation of funds for implementing the same should be made as part of the project cost.*	

CHAPTER 2: PROJECT AND STUDY AREA DETAILS-ANIALI LIMESTONE MINE LEASE (16.21ha)

2.1 SITE LOCATION

The mine lease area falls in survey no. 207/p of the village Aniali, Taluka- Ranavav, Dist- Porbandar. It is located at about 2.23 km to the South of Bordi village and about 4.5 km to the north of Aniali village. From Aniali mine leases site are approached by motorable road. The mine leases forms a part of the Survey of India topo sheet No. 41 G/14 and is bounded by following co-ordinates:

Latitude[2]	Between 21° 42' 17.60" and 21° 42' 30.80" N
Longitude	Between 69° 49' 13.45" and 69° 49' 28.90" E

2.2 DETAILS OF MINING LEASE

The project details mentioned in this chapter have been taken from the Mining Plan/ Mining Scheme of the mine, as described in **Table 2.1** duly approved by the Indian Bureau of Mines (IBM).

Table 2.1: Details of Mining Lease (Aniali – 16.21 ha)

State	Gujarat
District	Porbandar
Taluka	Ranavav
Village	Aniali
Khasra Details (Survey No.)	207/p
Lease area (Hectares)	16.21
Type of land	Government waste land

2.3 LAND USE OF CORE ZONE

The lease area namely Aniali (16.21 ha.) survey no. 207/part, which falls under the revenue limit of Aniali village. The lease area is a government waste land and there is no reserved forest or protected forestland within the lease area. There are no villages or hutments within the lease area. Existing land use pattern is given in **Table 2.2.**

[2] As per Latitude and longitudes taken at site.

Table 2.2: Present Position of Mining Lease Area in Hectare

Particulars of Mining Activity	Present Site Landuse in Ha.	Proposed Site Landuse (after 5 Years) in Ha.
Mining Activity		
Pits	7.60	9.03
Roads / Building	-	0.49
Plantation	Nil	0.5
Agricultural Land	Nil	Nil
Government Wasteland	8.61	6.19
Total area	**16.21**	**16.21**

2.4 MINE RESERVES

2.4.1 Reserve Quality

Different manufactures have developed their own specifications suiting to their process parameters and also looking to the availability. TCL has prescribed a marginally liberal chemical specification, presented in **Table 2.3**. In addition, there is a physical requirement of the lump size being between 50 mm & 100 mm.

Table 2.3: Specification of different grades of limestone prescribed by TCL

S.No	Grade	Characteristics
1.	Chemical grade	Total carbonate ≥ 92 % & SiO_2 < 4 %
2.	Marginal grade	Total carbonate ≥ 92 % & SiO_2 < 4 to 5 %
3.	Inferior grade	Total carbonate < 92 % & SiO_2 > 5 %

The management specified the soda ash and cement grade limestone requirement as under:

$CaCO_3$ + $MgCO_3$: ≥ 92 %
SiO_2: < 4 %
Size: + 50 mm to – 100 mm

Limestone with the same total carbonate but with 4 % or more of SiO_2 but not exceeding 5% is considered to be marginal quality but still acceptable for the manufacture of soda ash. For the purpose of cement making the following broad chemical specification for limestone may be accepted:

CaO: ≥ 44%
MgO:≤ 3.5%

2.4.2 Quantity Estimation of Reserves

Details of quantity and different grades are given in **Table 2.4**.

Table 2.4: Quantity of limestone in Million Tons

Chemical Grade Lime Stone	Inferior Cement Grade limestone	Total Limestone
0.434	1.033	1.467

2.5 PROJECT ACTIVITY

2.5.1 Mining Method

Taking into consideration shape and nature of deposit and the targeted production, the mine is being worked by mechanized opencast method of mining. Attempts have been made to design and exploit with minimum damage to environment and optimal utilization of limestone for soda ash and cement manufacture. Chemical grade limestone occurring as compact layer will be worked in 2 benches except in fifth year of working when there will be three benches. The drilling is done with the help of 100 mm diameter Wagon drill. The blasting is done mainly with ANFO as the column charge and slurry explosive as the base charge.

2.5.2 Blasting

Blasting is proposed to be done using explosive Ammonium Nitrate – Fuel Oil (ANFO) as the column charge and cap sensitive explosive (normally slurry explosives) as the base charge. The ratio of column charge to the base charge is 75:25. For drilling blast holes, wet drilling process will be adapted – this reduces dust emissions. Considering the nature of the limestone deposit, the blast hole parameters proposed are shown in **Table 2.5**.

Table 2.5: Blasting Parameters

S. No	Parameter	Dimension
1.	Bench Height	4.0 m
2.	Depth of hole	4.4 meter
3.	Diameter of hole	100 meter
4.	Burden	3.0 meter
5.	Spacing	4.0 meter
6.	Inclination of hole	15° to vertical
7.	Bulk Density	2.06 MT/M3
8.	Explosive efficiency	4.0 T/kg (For chemical grade limestone)

2.5.3 Blasting Pattern

Of the various firing patterns used in blasting, the multi row square grade V pattern of blasting with double row is proposed to be adopted in this mine. This is done for the benefit of the enhancement of the effective burden and spacing.

2.5.4 Secondary Blasting

With proper blast design, the need of secondary blasting is not anticipated. However, in the event of big size boulders getting generated, it is proposed them to be dozed and accumulated to one corner of the bench. These boulders, then, could be drilled with smaller holes (32 mm dia and up to 0.75 m depth) and blasted. Plaster shooting may also be carried out for secondary blasting as and when required. As far as possible this operation would be kept to a minimum and in case of requirement it will be carried out, along with the primary blasting operations, to reduce dust generation.

2.5.5 Weight and Velocity of particles

When blasting operations are carried out, the lime stone rock gets fragmented & the fragmented material is moved forward to make mucking of the fragmented mass easier & less costly. During the process lime stone dust particles of various sizes gets displaced and spread into the atmosphere. These particles behave depending upon its weight (size in terms of mass) and velocity during blasting.

Every blasting is designed considering various factors like – adequate spacing; specific charge; geological conditions etc., so that spread of these particles is minimized. Tata Chemicals implements blasting methodology as approved by the Indian Bureau of mines. Following observations are made to establish the relationship between velocity of particles with it's mass

The broad parameters of blasting operations:-

1) Spacing = 9 ft
2) Burden = 9 ft
3) Depth of hole = 12 to 18 ft
4) Hole Diameter = 100 mm
5) Detonators = TLD (25 ms) & DTH (450 ms)
   [These are shock tube detonators]

6) Hole to Hole Delay Timing = 475 ms
7) Stemming = 35 % of Hole depth
8) No. of Holes In a blast = 35 to 58
9) Booster charge = Kelvex-600 (water gel explosive) 25 %
10) Column Charge = Ammonium Nitrate Fuel Oil (ANFO) 75%.

Following data were observed after blasting:- **Table 2.6**

Table 2.6: Weight and velocity of Limestone particles

S. No.	Lime stone particles	
	Weight	Velocity
1	>1000 gm to < 10,000 gm	- 12 m./sec.
2	>100 gm to < 1,000 gm	
3	>100 gm to < 30 gram	

From the above study and estimations it is established that the weight and velocity of lime stone particles of the range from less 10,000 gm to 30 gm. attains an average velocity ranging from 6 to 12 m /sec.

2.6 PRODUCTION

The production plan of Limestone over five year is given in **Table 2.7.** It may be noted that maximum production proposed will be 0.089 Million Tonnes in per year (ROM).

Table 2.7: Production in Million tons of Limestone over one Year

Year / Production, tons	First Year	Second Year	Third Year	Fourth Year	Fifth Year
Chemical grade Total Production (ROM)	**0.0889**	**0.0889**	**0.0887**	**0.0888**	**0.0887**

2.7 LIFE OF MINE

Key details pertaining to the life of the mine are given in **Table 2.8.**

Table 2.8: Details Pertaining to Mine Life

S. No.	Descriptor	Details
1	Total mineable reserves of chemical grade limestone	1.47 Million tons
2	Total production (sized) in next five years	0.44 lac tons
3	Remaining reserves at the end of five years	1.03 lac tons
4	Rate of production per year	0.089 lac tons
5	Life of mine at the end of 5th year	11.5 years
6	Total life of the mine	16.5 years

2.8 WATER AND WASTE WATER MANAGEMENT

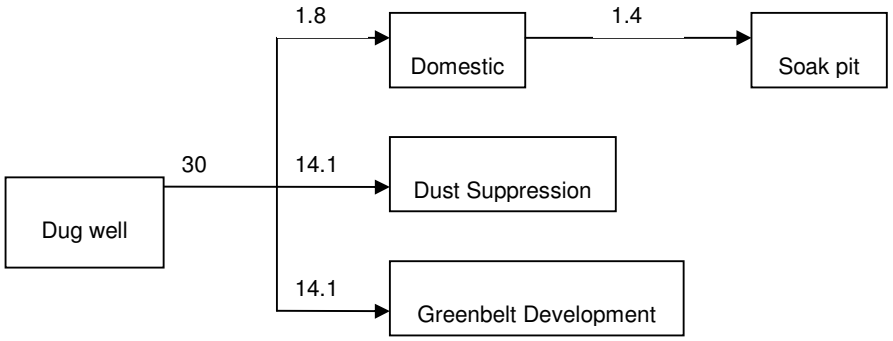
2.8.1 Source of Water Supply

The Aniali mine plans to abstract water from nearby privately owned dug well located near Aniali mine lease area.

2.8.2 Water Requirement & Wastewater Generation

The projected water requirements for the mine site are likely to be in the range of 30 kld. The major areas of water consumption are dust suppression (14.1 KLD), for domestic purposes (1.8 KLD) and green belt development (14.1 KLD). Breakup is given in the water balance as per **Figure 2.1.** Most of the water consumption proposed will be for dust suppression. It is to be noted that due to non-mechanical nature of mining in this lease the dust suppression will be low.

Figure 2.1: Water Balance Diagram



2.9 MINERAL TRANSPORTATION

Run of Mine (ROM) limestone will be transported to proposed crusher site at Aniali 21.04 Ha Mine lease for Sizing. Sized limestone will be transported to TCL's soda ash chemical complex at Mithapur. Undersize and inferior grade lime stone will also be used for cement manufacturing and transportation will be by trucks.

2.10 SITE FACILITIES

The lease area is connected to SH –27 by a fair weathered *(kutcha)* road running about 4.06 km to the West. This existing 8 m wide road is flat, will not require any leveling, and is sufficient for tippers to ply both ways.

Other specific mine site service requirements, are described in subsequent paragraphs of this section.

Mines Office

This mine is a captive source of limestone of chemical grade to the soda ash plant at Mithapur. Site services (such as office, maintenance room) already exist within the lease area, as a result of the past mining activities carried out at the site.

Rest Shelter

The two-rest shelters along with first-aid station, complying with relevant provisions of Mettaliferous Mines Rules already exists in the lease area itself.

Blasting Shelter

A portable blasting shelter will be provided for the mine employees to take shelter during blasting operations. Blasting operations will be usually carried out during lunch hours.

Water Supply

TCL plans to purchase water from the dug well located in vicinity of the mine for mining operations, as already mentioned earlier.

Power Supply

The mine will work in one shift (i.e. general shift) only, so no lighting arrangement will be required. At present there is no electric supply. Crusher will be installed at TCL's Aniali 21.04 ha lease area. So power will be required for Aniali 21.04 ha lease area. Power will be supplied by the Paschim Gujarat Vij Company Limited (PGVCL).

Workshop and Stores

Infrastructure for repair and maintenance is already available at the mine site; hence no major additional facilities will be required to be installed.

2.11 EMPLOYMENT POTENTIAL

At present no non-technical and technical staff is employed in the mine since mining activities are currently un operational. Managerial and supervisory staff likely to be employed at the mine is given in **Table 2.9**.

Table 2.9: Staff Required for Mining

S. No.	Designation	Number
1.	Agent mines	1
2.	Manager Quarries	1
3.	Assistant manager and P&W	1+1
4.	Assistant officer accounts	1
5.	Assistant Manager mining	2
6.	Assistant manager geology	1
7.	Assistant manager Maintenance	2
8.	Mining engineer	1
9.	Miscellaneous (such as Peons, Operators, Blasters and Helpers	51

Mining operations shall not be conducted unless qualified supervisory staff are appointed as required under the Regulation 34 (1) (a) of the MMR 1961, and a relevant notice is sent to DGMS, Dhanbad with a copy of the same to the Director of Mines Safety, Udaipur.

It is expected that a maximum additional staff of 99 persons will be kept on contract basis for undertaking the mining operations.

Manpower requirement for material handling and loading in the next one year is given in **Table 2.10.** This includes regular staff as well as contracted persons that will be deployed for the mining operations.

Table 2.10: Summary of Staff Working, Yearly

Year	I	II	III	IV	V
No. of Employees	150	150	150	150	150

Out of the total manpower to be engaged in the mine, one man will be allocated for proper care and maintenance of plantation and one for security purpose.

2.12 PROGRAMME OF AFFORESTATION

The lessee proposes to plant 750 trees in 0.50 ha area during five years of mining plan to be planted on the non-mineralized area. The afforestation programme would cover the northern part of lease area in block A. Survival rate is considered as 80%, as per past experience at TCL's Adityana mines. A number of species will be planted suiting to climate of this area like neem, sesam, badam, mango, ber, babool, jamun etc. The afforested area will be encircled by a boundary of local thorny bushes to protect it from cattle. Regular watering of thrice a week (except monsoons) will be carried. This covers the proposed landscaping and afforestation both during the mining as well as the post-mining phase.

CHAPTER 3: PROJECT ENVIRONMENTAL SETTING

3.1 LAND USE OF STUDY AREA

3.1.1 Land use of Buffer Zone

The study area is considered to be the mining lease area, and an additional area at a distance of 10 km all around the periphery of mining lease. Recent satellite imagery for the study area was collected from the National Remote Sensing Agency (NRSA). Map showing raw satellite imagery of the study area is presented as **Table 3.1.** Interpretation of this satellite image in terms of land-usage of the study area is presented in **M- 3.1**.

Table 3.1: Landuse of the Study Area

S.No.	Category	Area in Ha.	% Area Cover
1.	Habitation	331.49	1.05
2.	Vegetation	740.77	2.35
3.	Water bodies	500.94	1.59
4.	Land without scrub	359.86	1.14
5.	Agriculture	20122.82	64.05
6.	Forest Area	1990.33	6.33
7.	Hill without Vegetation	2184.00	6.95
8.	Land with semi arid vegetation	3005.42	9.56
9.	Rocky area	2180.29	6.94
Total		**31415.92**	**100**

Barda wildlife sanctuary within study area occupies area about 26.7607 Km^2

Naliya Dhar Reserve Forest within study area 11.6551 Km^2

Jambuda Reserve Forest within Study area 5.774 Km^2

Source: Based on satellite imagery interpretation and ground truth survey, KEC, 2009

3.2 PROXIMITY TO SEA/ WATER BODIES

Table 3.2: Proximity to Sea/ Water Bodies

Sea / Water body	Distance in km from Mining Boundary
Sea / Estuary	
Arabian sea	22.26
Rivers	
Minsar River	5.60
Bileshwari River	4.87

3.3 SALIENT FEATURES OF THE STUDY AREA

Barda wildlife sanctuary and Reserved forests are two ecosystems identified in the study area. Details of the important features along with other sensitive ecological locations in the study area are provided in **Table 3.3.**

Table 3.3: Important features and sensitive ecological locations in the study area

S. No.	Sensitive Ecological Features	Name (Area in km²)	Aerial Distance (in km.) from Mine Lease boundary
	National Park/Wildlife Sanctuary[3]	Barda wildlife sanctuary	3.92
	Reserved forest	Naliyadhar Reserved Forest	0.11
		Jamboda Reserved Forest	2.70
		Khageshri Reserved Forest	8.20
		Dudhiya Reserved Forest	12.31
	Tiger Reserve/Elephant Reserve /	None	---
	Turtle Nesting Ground	Few sporadic nesting beaches located well beyond the project site	> 22-32 km
	Core Zone of Biosphere Reserve	None	---
	Habitat for migratory birds	None	---
	Lakes/Reservoir/Dams	None	---
	Stream/Rivers	Minsar River	5.6
		Bileshwari River	4.86
0	Estuary/Sea	Arabian sea	22.26
	Mangroves	None	---
	Mountains/Hills	--	---
	Notified Archaeological sites	----	----
	Industries/Thermal Power Plants	Saurashtra Cement	10.77
	Defense Installation	----	----
	Other mines	Aniali Ranabordi (12.27 Ha)	0
		Aniali (21.04 Ha)	0
		Aniali (15.9953 Ha)	3.5
		Aniali (6.7 Ha)	4.4
	Airports	Porbandar	18.10
	Railway Lines	Porbandar- Ahmadabad	2.14
	National / State Highways	NH 8-B	5.23
		SH-27	4.06

3.3.1 Barda Wildlife Sanctuary [5]

Barda Wildlife Sanctuary is located at about 15 km from Porbandar, which faces Arabian Sea. Barda was a private forest of the ex-princely State of Ranavav (Porbandar) and Jamnagar and, therefore, it is still popularly known as Rana Barda and Jam Barda. Entire area is the reserve forest and had been notified as

[3] The distances to the Barda Wildlife Sanctuary as well as the Naliyadhar Reserved Forest have been attested by the ECOSMART's Environmental Information Centre (a joint venture between the Ministry of Environment & Forests (MoEF) and IL&FS.

Sanctuary in the year 1979. The settlement of the area has been completed, but final notification is yet to be issued. The sanctuary is distributed in two districts i.e. Porbandar and Jamnagar. The terrain is hilly with patches of flat plains at places, and the criss-crossing of numerous rivulets and streams. The sanctuary area has been surrounded by agriculture fields, wastelands and forests. The sanctuary has ***192.31 sq. km.*** area, but has one of the most diverse floral compositions and a potential source of many medicinal plants.

The terrain of Barda is almost hilly and undulating with an altitude ranging from 79.2 m to 617.8 m above mean sea level. At places, there are gentle slopes with exposed rocks. The two main ephemeral rivers are Bileshvary and Joghiri. Khambala and Fodara are important dams in the sanctuary.

The area supports 750 maldhari families (4000 people) in 68 nesses. The agriculture fields and wastelands surrounding the forest area experiences acute water scarcity during summer. However, this green patch of forest provides ecological security and environmental stability, since it improves the water regime of the area by recharging the ground water and forming catchments for the minor dams in the Sanctuary. Located barely at distance of 20 km from the Arabian Sea, the forest is standing as the guard against the salinity ingress in the region. The forest is endowed with very rich floral composition and it was also a home of Asiatic lion in not a distant past. Amongst the mammals leopard and wolf are threatened. Amongst the reptiles found here, crocodiles and chameleons are rare and endangered. Three common venomous snakes, (Russel's Viper, Cobra & Common Indian Krait) are found here. The avifaunal species also displays high diversity. Two species of birds: Spotted Eagle and Crested Hawk-Eagle, which were found in the sanctuary, are rare / endangered.

3.4 LONG TERM METEOROLOGY

The climate in the region shows broadly four seasonal variations[4], namely:

Winter : December - February

Summer : March – Mid June

[4] Source: District Gazetteer Jamnagar

Monsoon : Mid June - September

Post-monsoon: October - November

Information presented in subsequent paragraphs is from the Indian Meteorological Department (IMD), Long Term Climatological Tables, 1951-1980, Porbandar (A). These tables give useful information about a region's weather, since they are collected over a 30-years period.

3.4.1 Temperature

Maximum temperature recorded during the 30 years data is 45.5°C recorded on May 2, 1979. Minimum temperature recorded is 4.7°C recorded on January 22, 1962. April is normally having the warmest *day* (peak temperature of 39.8°C) while October is the warmest *month* (average peak temperature of 34.3°C). January generally has the coldest *day* (minimum temperature 9.1°C) and is also the coldest *month* (average minimum temperature of 13.7°C).

3.4.2 Wind

Long- term wind direction data is presented in **Table 3.4**, and indicates that the predominant wind direction during the study period (October & November) is observed to be from W and NW directions.

Table 3.4: Predominant Month Wise Wind Directions

Predominant Wind Direction	First Predominant Wind Direction		Second Predominant Wind Direction		Third Predominant Wind Direction	
Month	**Morning**	**Evening**	**Morning**	**Evening**	**Morning**	**Evening**
January	CALM	W	NE	N	N	NE
February	N	W	NW/ CALM	N	NE	NE/NW
March	NW	W	N	NW	CALM	SW
April	NW	W	N	SW	W	NW
May	W	W	SW	SW	NW	NW
June	SW	SW	W	W	S/NW	S
July	SW	SW	W	W	NW	NW
August	SW	SW	W	W	NW	NW
September	W	W	SW	SW	NW	NW
October	NW	W	N	SW / NW	CALM	N
November	CALM	W	NE	N	N	SW
December	CALM	W	NE	N	N	NE

3.4.3 Cloud Cover

The area remains cloudy between June – September period, which is the active period of the monsoon season. Generally cloud cover ranges from 6 to 7 Oktas during this monsoon season.

3.4.4 Rainfall

The total rainfall in a year is observed to be 639.9 mm. Distribution of rainfall by season is 4.3 mm in winter (December, January, February), 3.8 mm in summer (March, April, May), 594.3 mm in monsoons (June, July, August, September) and 37.5 mm in post-monsoons (October - November).

3.4.5 Humidity

Most humid conditions are found in the monsoons, followed by summer, post-monsoons and winter in that order. Mornings are more humid than evenings and humidity ranges from a high of 80-86% in monsoon mornings to a low of 40-45% in winter evenings. During post-monsoon season, in the morning humidity remains between 59-74 % and in the evening it remains between 47-58%

Nearest IMD station from the lease area is Porbandar Airport. It is located at a distance of 30 km in WSW direction.

3.4.6 Site-Specific Meteorology

Site-specific meteorological data representing the summer season 2007 have been collected from the site. The parameters for which data have been collected are: Wind speed, Wind direction, Temperature, Relative humidity and Cloud cover. Monitoring methodology for meteorological data refer **Table 3.5.**

Table 3.5 : Monitoring methodology of meteorological data- Aniali (16.21 ha)

S. No.	Env. Component and Sampling Location	Sampling Parameters	Total Sampling Period	Sampling Frequency	Sample collection		Sample Analysis		Methodology	Remarks
					Sampling equipment	Sensitivity/ Detection Limit	Analytical Equipment	Sensitivity/ Detection Limit		
1.	Meteorology Project Site	Wind speed, wind direction, temperature, Relative humidity, cloud cover and rainfall	Summer season	Hourly for all parameters except cloud cover (3 hourly)	Wind speed: Anemometer cup counter (0° to 65°)	2%	-	-	As per manufacturer's manual. Instruments are calibrated. Cloud cover is done by visual interpretation of the sky by the observer	-
					Wind direction: Wind vane (0° to 357°)	1 °				
					Temperature: Thermometer (-40° to 60°)	0.1°C				
					Humidity: Relative Humidity meter	3%				
					Rain fall: Rain gauge	0.2 to 0.5 mm				
					Cloud cover	-				

3.4.7 Site Specific Data of Summer Season

TCL has an online weather logger *(Envirotech make)* at its Aniali mine office, data from which has been used to describe the site specific data for the summer season. Site specific data of meteorology were collected for the same duration (summer season - March to June, 2007).

Site-specific meteorological data show that average wind speed in the summer season is 8.3 km/hr and mostly the noon hours are windier with maximum wind speed of 10.5 km/hr.

Windrose prepared for summer season is shown in **Figure 3.1**. It shows that wind blows predominantly from W, NW, and SW sector.

The meteorological data collected at site during summer season shows that wind blows predominantly from West- Northwest & Southwest sector.

Mean average temperature recorded for summer season was 34.3 °C with mean maximum temperature of 43.3 °C and mean minimum of 27.2 °C, which is a characteristic of this study area.

The mean average humidity recorded was 62.2 % with mean maximum humidity of 70.3 % and mean minimum of 47 %.

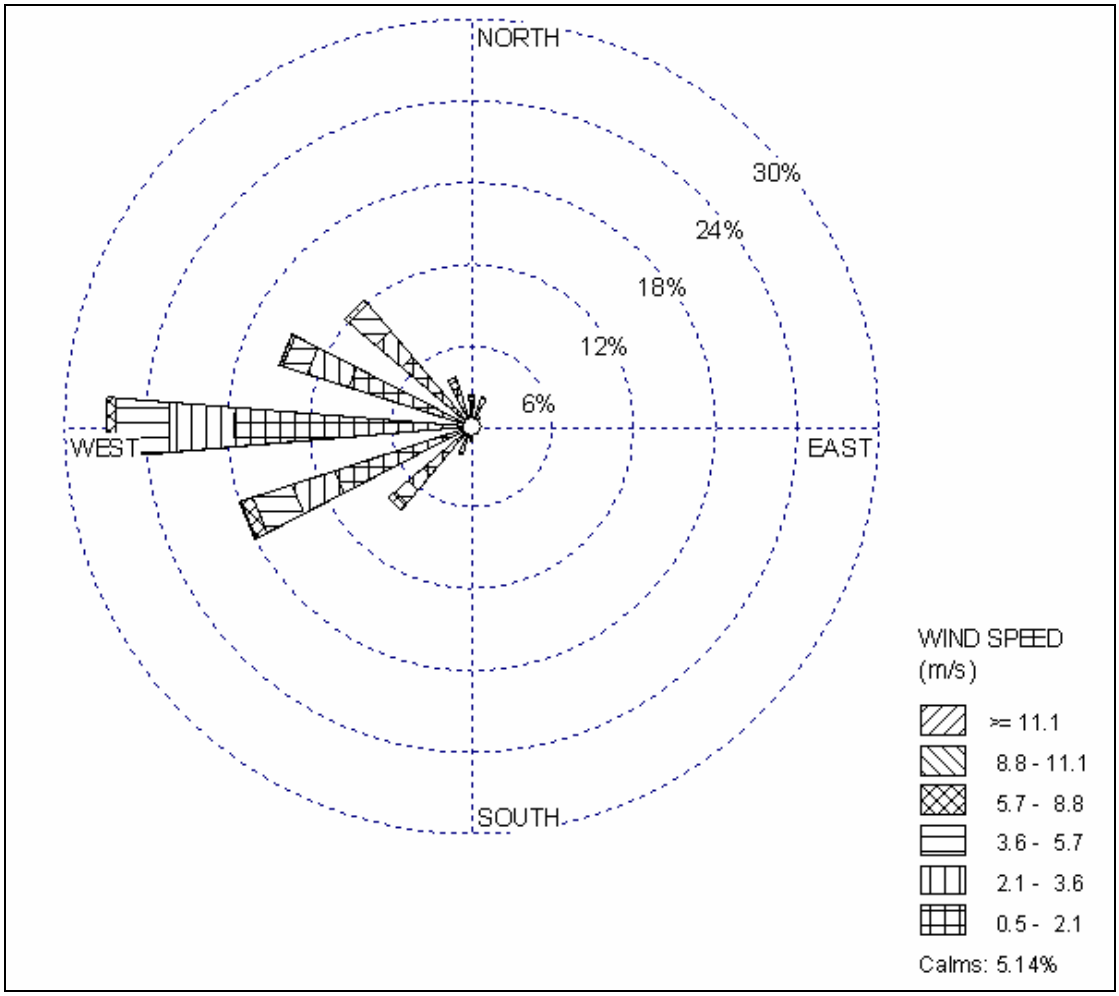
The sky is observed to be largely cloudless in the summer season. The data obtained have then been compiled to obtain average data. Compiled mean meteorological data are represented in **Table 3.6.**

Table 3.6: Mean / predominant meteorological data

Hour	Mean Dry Bulb Temp. °C	Mean Relative Humidity %	Predominant Wind Direction	Mean Wind Speed km/hr	Predominant Cloud Cover (Oktas)
100	28.3	69.2	W	6.9	0.8
200	28.3	68.5	WSW	7.1	0.8
300	27.8	66.7	W	6.7	0.9
400	27.2	65.2	W	6.6	0.8
500	27.7	66.4	W	6.3	0.6
600	29.1	68.3	WSW	6.2	0.8
700	29.4	67.8	W	7.3	0.6
800	32.8	68.9	W	7.5	0.6
900	34.7	67.2	W	7.8	0.6
1000	37.6	63.9	W	8.5	0.6
1100	39.9	57.0	W	8.6	0.5
1200	41.5	54.2	W	8.9	0.5
1300	42.6	52.1	W	9.3	0.5
1400	43.3	48.0	w	9.5	0.5
1500	43.3	47.0	W	9.2	0.6
1600	42.7	48.0	W	10.2	0.6
1700	41.7	52.0	W	10.4	0.8
1800	38.5	56.4	W	10.3	0.6
1900	35.5	66.0	WNW	9.4	0.5
2000	32.6	68.8	w	9.4	0.6
2100	31.4	70.3	W	8.7	0.5
2200	29.0	64.0	W	8.4	0.5
2300	29.2	68.3	W	7.7	0.6
2400	28.7	67.4	W	7.5	0.5
Average / Predominant	**34.3**	**62.2**	**W**	**8.3**	**0.6**

Source: Meteorological Station at Site

Figure 3.1: Windrose for Summer Season, site specific



NOTE: Frequencies indicate directions from which the wind is blowing

CHAPTER 4: STUDY APPROACH AND METHODOLOGY

4.1 DATA COLLECTION

In order to understand the ecological status of different habitats, status of biodiversity in and around the proposed **Aniali (16.21 ha)** limestone mine project area, the field work was carried out from August – March 2009. Parellely data analysis and report preparation was carried out from April – September 2009. Summary of the field surveys are given in **Table 4.1.**

Table 4.1. Field Survey and Report Preparation Schedule

Month /season	Broad level approach
August - 2008	Reconnaissance of the Existing Environmental Setup of the proposed **Aniali** limestone Mine project area
September 2008 – March 2009	Data collection pertaining to different scopes of work
April – September 2009	Data analysis & Report Preparation

4.2 MACRO LEVEL APPROACH

4.2.1 Secondary data collection

- Collection and collation of project related secondary information.
- Rapid survey of the project area to identify existing major habitat types within the study area (Forest area, Grassland, and Wetlands, i.e., village ponds, tanks and reservoirs).
- Preparation of relevant base maps using 1:50,000 Sol Topo sheets.
- In addition relevant documents and maps were also obtained from TCL and intensively referred and used.

4.2.2 Delineation of the Study Area

The project study area was delineated into two zones for biodiversity inventory study. The mine lease area **Aniali (16.21 ha)** was considered as **Core Zone -CZ**, while, the area encompassing 10 km radius from the mine site was designated as **Buffer Zone - BZ (Figure 4.1 & 4.2)**. Since the Barda Sanctuary and Naliyadhar reserved forest areas overlap with the buffer zone, further the buffer zone was delineated in three areas that include: Buffer zone inside the Barda Sanctuary limit, Buffer Zone

Naliyadhar Reserved Forest, and Buffer zone outside the Sanctuary area. Details of the project study area given in **Table 4.2.**

Table 4.2: Delineation details of the Project study area of Aniali (16.21ha) of TCL

Zone and area Details	Zones
Covers the entire mine lease area of **Aniali 16.21 ha**	**CZ**
The area covering 10km radius from the center/ boundary of Core zone	**BZ**
The buffer zone area fall within the Barda sanctuary limit	**BIS**
The buffer zone area fall within the Naliyadhar Reserved Forest	**BNRF**
The buffer zone area fall out side the Barda Sanctuary limit	**BOS**
The Project Study Area include the Buffer zone and the Core Zone	**SA**

4.3. MICRO LEVEL APPROACH- FIELD DATA COLLECTION

Micro level approach involved mainly the field based primary data collection on different components of the project objectives. The field data collection mainly included biodiversity status assessment of different life forms of floral elements such as trees, shrubs, herbs, grass. Faunal diversity was assessed by inventorying the major taxa like herpetofauna (amphibian and reptiles), birds (both aquatic and terrestrial) and mammals.

4.3.1 Floral Status

- Status of floral diversity was assessed in representative habitats of each type like; waste lands which include: open scrub forest and *Prosopis juliflora* thickets, agricultural hedge, plantation, stream and river beds and existing wetlands.
- Quantitative data was collected using standard methods (Circular plot) followed by Mueller-Dombois and Ellenberg 1967, Kershaw, 1973.
- Status of tree, shrub and annuals (grass and herb) was quantified using circular plots of different sizes of 15m, 8m radius and 1m ^{2} plots respectively.
- In addition, 50 m radius of area surrounding the sampling locations were perambulated to make a floral inventory and record additional species not encountered within the sample plots laid for quantification.

4.3.2 Faunal Status

4.3.2.1 Herpetofauna

- Status of herpetofauna was assessed using Intensive Time Constrained Search Method covering different micro habitats (Welsh, 1987, Welsh and Lind 1991). Intensive search was made within 15m radius circular plot.

4.3.2.2 Birds

Avifaunal status was assessed both in terrestrial and aquatic habitats

- Total count or flock count method was adopted to assess the status of aquatic birds in the existing water bodies (Sridharan 1989 and Bhupathy 1991).
- Point count method was used to assess the status of terrestrial birds (Bibby *et al.,* 1992 and Hutto *et al*., 1986). The second technique adopted was area search method (Dieni and Jones 2002), a time area constrained survey technique that has been widely and commonly used in several bird monitoring programs.

4.3.2.3 Mammals

Status and distribution of different mammal species was quantified using Direct count along the Line transect (Burnham *et al.* 1980) and indirect evidences within the circular plots of 50 m radius (Rodgers 1988 and Sale and Berkmuller, 1988).

- Indirect evidences like, Pellet, dung, tracks (Thommpson *et al* 1989, Allen *et al* 1996) scat count (Henke and knowlton 1995) and other signs were enumerated using quadrate method (Daniels 1992) **Plate 1.**
- An additional effort was made to assess the status of mammalian fauna which is night count (late evening) along road (Ravi *et al* 1994., Rall and Eberhardt 1997 and Edwards *et al* 2000). This survey was done to record lesser mammals and species that were shy in nature only in the buffer zone of the outside sanctuary area and core zone.
- Presence of different faunal species was also substantiated by interviewing the local people and experts with pictorial representation.

4.4. SAMPLING DETAILS

4.4.1 Sample size

4.4.1.1 Flora

To quantify floral status a total of **112 x 15 m** radius circular plots (**12 core zone and 100** buffer zone) were laid and within the sample plots matured tree species were identified and their numbers counted. Shrub species status was assessed in **112 x 8** m radius circular plots. Annuals like herbs, sedges and grass were identified and counted using 1x1 m quadrates. A total of **224** such quadrates were laid covering both core **(24)** and buffer **(200)** zones.

4.4.1.2 Herpetofauna

A total of **12** and **100** circular plots of 50 m radius were laid and intensively searched all the micro habitats for herpetofauna in both Core and Buffer zones respectively.

4.4.1.3 Birds

To quantify terrestrial birds, **112 x 50m** radius Point centre quadrates were used including core and buffer zones. Total count and flock count techniques were used to quantify the aquatic bird species during different times of the study period. A total of three water bodies were identified within the study area which include Khambhaliya dam inside the sanctuary area and Minsar and Bileshwari River in tne main land – Buffer zone of outside the sanctuary. No water bodies exist within the core zone. Whenever aquatic birds encountered in small streams were also listed.

4.4.1.4 Mammals

To assess the status of mammalian fauna **112** plots were searched for indirect evidences. In addition, roads crisscrossing the project area were traveled exclusively during early morning and late evenings for the direct sightings of mammalian fauna. Details of number of sample plots were laid to assess the floral and faunal diversity status is given in **Table 4.3.**

All the nomenclature and scientific names have been referred from standard flora for plants (Shah 1978 and Bhandari 1990) and pictorial guides for fauna (Herpetofauna - Daniels. R.J.R. 1992, Daniel J.C. 2002, Daniels R.J.R. 2005., Birds: Ali, S. 2002, Grimmett, et al.2006., Mammals: Prater. 2005).

Table 4.3: Number of Sample Locations and Plots Used to Assess the Floral and Faunal Status Aniali limestone (16.21ha) Mine lease Project Study Area of TCL.

Components	Plot size	Core Zone	BIS	BNRF	BOS	OBZ	SA
Plants	**Trees:** 15 m Radius circular plot	**12**	**35**	**35**	**30**	**100**	**112**
	Shrub: 8 m Radius circular plot	**12**	**35**	**35**	**30**	**100**	**112**
	Herbs & Grass: 1m x1m plots	**24**	**70**	**70**	**60**	**200**	**224**
Herpetofauna	50 m Radius circular plot	**12**	**35**	**35**	**30**	**100**	**112**
Birds	**Terrestrial:** Point centre quadrate method 100 m radius	**12**	**35**	**35**	**30**	**100**	**112**
	Aquatic: Total count and flock count	**0**	**1**	**0**	**2**	**3**	**3**
Mammals –	**Indirect evidences: 50** m Radius circular plot	**12**	**35**	**35**	**30**	**100**	**112**

CZ= Core Zone, BIS=Buffer Zone Inside Sanctuary, BNRF = Buffer Zone Naliyadhar Reserved Forest, BOS= Buffer Zone Outside Sanctuary, Overall Buffer Zone, SA = Study Area

CHAPTER 5: STATUS OF FLORA AND FAUNA- ANIALI LIMESTONE (16.21ha) STUDY AREA - TCL

5.1 BIODIVERSITY STATUS

This chapter discuses the ecological status of biota of the Aniali **(16.21 ha)** limestone mine project area in terms of biodiversity covering different life forms of plant species (tree, shrub, herb, grass and others) and major faunal groups (amphibians, reptiles, terrestrial birds , aquatic birds and mammals). The baseline status of biota (plant and animals) discussed at five levels i.e., 1. **Core zone:** *i.e.,* only the mine lease area, 2. **Buffer zone inside the Sanctuary**, **3. Buffer Zone Naliyadhar Reserved Forest,** 4. **Buffer zone outside the sanctuary** and 5. **Study area:** i.e., overall combining the status of the both core and buffer zones.

5.2 STUDY HABITATS

Based on the Survey of India 1:50,000 Topo sheet **(No. 41 G/14)**, the area falling within 10 km radius (Buffer Zone) from the Ranavav mining site was dominated by three major habitat types such as: agricultural land (agro-ecosystem), wastelands and forest areas. However, for the study purpose they have been delineated into six sub-habitat types according to the nature of vegetation existing and use of faunal species.

1. **Agro-ecosystem;** it means areas currently under intensive agriculture use (irrigated lands, un-irrigated lands/rain fed irrigation) and it's surrounding hedge vegetation (locally known as - wadis) owned by the private people. Since these areas are rich in moisture availability due to continuous cultivation it supports diverse floral and faunal species and formed major habitat of the study area.
2. **Waste Land with Open scrub Forest;** mainly small patches of waste lands (Gauchar lands, cultivable waste) with wild species of scrub vegetation and scattered tree species which belongs to revenue /government or private. These patches are not true and designated forest areas.

3. **Waste land with Prosopis Scrub;** all the categories of waste lands (Gauchar land, permanent fallow lands) but purely – dominated with *Prosopis juliflora* (gando baval) and Lantana belongs to revenue or government.
4. **Stream Beds;** this includes the area on the banks of seasonal rivers, streams and small nallahs.
5. **Wetland:** This habitat type includes. Talav, village ponds, dams, perennial rivers and streams located within the study area of the proposed mine project sit.

6. **Forest land:** This includes the forest area of Barda Sanctuary which is overlapping with the buffer zone of the concerned mine lease project area. This sanctuary area has three major forest types like: *Acacia senegal* dense thorn forest, riverine forest with mixed tree species, mixed forest along the river with euphorbia domination.

5.3 STATUS OF FLORA

5.3.1 Taxonomical status of Plant Species

Study Area: Status of floral species in Aniali mine lease (16.21ha) study area covering 10 km radius reported 212 species belong to 161 genera and 55 families. The entire study area estimated plant species diversity of H'3.97(**Table 5.1**) Species list with their life form and local names are given in **Annexure 1.**

Overall Buffer Zone: The entire buffer zone covering areas of outside and inside sanctuary and reserved forest recorded 209 plant species of 156 genera and 54 families. This species list formed 98.58% of the study area (**Table 5.1**) and estimated species diversity of H' 4. 00.

Buffer Zone OS: Buffer zone covering the area outside the sanctuary and Reserved forest identified 117 species and they come from 88 genera of 44 families and formed 55.18% of the total list of study area. Estimated plant species diversity for BOS was H' 3.76 (**Table 5.1**).

Buffer Zone NRF: Inside the Naliyadhar Reserved Forest a total of 88 species were identified and they belong to 64 genera of 32 families. This species list shared 41.50% of the study area and estimated 3.50 as species diversity (**Table 5.1**).

Buffer Zone IS: The sanctuary area fall within the buffer zone reported 116 species and they belongs to 90 genera of 38 families and showed the diversity of H' 3.42. This list contributed 54% of the study area list (**Table 5.1).** All the species recorded within the sample locations of study area was compared with the Barda Sanctuary plant list given in GEER & GSF (2002) report as base reference **(See Annexure 1).**

Core Zone: Core zone i.e., the mine lease area showed species richness of 35 species of 23 genera and 22 families. This species list shared 16.50% of the study area and estimated 2.85 as species diversity (**Table 5.1**).

Table 5.1: Overall taxonomic Status of Plant Species in Aniali Limestone Mine lease (16.21ha) Study Area of TCL

Parameter/ Group	CZ	Buffer Zone			OBZ	SA
		BIS	BNRF	BOS		
Family	22	38	32	44	54	55
Genera	23	90	64	88	156	161
Species	35	116	88	117	209	212
Relative %	16.50	54.71	41.50	55.18	98.58	100.00
Diversity 'H	2.84	3.42	3.50	3.76	4.00	3.97

CZ = Core Zone, BIS = Buffer zone inside Sanctuary, BNRF = Buffer Zone Naliyadhar Reserve Forest, BOS = Buffer zone outside Sanctuary, OBZ = Overall Buffer Zone, SA= Study Area

5.3.2 Life form Status of Plant species

Study Area: All the 212 plant species reported from the Aniali mine lease study area fall under 10 types of life forms. Among the life forms, the study area identified maximum of 70 herb species and they formed 33.01 % followed by tree species 23.58% with 50 species. The third level domination was observed from shrub (23 species) and grass (21 species) species with little variation of 10.84% and 9.90% respective. Sedges reported with four species (**Table 5.2**).

Overall Buffer Zone: Buffer zone area showed the same trend as in case of the study area with the domination of herb (67 species) followed by tree (50 species). Shrub (23 species) and grass species dominated by 21 species at third level (**Table 5.2**)

Buffer Zone OS: Buffer zone area excluding the sanctuary and reserved forest identified same number of herb and tree with 34 species and they contributed 50.74% and 68% of the overall buffer zone of the specific life form. BOS area reported three sedge plant species **(Table 5.2**).

Buffer Zone RF: Out of 212 plant species reported from the Aniali mine lease study area, the reserved forest identified maximum of 26 herb species followed by 14 tree species. The Third level domination was observed from grass (13 species) and shrub (12 species).

Buffer Zone – IS: Though, life form status inside sanctuary area showed the same trend of BOS with the domination of herb (38 species) followed by Tree (21 species) their contribution to the entire buffer zone is 56.71% and 42% which is lower than the share of BOS area. However, being forest area it had two sedge species (**Table 5.2**).

Core Zone: In case of core zone herbaceous species showed richness of 13 species followed by grass species and tree with 6 species, they positioned second in life form status. Core zone also reported four species of shrub and less number of under shrub compared to BOS and BIS respectively (**Table 5.2**). Core zone being waste land presence of only 6 species of trees and 4 species of shrub clearly indicate poor above ground vegetation (**Table 5.2**).

Table 5.2: Status of Life form of plant species reported in Aniali Limestone Mine lease (16.21ha) Study Area of TCL

Life Form	CZ	Buffer Zone			OBZ	SA	R %
		BIS	BNRF	BOS			
Climber	0	4	4	2	4	4	1.88
Grass	6	12	13	13	21	21	9.90
Herb	13	38	26	34	67	70	33.01
Sedge	0	2	0	3	4	4	1.88
Shrub	4	17	12	10	23	23	10.84
Small Tree	3	9	8	10	17	17	8.01
Straggling Shrub	0	2	2	3	4	4	1.88
Tree	6	21	14	34	50	50	23.58
Twiner	0	4	2	2	6	6	2.83
Under Shrub	3	7	7	6	13	13	6.13
Total	**35**	**116**	**88**	**117**	**209**	**212**	**100.00**

CZ = Core Zone, BIS = Buffer zone inside Sanctuary, BNRF=Buffer Zone Naliyadhar Reserve Forest, BOS = Buffer zone out side Sanctuary, OBZ = Overall Buffer Zone, SA= Study Area, R%= Relative Percent

5.3.3 Status of Tree species

Status of common/wild tree species (including large and small trees) was discussed based on the density estimated per ha and only for the zones and not for the overall study area.

5.3.3.1 Status of Common/Domestic Tree species

Overall Buffer zone: Common tree species identified within the sample area of buffer zone listed 25 species. Common tree density varied from minimum of 0.43 tree/ha to maximum of 14.34 tree/ha. Overall, the buffer zone showed low tree species density and out of 25 species 6 species estimated less than one tree/ha and it formed 40% of the total list (**Table 5.3**).

Buffer Zone OS: Buffer zone outside forested area was identified with 24 species and the density varied from minimum of 0.55 tree/ha to maximum of 36.66 1trees/ha. Overall density status showed healthy trend and only one species estimated density less than a tree/ha. Among the tree species, *Cocus nucifera (*Coconut*)* was estimated maximum density of 36.66 tree/ha followed by *Magnifera indica (*Mango *17.11* trees/ha), *Azadirachta indica* (Neem-16.11 trees/ha) and Ficus benghalensis (11.66 trees/ha*)*. Since the BOS covers mostly agricultural area these species were found common (**Table 5.3**)

Buffer Zone NRF: This Naliyadhar reserved forest area reported only one common tree species which is *Azadirachta indica* with the low density of 11 trees/ha.

Buffer Zone IS: The sanctuary area identified only five common/domestic tree species such as; *Azadirachta indica, Delonix regia, Tamarindus indica and Ficus racemosa and Psidium guajava* within the sample plots and they estimated density of 2.94, 2.35, 1.17 and 0.58 trees/ha. Sanctuary area being dominated by wild trees, representation of common/domestic species found to be few and with very low density **(Table 5.3**).

Core Zone: The core zone i.e., the mine lease area reported only two common species such as; *Ficus benghalensis* and *Azadirachta indica* within the sample plots and they estimated density of 5.00 and 10.00 trees/ha respectively. Core area of the

Aniali mine lease dominated with *Acacia nilotica with the invasion of Prosopis juliflora* and therefore it reported few common trees with very low density.

Table 5.3: List and Density of Common/Domestic tree species reported in Aniali Mine lease (16.21 ha) Study Area of TCL

S. No.	Species Name	CZ	D/ha	Buffer Zone						OBZ	D/ha	SA	D/ha
				BIS	D/ha	BNRF	D/ha	BOS	D/ha				
1	*Annona squamosa*	0	0	0	0	0	0	9	5.00	9	1.95	9	1.80
2	*Azadirachta indica*	2	5.00	5	2.94	11	11.00	29	16.11	45	9.78	47	9.40
3	*Carica papaya*	0	0	0	0	0	0	8	4.44	8	1.73	8	1.60
4	*Citrus limon*	0	0	0	0	0	0	5	2.77	5	1.08	5	1.00
5	*Cocus nucifera*	0	0	0	0	0	0	66	36.66	66	14.34	66	13.20
6	*Cordia dichotoma*	0	0	0	0	0	0	7	3.88	7	1.52	7	1.40
7	*Cordia gharaf*	0	0	0	0	0	0	23	12.77	23	5.00	23	4.60
8	*Delonix regia*	0	0	4	2.35	0	0	0	0	4	0.86	4	0.80
9	*Eucalyptus globulus*	0	0	0	0	0	0	12	6.66	12	2.60	12	2.40
10	*Ficus amplissima*	0	0	0	0	0	0	2	1.11	2	0.43	2	0.40
11	*Ficus benghalensis*	4	10.00	0	0	0	0	21	11.66	21	4.56	25	5.00
12	*Ficus microcarpa*	0	0	0	0	0	0	5	2.77	5	1.08	5	1.00
13	*Ficus racemosa*	0	0	1	0.58	0	0	6	3.33	7	1.52	7	1.40
14	*Magnifera indica*	0	0	0	0	0	0	31	17.22	31	6.73	31	6.20
15	*Manilkara zapota*	0	0	0	0	0	0	17	9.44	17	3.69	17	3.40
16	*Moringa oleifera*	0	0	0	0	0	0	5	2.77	5	1.08	5	1.00
17	*Murraya koenigii*	0	0	0	0	0	0	2	1.11	2	0.43	2	0.40
18	*Musa paradisiaca*	0	0	0	0	0	0	3	1.66	3	0.65	3	0.60
19	*Phoenix sylvestris*	0	0	0	0	0	0	9	5.00	9	1.95	9	1.80
20	*Polyalthia longifolia*	0	0	0	0	0	0	5	2.77	5	1.08	5	1.00
21	*Psidium guajava*	0	0	1	0.58	0	0	14	7.77	15	3.26	15	3.00
22	*Punica granatum*	0	0	0	0	0	0	6	3.33	6	1.30	6	1.20
23	*Syzygium cumini*	0	0	0	0	0	0	8	4.44	8	1.73	8	1.60
24	*Tamarindus indica*	0	0	2	1.17	0	0	1	0.55	3	0.65	3	0.60
25	*Terminalia catappa*	0	0	0	0	0	0	4	2.22	4	0.86	4	0.80
	Total Species	**2**		**5**		**1**		**24**		**25**		**25**	

CZ = Core Zone, BIS = Buffer zone inside Sanctuary, BNRF = Buffer Zone Naliyadhar Reserve Forest, BOS = Buffer zone outside Sanctuary, OBZ = Overall Buffer Zone, SA = Study Area, D/Ha – Density / Hectare

5.3.3.2 Status of Wild Tree Species

Overall Buffer Zone: out of 42 wild tree species reported in the study area, all the 42 species were reported from the buffer zone. Within the species list 16 species estimated low density of less than one tree/ha. *Acacia Senegal (160.86 Trees/ha), Prosopis juliflora* (31.43 T/ha), *Commiphora wightii* (21.30 T/ha), *Acacia nilotica* (20.86 T/ha), *Balanities aegyptia* (19.78 T/ha), *Carissa congesta* (8.26 T/ha), *Acacia*

leucopholea (6.95 T/ha), *Manilcara hexandra and Zizyphus xylopyrus* (5.43 T/ha of each species) *were* top dominant tree species of the overall buffer zone (**Table 5.4**).

Buffer Zone OS: Buffer zone outside sanctuary and reserved forest area reported 20 wild tree species. Of that, only three species showed low density of less than one tree/ha. Since this area dominated by *Prosopis juliflora* was dominated with the maximum density of *78.33 T/ha* followed by *Acacia nilotica* (17.22 T/ha). *Pithecellobium dulce* (11.66 T/ha), *Commiphora wightii* (10.00 T/ha), *Balanities aegyptia and Zizyphus mauritiana each with* 3.88 T/ha).

Buffer Zone NRF: This area reported 21 wild tree species all the species had estimated density above one tree/ha. Since this area is thorny forest in nature, *Acacia senegal* dominated with the highest density of 330 trees/ ha followed by *Balanities aegyptia* with 70 trees/ha (**Table 5.4)**.

Buffer Zone IS: This zone represent the sanctuary area reported 25 wild tree species and it was higher than the species richness of outside sanctuary area (20 species). However, species specific density showed variation in domination. Since the sanctuary area dominated by *Acacia senegal* thorn forest, this species dominated with the highest density of 237.64 trees/ha followed by other thorny species like; *Acacia nilotica (24.70 T/ha), Carissa congesta* (15.88 T/ha) and *Acacia leucopholea* (13.52 trees/ ha) were the fourth and fifth dominating tree species in the sanctuary area respectively (**Table 5.4**). *Commiphora wightii* a threatened species estimated density of (33.52 T/ha) *and*

Core Zone: This area reported only 6 wild tree species. Since this area is thorny forest in nature, *Acacia nilotica* dominated with the highest density of 132.50 trees/ ha. However, this area is under severe invasion of *Prosopis juliflora* and it showed second level of domination with the density of 117.50 T/h. *Balanities aegyptia* (75.00 T/ha) and *Commiphora wightii* estimated density of 37.50 T/ha third and fourth level of domination (**Table 5.4**).

Table 5.4: List and Density of Wild tree species reported in Aniali Limestone Mine lease (16.21 ha) Study Area of TCL

S. No.	Species Name	CZ	D/ha	Buffer Zone						OBZ	D/ha	SA	D/ha
				BIS	D/ha	BNRF	D/ha	BOS	D/ha				
1	*Acacia leucopholea*	0	0	23	13.52	9	9.00	0	0	32	6.95	32	6.40
2	*Acacia nilotica*	53	132.5	42	24.70	23	23.00	31	17.22	96	20.86	149	29.80
3	*Acacia planifrons*	0	0	4	2.35	5	5.00	0	0	9	1.95	9	1.80
4	*Acacia senegal*	1	2.50	40	237.6	330	330.0	6	3.33	740	160.8	741	148.2
5	*Aegle marmelos*	0	0	0		0	0	1	0.55	1	0.21	1	0.20
6	*Albizia lebbeck*	0	0	0	0	0	0	3	1.66	3	0.65	3	0.60
7	*Annona reticulate*	0	0	0	0	0	0	1	0.55	1	0.21	1	0.20
8	*Areca catechu*	0	0	0	0	0	0	5	2.77	5	1.08	5	1.00
9	*Balanities aegyptia*	30	75.00	14	8.23	70	70.00	7	3.88	91	19.78	121	24.20
10	*Bauhinia purpurea*	0	0	8	4.70	2	2.00	0	0	10	2.17	10	2.00
11	*Bauhinia racemosa*	0	0	3	1.76	2	2.00	0	0	5	1.08	5	1.00
12	*Bombax malabaricum*	0	0	0	0	0	0	4	2.22	4	0.86	4	0.80
13	*Butea monosperma*	0	0	0	0	0	0	3	1.66	3	0.65	3	0.60
14	*Carissa congesta*	2	5.00	27	15.88	11	11.00	0	0	38	8.26	40	8.00
15	*Clerodendrum multiflorum*	0	0	0	0	2	2.00	0		2	0.43	2	0.40
16	*Commiphora wightii*	15	37.50	57	33.52	23	23.00	18	10.00	98	21.30	113	22.60
17	*Cordia perrottrii*	0	0	5	2.94	1	1.00	0	0	6	1.30	6	1.20
18	*Derris indica*	0	0	0	0	0	0	1	0.55	1	0.21	1	0.20
19	*Diospyros melanoxylon*	0	0	12	7.05	0	0	0	0	12	2.60	12	2.40
20	*Ehretia aspera*	0	0	14	8.23	2	2.00	0	0	16	3.47	16	3.20
21	*Gardenia recinifera*	0	0	1	0.58	0	0	0	0	1	0.21	1	0.20
22	*Helicteres isora*	0	0	18	10.58	0	0	0	0	18	3.91	18	3.60
23	*Holarrhena antidysenterica*	0	0	15	8.82	1	1.00	0	0	16	3.47	16	3.20
24	*Holoptelea integrifolian*	0	0	7	4.11	7	7.00	0	0	14	3.04	14	2.80
25	*Ixora arborea*	0	0	8	4.70	0	0	0	0	8	1.73	8	1.60
26	*Leucaena latisiliqua*	0	0	0	0	0	0	4	2.22	4	0.86	4	0.80
27	*Leucaena leucocephala*	0	0	2	1.17	0	0	0	0	2	0.43	2	0.40
28	*Manilcara hexandra*	0	0	14	8.23	9	9.00	2	1.11	25	5.43	25	5.00
29	*Melhania futteyporensis*	0	0	0	0	6	6.00	0	0	6	1.30	6	1.20
30	*Mitragyna parvifolia*	0	0	9	5.29	1	1.00	0	0	10	2.17	10	2.00
31	*Morinda tomentosa*	0	0	1	0.58	0	0	0	0	1	0.21	1	0.20
32	*Pithecellobium*	0	0	0	0	0	0	21	11.66	21	4.56	21	4.20

S. No.	Species Name	CZ	D/ha	Buffer Zone						OBZ	D/ha	SA	D/ha
				BIS	D/ha	BNRF	D/ha	BOS	D/ha				
	dulce												
33	*Prosopis cineraria*	0	0	0	0	0	0	3	1.66	3	0.65	3	0.60
34	*Prosopis juliflora*	47	117.5	0	0	5	5.00	141	78.33	146	31.73	193	38.60
35	*Salvadora oleoides*	1	2.50	0	0	7	7.00	0	0	7	1.52	8	1.60
36	*Salvadora persica*	0	0	0	0	0	0	2	1.11	2	0.43	2	0.40
37	*Terminalia belerica*	0	0	1	0.58	0	0	0	0	1	0.21	1	0.20
38	*Thespesia populnea*	0	0	0	0	0	0	3	1.66	3	0.65	3	0.60
39	*Wrightia tinctoria*	0	0	2	1.17	2	2.00	0	0	4	0.86	4	0.80
40	*Zizyphus glaberrima*	0	0	1	0.58	0	0	0	0	1	0.21	1	0.20
41	*Zizyphus mauritiana*	0	0	0	0	0	0	7	3.88	7	1.52	7	1.40
42	*Zizyphus xylopyrus*	0	0	22	12.94	1	1.00	2	1.11	25	5.43	25	5.00
	Total Species	**6**		**25**		**21**		**20**		**42**		**42**	

CZ = Core Zone, BNRF=Buffer Zone Naliyadhar Reserve Forest, BIS = Buffer zone Inside Sanctuary, BOS = Buffer zone Outside Sanctuary, OBZ= Overall Buffer Zone, SA= Study Area, D/Ha – Density per Hectare

5.3.4 Status of crop Species

Status of agriculture crops was assessed only in the buffer zone covering outside the sanctuary area. The list of species was prepared based on the casual observation while collecting data in and around the agriculture habitat. Based on the survey a total of 36 crop species were reported in the study area of Aniali mine lease area and based on their use value they have been grouped into four categories.

Among the species list 8 species fall under grain crops, 10 species fruit crops, 11 vegetable crops and 6 commercial crops of the study area. Within the grain crops, Bajri, Juwar, Makai Devil was cultivated extensively. Though, 10 fruit yielding species were reported, they grown in small extent of areas along the agricultural hedges and mainly for local use and market. All the six commercial crops cultivate extensively and they for major income of the local agriculturalists **(Table 5.5)**.

Table 5.5: List of Agriculture and Commercial Crop Species Recorded in and around Aniali Mine lease (16.21ha) Study Area of TCL

S.No	Scientific Name	Family	Local Name	Habit
	Grain Crops			
1/1	*Pennisetum typhoides* A. Rich.	Poaceae	Bajri, Bajaro	Herb
2/2	*Sorghum bicolor* (L.) Moench.	Poaceae	Juwar,	Grass
3/3	*Cajanus cajan* (L.) Millsp.	Fabaceae	Tuver	Herb
4/4	*Triticumaes tibvum(L.)l*	Poaceae	Wheat -	Grass
5/5	*Vigna radiate* (L.)wilczek.Var. *radiata*	Fabaceae	Udad	Herb

S.No	Scientific Name	Family	Local Name	Habit
6/6	*Ricinus communis* L.	Euphorbiaceae	Arando, Divel	Shrub
7/7	*Vigna trilobata* (L.) Verdcourt	Fabaceae	Mung, Math	Herb
8/8	*Zea mays* L.	Poaceae	Makai	Grass
Fruit Crops				
9/1	*Annona squamosa* L.	Annonaceae	Sitafal	Small Tree
10/2	*Annona reticulata* L.	Annonaceae	Ramphal	Small Tree
11/3	*Psidium guajava* L.	Myrtaceae	Jamphal	Tree
12/4	*Citrus aurantifolia* (Chr.) Swingle	Rutaceae	Kag Ji Limbu	Small Tree
13/5	*Limonia elephantum* (Correa) Panigrahi	Rutaceae	Kotha	Tree
14/6	*Citrus limon* (L.) Burm. f.	Rutaceae	Limbu	Shrub
15/7	*Musa paradisiacal* L.	Musaceae	Kela, Kelu	Small Tree
16/8	*Punica granatum* L.	Punicaceae	Dadam	Small Tree
17/9	*Phyllantus embelica*	Euphorbiaceae	Amala	Small tree
18/10	*Morus alba* L.	Moraceae	Shetur	Tree
Vegetable Crops				
19/1	*Abelmoschus esculentus* (L.) Moench	Malvaceae	Bhinda, Bhindo	Under Shrub
20/2	*Capsicum annuum* L. var *acuminatum* Fingerh.	Solanaceae	Marchi	Herb
21/3	*Cucumis sativus* L.	Cucurbitaceae	Kakadi	Climber
22/4	*Lageneria leucantha* (Duch.) Rusby.	Cucurbitaceae	Dudhi	Herb
23/5	*Cicer arietinum* L.	Fabaceae	Chana	Herb
24/6	*Momordica charantia* L.	Cucurbitaceae	Karela	Climber
25/7	*Allium sativum vineale*	Liliaceae	Lasun	
26/8	*Moringa oleifera* Lam.	Moringaceae	Mitho Saragvo	Tree
27/9	*Lycopersicon lycopersicum* (L.) Karst.	Solanaceae	Tamata, Tamatu	Herb
28/10	*Solanum melongena* L.	Solanaceae	Ringana, Ringan	Under Shrub
29/11	*Daucus carota L. var.sativa*	Apiaceae	Gajar	Under Shrub
Cash/Commercial crops				
30/1	*Saccharum officinarum* L.	Poaceae	Sherdi, Ganna	Grass
31/2	*Gossypium herbaceum* auct. Non L. var. *acerifolium* (Guill. & Perr.) Chevalier	Malvaceae	Kapas, Desi Kapas	Shrub
32/3	*Arachis hypogea* L.	Fabaceae	Magphali	Herb
33/4	*Cocus nucifera* L.	Arecaceae	Neriel,Tarafoo	Tree
34/5	*Mangifera indica* L.	Anacardiaceae	Ambo, Kheri *	Tree
35/6	*Manilkara zapota* (L.) van Royen	Sapotaceae	Chiku	Tree

5.4 STATUS OF FAUNA

This section includes the discussion of major faunal groups like; amphibians, reptiles, birds (terrestrial and aquatic) and mammals. Among the groups, due to taxa specific nature of life, direct sightings of herpetofauna and mammalian fauna are always lower than the avifauna which is comparatively more active. Therefore

status of herpetofauna and mammals groups were discussed at species richness and abundance levels predominately based on indirect evidences for mammals reported within the sample area.

5.4.1 Status of Herpetofauna.

5.4.1.1 Taxonomic status-Amphibians.

During the study period only three species of amphibians were reported from the study area and they belong to three genera and single family. Within buffer zone, area fall inside the sanctuary had three species and rest of the zones not reported any amphibian. Absence of perennial water resources within the core zone results no amphibian in the mine lease area.

Table.5.6. Taxonomic Status of Amphibians in the Aniali Limestone Mine lease (16.21 7ha) Study area of TCL

Taxonomic Status	CZ	Buffer Zone			OBZ	SA
		BIS	BNRF	BOS		
Family		1			1	1
Genus		3			3	3
Species		3			3	3

CZ= Core Zone, BIS = Buffer zone inside the Sanctuary, BNRF= Buffer Zone Naliyadhar Reserve Forest, BOS = Buffer zone outside the Sanctuary, OBZ= Overall Buffer Zone, SA=Study Area

5.4.1.2 Abundance Status – Amphibian

Abundance status showed, out of 29 animals reported from three species, majority of 23 animals were contributed by *Fejevarya limnocharis* followed by Indian skittering frog (*Euphlictis cyanphylictis)* with 5 individuals and one Indian bull frog (*Hoplobarahus tigerinus*) (**Table 5.7**). All the species were reported from the Buffer were come from inside the sanctuary. Low species richness, abundance status and restricted distribution claims no significant impacts have been observed.

Table.5.7. Abundance status Amphibians in Aniali Limestone Mine lease (16.21 7ha) Study area of TCL

S. No	Species Name	Common Name	CZ	Buffer Zone			OBZ	SA
				BIS	BNRF	BOS		
1	**Ranidae**							
1	*Euphlictis cyanphylictis*	Indian skittering frog		5			5	5
2	*Hoplobarahus tigerinus*	Indian bull frog		1			1	1
3	*Fejevarya limnocharis*	Cricket frog		23			23	23
	Total			**29**			**29**	**29**

CZ= Core Zone, BIS = Buffer zone inside the Sanctuary, BNRF= Buffer Zone Naliyadhar Reserve Forest, BOS = Buffer zone outside the Sanctuary, OBZ = Overall Buffer Zone, SA-Study Area.

5.4.1.3 *Taxonomical status – Reptiles*

Study Area: Reptilian status in the study area showed moderate species richness with overall 10 species belongs to 10 genera and five families.

Overall Buffer Zone: overall buffer zone covering sanctuary, reserved forest and other habitat types reported all the ten species reported for the study area. This list belongs to 10 genera and five families

Buffer Zone OS: Buffer zone of other habitat types (Excluding the sanctuary and Reserved forest) identified six species come from six genera and four families and it formed 50% of the species richness of the study area.

Buffer RF: Naliyadhar reserve forest was reported low species richness of 20% of the species (2) of the study area each species belong to separate genus and family.

Buffer Zone IS: Buffer zone area overlap with the sanctuary limit reported 70% of the species (7 species) of the study area and each species belong to separate genera and five families.

Core Zone: Core zone area identifies only three reptile species and they fall under three genera and three families with the contribution of 30% of the total species list. Details of Taxonomical status of reptiles are given in **Table. 5.8.**

Table.5.8. Taxonomic Status of Reptiles in Aniali Limestone Mine lease (16.21 7ha) Study area of TCL

Taxonomic Status	CZ	Buffer Zone			OBZ	SA
		BIS	BNRF	BOS		
Family	3	5	2	3	5	**5**
Genus	3	7	2	5	10	**10**
Species	3	7	2	5	10	**10**

CZ=Core Zone, BIS = Buffer zone inside the Sanctuary, BNRF= Buffer zone Naliyadhar Reserve Forest, BOS = Buffer zone outside the Sanctuary, OBZ = Overall Buffer Zone, SA – Study Area

5.4.1.4 *Abundance status – Reptiles*

A total of 54 animals were enumerated from 10 species in the study area. Among the 10 species, presence of one snake species (Saw scaled viper - *Echis carinata)* was conformed based on indirect evidences. Abundance status of reptiles in the

study area showed distribution of animals in all the zones (CZ, BOS and BIS) (**Table 5.9**) with maximum of 24 animals in OBS followed by 17 in buffer zone.

Species specific abundance status showed among the 10 species, only one species: Fan-throated lizard (*Sitana ponticeriana*) was comparatively fund more than other species. Record of other 6 species less than five individuals clearly indicates low abundance status and it may be due to very sensitive and secretive in nature they were enumerated with few individuals. The core zone counted with 4 animals of three species, of that 2 were Common bronze-back skink which is one of the commonest species in the study area **(Table 5.9)**.

Table.5.9. Abundance Status of Reptiles in Aniali Limestone Mine lease (16.21 ha) Study area of TCL

S. No	Species Name	Common Name	CZ	Buffer Zone			OBZ	SA
				BIS	BNRF	BOS		
1	**Geckonidae**							
1	*Hemidactylus flaviviridis*	Yellow-green house gecko	1			8	8	9
2	*Hemidactulus maculatus*	Rock gecko		1			1	1
3	*Cyrtopodian Sp?*			1			1	1
2	**Agamidae**							
4	*Calotes versicolar*	Indian garden lizard		3		4	7	7
5	*Calotes Sp?*					9	9	9
6	*Sitana ponticeriana*	Fan-throated lizard	1	7	8	2	17	18
3	**Scincidae**							
7	*Mabuya carinata*	Keeled grass skink		1			1	1
8	*Mabuya macularia*	Common bronze-back skink	2		1	1	2	4
4	**Varanidae**							
9	*Varanus bengalensis*	Bengal monitor		3			3	3
5	**vipridae**							
10	*Echis carinatus*	Indian saw scaled viper		1*			1*	1*
	Total		**4**	**17**	**9**	**24**	**50**	**54**

CZ= Core Zone, BIS = Buffer zone Inside the Sanctuary, BNRF= Buffer zone Naliyadhar Reserve Forest, BOS = Buffer zone outside the Sanctuary, OBZ= Overall Buffer Zone, * Species reported based on indirect evidences. SA= Study area.

5.4.2 Status of Avifauna

5.4.2.1 Taxonomical Status - Overall

Study Area: The Aniali limestone mine lease study area covering both the core and buffer zone reported a total of 115 bird species belong to 88 genera and they fall under 41 families and estimated species diversity was H'3.64 (**Table 5.10).**

Overall Buffer zone: Comparatively buffer zone had high species richness and the species number reached up to 114 of 87 genera and 41 families which are close to study area. Since the buffer zone covers large extent of area (10km radius) and dominated by different habitat types it supported more species than other zones. The estimated relative percent was 99% with the diversity of H' 3.67 **(Table 5.10)**.

Buffer zone- OS: Out of 114 species reported within the buffer zone area, the area fall outside the sanctuary limit estimated 55 species belong to 47 genera and they come from 27 families. This species list formed 48% of the total species of the study area and estimated diversity was H' 3.17 **(Table 5.10)**

Buffer Zone- NRF: The buffer zone area overlaps with Naliyadhar Reserve forest identified 51 species belong to 43 genera and 24 families with a diversity of H' 3.04. This covers 44 % of species that reported in the study area. The comparatively less species richness in this area could be absence of different habitat types as the entire area is dominated by dense *Acacia senegal* thorn forest.

Buffer Zone–IS: The buffer zone area covers the Sanctuary limit reported maximum species richness of 82 and they belong to 66 genera and 36 families. Since this area fall under the sanctuary limit and inhabits different forest types supported high species richness and diversity (H' 3.51) and contributed 71 % of the species of the entire study area (**Table 5.10**).

Core zone: Status of birds assessed within the Aniali mine lease area (16.21 ha) reported a total of 16 species belongs to 15 genera and 13 families. Since, this mine lease area covers only 16.21 ha and mainly dominated by Prosopis juliflora and Acacia nilotica thorn forest the reported species richness found to be low and it formed only 14 % of total species of the study area with the diversity of H' 2.06 (**Table 5.10**).

Table 5.10: Overall taxonomic Status of Overall Avifauna in the Aniali Limestone Mine lease (16.21 ha) Study Area of TCL

Taxonomic Status	CZ	Buffer Zone			OBZ	SA
		BIS	BNRF	BOS		
Family	13	36	24	27	41	41
Genus	15	66	43	47	87	88
Species	16	82	51	55	114	115
Relative %	13.91	71.30	44.35	47.83	99.13	
Diversity	2.06	3.51	3.04	3.17	3.67	3.64

CZ=Core Zone, BIS = Buffer zone Inside Sanctuary, BNRF= Buffer Zone Naliyadhar Reserve Forest, BOS = Buffer zone outside Sanctuary, OBZ= Overall Buffer Zone, SA=Study Area

5.4.2.2 Taxonomical Status and Species Richness- Terrestrial

Study area: In the study area of Aniali mine lease, a total of 83 species of terrestrial birds have been reported and they belong to 65 genera and 28 families. This species richness resulted diversity of H' 3.33 for the entire study area (**Table 5.11)**

Overall Buffer Zone: Extensive area of the buffer zone covering 10km radius estimated 82 species of 64 genera and 28 families. Since it covers large extent of area and occurrence of diverse habitats, it estimated species high diversity of H' 3.36 (**Table 5.11)**

Buffer Zone OS: Buffer zone excluding the sanctuary and reserved forests recorded 47 species and they come under 40 genera and 22 families. The estimated species diversity outside the wilderness area was H' 3.04 (**Table 5.11)**.

Buffer Zone NRF: The buffer zone inside the Naliyadhar reserve forest reported 43 terrestrial birds belong to 35 genera and 20 families with a diversity H' 2.93. The comparatively less diversity is due to the absence of diverse habitat types.

Buffer Zone IS: The buffer zone area of the sanctuary limit was identified 54 species of 43 genera and 23 families. Since this is purely forest area reported comparatively more species and showed species diversity of H' 3.02 **(Table 5.11).** However, the sanctuary area dominated by wild plant species, comparison of species richness with the outside sanctuary area showed variation of 7 species with little difference (BOS H' 3.04 and BIS 3.02) in species diversity (**Table 5.11**).

Core Zone: Within the core zone, only 15 species were reported from 14 genera and 12 families. Being a small extent of area, core zone showed low species richness and estimated species diversity of H' 2.02 (**Table 5.11**).

Table 5.11: Taxonomic Status of Terrestrial Avifauna in the Aniali Limestone Mine lease (16.21 ha) Study Area of TCL

Taxonomic Status	CZ	Buffer Zone			OBZ	SA
		BIS	BNRF	BOS		
Family	12	23	20	22	28	28
Genus	14	43	35	40	64	65
Species	15	54	43	47	82	83
Diversity	2.02	3.02	2.93	3.04	3.36	3.33

CZ=Core Zone, BIS = Buffer zone Inside Sanctuary, BNRF= Buffer Zone Naliyadhar Reserve Forest, BOS = Buffer zone outside Sanctuary, OBZ= Overall Buffer Zone, SA=Study Area

5.4.2.3 Taxonomical Status and Species Richness- Aquatic

Study Area: Overall in the study area, status of aquatic bird species showed identification of 32 species belong to 25 genera and 16 families and the calculated species diversity was H' 2.71 (**Table 5.12**) and these species were recorded from three water bodies within the study area

Overall Buffer Zone: The entire buffer zone reported 32 aquatic bird species fall under the same number of genera (25) and families (16) of the study area. Since only one species was added as new species from the core zone, the species diversity (H' 2.72) was close to the study area (H' 2.71).

Buffer Zone – OS: Survey of buffer zone outside the sanctuary area identified species richness of 8 species of 7genera and 6 families. Though, this area had two rivers due to highly seasonal the species richness was low with the diversity of 1.55(**Table 5.12**).

Buffer Zone -NRF: The buffer zone inside the reserve forest reported eight aquatic species belongs to eight genera and five families. Absence of permanent water bodies inside the reserve forest resulted in less number of aquatic birds **Table 5.11)**.

Buffer Zone – IS: The buffer zone inside the sanctuary reported a total of 28 species of 23 genera and 15 families. This high species richness was mainly the area encompasses Khambhaliya dam within the sanctuary limit and it had species diversity of H' 2.94 (**Table 5.12**).

Core Zone: The core zone with 16.21 ha does not have any perennial river or streams within it and therefore only one aquatic bird species was reported.

Table 5.12: Taxonomic Status of Aquatic Avifauna in the Aniali Limestone Mine lease (16.21 ha) Study Area of TCL

Taxonomic Status	CZ	Buffer Zone			OBZ	SA
		BIS	BNRF	BOS		
Family	1	15	5	6	16	16
Genus	1	23	8	7	25	25
Species	1	28	8	8	32	32
Diversity		2.94	2.08	1.55	2.72	2.71

CZ=Core Zone, BIS = Buffer zone Inside Sanctuary, BNRF= Buffer Zone Naliyadhar Reserve Forest, BOS = Buffer zone outside Sanctuary, OBZ= Overall Buffer Zone, SA=Study Area

5.4.2.4 Overall Abundance Status

Study area: A total of 1835 birds were reported from the area sampled, of that 1592 were terrestrial while 243 aquatic birds. The estimated overall density resulted in 2698 birds/km^2 (**Table 5.13).**

Overall Buffer zone: The buffer zone area (including sanctuary and reserve forest area) was counted a total 1751 birds. Of those 1511and 240 birds belongs to terrestrial and aquatic in nature respectively and the bird density for the entire buffer zone was 2870 birds/km^2 (Table **5.13**).

Buffer Zone OS: The buffer zone area outside the sanctuary counted 590 terrestrial and 35 aquatic birds in the area sampled and it showed the overall abundance of 625 birds with the density of 3472 birds/Km^2 (**Table 5.13**).

Buffer Zone NRF: The buffer zone area overlap with reserve forest counted 459 terrestrial birds and 12 aquatic birds with a total of 471 birds. The estimated bird density was 2243 birds/km^2.

Buffer Zone IS: Abundance status inside the sanctuary of the buffer zone showed overall the abundance of 655 birds with 462 terrestrial and 193 aquatic birds. The calculated density showed overall 3119 birds/Km^2 which is higher than the estimation of outside sanctuary area (**Table 5.13**).

Core Zone: Comparatively being a small area, the core zone was enumerated a total of 84 birds with the density of 1200 birds/Km^2. These 84 birds include 81 terrestrial birds and only 3 aquatic birds (**Table 5.13).**

Table 5.13: Overall Abundance Status of Avifauna in the Aniali Limestone Mine lease (16.21 ha) Study Area of TCL

Habitats	CZ	Buffer Zone			OBZ	SA
		BIS	BNRF	BOS		
Terrestrial Birds	(81)1157	(462) 2200	(459) 2186	(590) 3278	(1511) 2477	(1592) 2341
Aquatic Birds	(3)43	(193) 919	(12)57	(35) 194	(240) 393	(243)357
Overall	**(84)1200**	**(655) 3119**	**(471) 2243**	**(625) 3472**	**(1751) 2870**	**(1835) 2698**

CZ=Core Zone, BIS = Buffer zone Inside Sanctuary, BNRF= Buffer Zone Naliyadhar Reserve Forest, BOS = Buffer zone outside Sanctuary, OBZ= Overall Buffer Zone, SA=Study Area, Actual number in parenthesis

5.4.2.5 Density status – Category

Abundance status of bird species in the study area was further categorized into five density classes based on the number of birds reported in each species. The category status was discussed for all the zones.

Study Area: Though the study area estimated the density of 2698 birds/Km^2, out of 115 species reported 97% of the species (111 species) were found in low density category and these species were estimated less than 100 birds /km^2. Two species were in moderate density category and one species in common and high abundant density category each. The high abundant species was Red-vented Bulbul (509 birds /Km^2) (**Table 5.14 and Annexure 2**).

Overall Buffer Zone: Avifauna abundance of buffer zone area showed the same trend with 96% of the species (110 species) fall under low density category out of 114 species reported. Two species (2 %) were grouped under moderate density class while one species (1%) in common and high abundant density category each (**Table 5.14**). Red-vented Bulbul (520 birds /Km^2 was in the high abundant density category.

Buffer Zone OS: Buffer zone excluding sanctuary and reserved forest areas estimated 84 % of the species (46 species) as low density speciers, while 9 % (5 species) at moderate and three in common and one in high abundant density category. Rock

Pigeon (711 birds /Km^2) was the only abundant species in the buffer zone outside the forested areas (**Table 5.14 and Annexure 2**).

Buffer Zone NRF: Among the 51 species of birds reported from the Naliyadhar reserved forest 92 % of species (47 species) were in low density category, 3 species (6 %) in moderate density and one species in high abundant density category. Red-vented Bulbul was the high abundant with 127 individual (density 605 birds/Km^2).

Buffer Zone IS: Inside the sanctuary area, the species reported showed maximum of 94% (77 out of 82 species) estimated low density while three species under moderate density level. Red-vented bulbuls were found abundant (136 birds) and estimated density was 648 birds /Km^2.

Core Zone: Out of 16 species reported from the core zone, 13 species (showed low density which formed 81 % of the total species. Rest of the three species, one each fall under moderate, common and abundant density category each. Red-vented Bulbul (414 birds/ km^2) was the abundant bird in the core zone ((**Table 5.14**). Species specific abundance and density status of terrestrial and aquatic birds are given in **Annexure 2.**

Table 5.14: Density status (category) of Avifauna in the Aniali Limestone Mine lease (16.21 ha) Study Area of TCL

Density Category	CZ	R %	Buffer Zone						OBZ	R %	SA	R %
			BIS	R %	BNRF	R %	BOS	R %				
Low 1-100	13	81.25	77	93.9	47	92.2	46	83.64	110	96.49	111	96.52
Moderate 101-200	1	6.25	3	3.66	3	5.88	5	9.09	2	1.75	2	1.74
Common 201-300	1	6.25	1	1.22	0	0	3	5.45	1	0.88	1	0.87
Abundant 301-500	1	6.25	0	0	0	0	0	0.00	0	0.00	0	0.00
High Abundant >500	0	0	1	1.22	1	1.96	1	1.82	1	0.88	1	0.87
Total	**16**	**100**	**82**	**100**	**51**	**100**	**55**	**100**	**114**	**100**	**115**	**100**

CZ=Core Zone, BIS = Buffer zone Inside Sanctuary, BNRF= Buffer Zone Naliyadhar Reserve Forest, BOS = Buffer zone outside Sanctuary, OBZ= Overall Buffer Zone, SA=Study Area, R%=Relative Percentage

5.4.2.6 Migratory Status

Study area: Out of 115 bird species reported from the study area come under two types of migratory status. Of that 94 species are resident and 21 species reported as winter visitor and they formed 82 % and 18 % of the total list respectively.

Overall Buffer Zone: Migratory status of overall buffer zone also showed the same trend as in the case of the study area with 82 % resident and 18 % belong to winter visitor (**Table 5.15**).

Buffer zone – OS: Within the buffer zone, the area outside the sanctuary support proportionally more resident birds (54 species and 98%) than the winter visitor (1 species and 2 %) showing the area supported comparatively less number of migratory species (**Table 5.15**).

Buffer zone NRF: The buffer area within the reserve forest reported 82% resident species (42 out of 51) and 18% winter visitor.

Buffer Zone – IS: Among the 82 species reported from the sanctuary area 23% (19 species) belong to winter visitor which is comparatively higher than the area of outside sanctuary limit. Presence of diverse forest types and one dam site within the sanctuary supported more migratory species compared to other zones (**Table 5.15**).

Core Zone: Out of 16 species reported from the core zone – i.e., the mine lease area, all the species (100 %) belong to Resident status. Winter Visitor was absent in the core zone (**Table 5.15**).

Table 5.15: Overall Migratory Status of Avifauna in the Aniali Limestone Mine lease (16.21 ha) Study Area of TCL

Migratory Status	CZ	R %	Buffer Zone						OBZ	R %	SA	R %
			BIS	R %	BNRF	R %	BOS	R %				
Resident	16	100	63	76.83	42	82.4	54	98.18	93	81.58	94	81.74
Winter Visitor	0	0	19	23.17	9	17.6	1	1.82	21	18.42	21	18.26
Total	**16**	**100**	**82**	**100**	**51**	**100**	**55**	**100**	**114**	**100**	**115**	**100**

CZ=Core Zone, BIS = Buffer zone Inside Sanctuary, BNRF= Buffer Zone Naliyadhar Reserve Forest, BOS = Buffer zone outside Sanctuary, OBZ= Overall Buffer Zone, SA=Study Area, R%=Relative Percentage

5.4.3 Status of Mammals

5.4.3.1 Taxonomical status of Mammals

Study Area: Status of mammalian fauna in the study area showed moderate level of species richness with overall 12species belongs to 12 genera and 10 families.

Overall Buffer Zone: All the 11 species reported for the study area were encountered in overall buffer zone. This list belongs to same number of genera (12) and families (10).

Buffer Zone OS: Buffer zone of other habitat types (excluding the sanctuary and reserved forest) identified 10 species and each belongs to separate genus and nine families and they formed 81% of the species richness of the study area.

Buffer Zone NRF: Naliyadhar reserved forest sharing the buffer zone reported eight species and each belongs to different genus and family. This list formed 67% of the study area list.

Buffer Zone IS: Buffer zone area overlap with the sanctuary limit reported 8 species and each belongs to separate genus (8) and family (8). This species richness is lower than the reserved forest and the other habitats of the buffer zone.

Core Zone: Core zone showed comparatively less species richness than the area covering outside the sanctuary limit and it had six species of six different genera and each belong to separate family. This richness shared 50% of the overall study area species richness. Details of Taxonomical status of mammalian fauna is given in **Table 5.16.**

Table.5.16. Taxonomic Status of mammals in Aniali Limestone Mine lease (16.21ha) Study area of TCL

Taxonomic Status	CZ	Buffer Zone			OBZ	SA
		BIS	BNRF	BOS		
Family	6	7	9	9	10	**10**
Genus	6	8	9	10	12	**12**
Species	6	8	9	10	12	**12**

CZ = Core Zone, BIS = Buffer zone inside the Sanctuary, BNRF = Buffer zone Naliyadhar Reserve Forest, BOS = Buffer zone outside the Sanctuary, OBZ = Overall Buffer Zone, SA = Study Area

5.4.3.2 Abundance status – Mammals

Study Area: Within the study area covering 10 km radius and including of buffer and core zone 12 mammal species reported with direct count of 42 animals and 388 indirect evidences. Among the 12 species, based on the indirect evidences two species, Nilgai and Jackal were the common species of the study area and their

presence was reported with 154 and 45 evidences respectively. Only Five-striped Palm Squirrel (27) and Indian Hare (7) were counted through direct sightings.

Overall Buffer Zone: Presence of 12 species in the buffer zone area was conformed based on direct sightings of 41 animals and 328 indirect evidences. The abundance status showed domination of Nilgai (3 DS and 141 IE), Indian Hare (6DS and 67 IE) and Five-striped Palm Squirrel (27 DS) **Table 5.17.**

Buffer Zone OS: Since this area dominated with agriculture habitat showed less no of species richness (10 species) and abundance status of 29 direct sightings and 62 indirect evidences. Except 24 sightings of Five-striped Palm Squirrel, rest of five species reported with low evidences.

Buffer Zone NRF: This reserved forest identified nine species based on 6 direct sightings of animals and 195 indirect evidences. Out of 154 Nilgai pellet groups were encountered in the study area, maximum of 100 pellet groups were come from this reserved forest. Indian hare was the second dominated species reported 40 pellet groups and two direct sightings.

Buffer Zone IS: Sanctuary area recorded 8 species with 6 direct sightings and 70 indirect evidences. However, this area showed only Nilgai (27 IE), Indian Hare (3DS - 15 IE) were found common in the sanctuary area. Porcupine (11), Striped Hyena (7), and Wild boar (6) were other mammals dominated second level in the sanctuary. Presence of leopard and Jungle cat was conformed based on two and three indirect evidences (**Table 5.17**). Since these species are predominately nocturnal and shy in nature they were reported with few evidences.

Core Zone: The mine lease area of Aniali cluster (16.21) had six species with 1 direct sighting and 60 indirect evidences. Since this area located close to the Barda sanctuary, Jackal (27 IE), Jungle cat (5 IE), stripped hyena (4 IE), Nilgai (13 IE), Indian Hare (1DS-8IE) were found using this area (**Table 5.17**)

Table.5.17. Abundance Status of Mammals in Aniali Limestone Mine lease (16.21 7ha) Study area of TCL

S. No	Species Name	Common Name	CZ		Buffer Zone						OBZ		SA	
					BIS		BNRF		BOS					
			DS	IE	DS	IE	DS	IE	DS	IE	DS	IE	SD	IE
1	**Bovidae**													
1	*Boselaphus tragocamelus*	Nilgai		13		27	3	100		14	3	141	3	154
2	**Suidae**													
2	*Sus acrofa*	Wild boar		3		6		19		6		31		34
3	**Herpestidae**													
3	*Herpestes edwardsi*	Common Mongoose					1	2	4	5	5	7	5	7
4	**Hyaenidae**													
4	*Hyaena hyaena*	Striped Hyena		4		7		6		5		18		22
5	**Canidae**													
5	*Canis aureus*	Jackal		27				8		10		18		45
6	**Felidae**													
6	*Panthera pardus*	Leopard				2		2				4		4
7	*Felis chaus*	Jungle cat		5		3				8		11		16
7	**Leporidae**													
8	*Lepus nigricollis*	Indian Hare	**1**	8	3	15	2	40	1	12	6	67	7	75
8	**Sciuridae**													
9	*Funambulus pennanti*	Five-striped Palm Squirrel			3				24		27		27	
9	**Hystridae**													
10	*Hystrix indica*	Porcupine				11		15		1		27		27
10	**Muridae**													
11	*Rattus rattus*	House Rat						3				3		3
12	*Tatera indica*	Indian Gerbil								1		1		1
	Total		**1**	**60**	**6**	**71**	**6**	**195**	**29**	**62**	**41**	**328**	**42**	**388**

BIS = Buffer zone inside the Sanctuary,BRF= Naliyathar Reserve Forest, BOS = Buffer zone outside the Sanctuary, OBZ = Overall Buffer Zone. DS = Direct sighting, IE = Indirect evidences, SA= Study area.

Overall list of Amphibian, Reptile, Terrestrial birds, Aquatic birds and Mammalian fauna reported in the study area of Aniali Mine lease area was compared with the Barda sanctuary list given in the report prepared by GEER- foundation and Gujarat Forest Department report (2002) as Based reference **(Annexure 4, 5, 6, 7 & 8**). The mine lease area showed some variation by missing of some species, since the study area of 10 km radius cover only part of sanctuary area and added few more species in the list due to survey of other habitat types falling outside the sanctuary area. Further, the variation may be due to different survey techniques and locations. Some of the faunal species of the study area is given in **Plate 2.**

5.5 STATUS OF THREATENED BIOTA

5.5.1 Threatened Plant

This study enumerated a total of 113 plants of *Commiphora wightii* within the sample area which has been categorized as threatened plant by WCMC (1994). Out of 113 plants, maximum of 57 plants were recorded in the sample plots of the buffer zone of the sanctuary area followed by 23 in Naliyadhar Reserved forest and other habitat counted 18 plants. A total 15 plants were counted within the area sampled in Core zone (**Table 5. 18**).

5.5.2 Threatened Animals

5.5.2.1 Threatened herpetofauna

Amphibians: Overall amphibian group was very poorly represented with only 3 species and they were reported from the sanctuary area and no amphibian was reported from the core zone. Among the species none of them fall under the endangered category of Indian Wildlife Protection Act (1972).

Reptiles: A total of ten reptilian fauna reported from the study area and none of them belongs to threatened category of Indian Wildlife Act (1972). Though Indian flap shell turtle and Mugger crocodiles were found in the water bodies of the sanctuary area, Khambhaliya dam surveyed was not encountered these scheduled species.

5.5.2.2 Avifauna

Indian Peafowl (*Pavo cristatus),* was the schedule I species reported in and around the study area with a total of 34 birds. Of that maximum of 15 birds were counted Buffer zone outside the forested area. Sanctuary and Naliyadhar Reserved forests were counted 7 and 12 birds respectively (**Table 5.18**). No Peafowls were reported from the Core zone.

5.5.2.3 Mammals

The study area of Aniali (16.21ha) reported high species richness of 12 mammalian fauna which is 57% of the mammalian fauna reported from the nearby Barda sanctuary area (21 Species GEER and GSFD 2005). Even though, Leopard (*Panthera pardus*, Indian wolf (*Canis lupus*), Ratel (*Mellivora capensis*) and Pangolin (*Manis crassicaudata*) are the schedule I species said to occur in the sanctuary, only four leopard pug marks of leopard were recorded and two evidence were inside the sanctuary and other two within the Naliyadhar Reserved forest. No evidences and any direct sightings of threatened mammalian fauna were reported from the core zoen area (**Table 5.18**).

Table: 5.18 Status of Threatened biota in Aniali Limestone Mine lease (16.21ha) Study Area of TCL

Species Name	Common Name	CZ	Buffer Zone			OBZ	SA
			BIS	BNRF	BOS		
Plants							
Commiphora wightii	Guggal	15	57	23	18	98	113
Amphibians							
No threatened species reported in the study area							
Reptiles							
No threatened species reported in the study area							
Birds							
Pavo cristatus	Indian Peafowl	0	7	12	15	34	34
Mammals							
Panthera pardus	Leopard		2*	2*		4*	4*

CZ= Core Zone, BIS = Buffer zone Inside the Sanctuary, BOS = Buffer zone outside the Sanctuary, OBZ= Overall Buffer Zone, SA- Study Area, * Species reported based on indirect evidences

5.5.2.4 Elephant and Tiger reserves

Gujarat state does not provide habitat for Tiger and elephant and therefore no any designated protected forests, elephant and tiger reserves are exist in the state.

5.5.2.5 Turtle nesting beaches

Porbandar coast reported nesting beaches of Olive ridley and Green turtles and monitoring of three nesting beaches for a period of one year resulted monthly density of 26.88 nests/ km. During the year 2004-05 Gujarat State Forest Department collected turtle eggs from 174 nests along the Porbandar coast for hatchery management which showed 71% hatching success (Sunderraj *et al* 2002 and 2006). However, earlier survey showed that three stretches estimated low nesting density of

4-5 nests/km. The nearest nesting beaches like; Odadra and Gosabara stretch located more than 22 km from the mining site while Navibandar – Ratia distanced maximum of 28.5 – 33.5 km from the core zone. The estimated distance from the buffer zone varied from minimum of 12 to maximum of 22.5 (**Table 5.19**).

Table 5.19. Location of Sea Turtle nesting beaches from Aniali (16.21 ha) mine lease of TCL

Nesting Beaches segment	Beach length	Monthly Density	Distance from	
			Mine lease	Buffer zone
Odadara –Gosabara *	6.0 km	5 nests/km	22 km	12
Gosabara – Navbandar *	13 km	5.5 nests/km	22-28.5 km	12-18.5
Navibandar – Ratia **	6 km	4 nests/km	28.5 – 32.5	18.5 22.5

Source: * Sinderraj *et al.* 2002, ** Sunderraj *et al* 2006 (Distance estimated based on Survey of India Toposheets)

CHAPTER 6: IMPACT IDENTIFICATION AND EVALUATION

6.1 INTRODUCTION

Government or private developmental programs, policies and projects can cause potential significant changes in many features of the physical, biological and socioeconomic environment. In some cases the changes may be beneficial while in other it may be detrimental. Accordingly, environmental impacts studies must systematically identify, qualify, where possible and appropriately interpret the significance of these anticipated changes. However, occurrence and magnitude of these impacts are entirely depends on project location, mode of operation and technology involved.

6.2 IMPACT IDENTIFICATION AND EVALUATION

In general, impact prediction methods argue that the foremost step in impact appraisal must consider and identify project actions that are likely to bring significant changes in the project environment. The present study determined to predict the likely impacts of **Aniali lease of (16.21 ha)** limestone mining project in the surrounding environment with specific to biological attributes covering habitats/ecosystems and associated biodiversity. Special care was taken to predict the impact on the biological diversity of the Sanctuary area and threatened floral and faunal species. Likely impacts identified were categorized into different levels like, direct or primary, indirect or secondary and short term or long term impacts based on the influence of sources and magnitude of impacts. In addition to it, certain project related activities can improve the surrounding environmental status in terms of improvement in infrastructural facility, natural resource, social and cultural development of the local community. These, changes can be identified as positive impacts of the proposed project.

6.3 PROJECT SPECIFIC LIKELY IMPACTS

6.3.1 Accusation of Forest land/ habitat

Accusation of forest land for mine lease area and development of infrastructures (office, workshops & additional roads) will have the following direct/primary impacts like:

Impact1. Conversion of forest land for mining activities and followed by deforestation, soil erosion and land degradation.

Evaluation: The mine lease area; core zone of Aniali **(16.21 ha)** is an existing mine lease operating since **1985-1994,** the mine lease is due for renewal and it fall under the land use of waste land (**Refer Table 2.1**). Further mine lease boundary is located 3.92 km from the boundary of Barda Wildlife Sanctuary and 0.11km from the Naliyadhar Reserved forest. In addition the proposed project seeking permission for renewal and do not require any additional forest land. Due to these reasons, the above said impacts like: accusation of land from protected forest and thereby loss of true forest habitat was not visualized.

Impact 2. Conversion of forest land which directly impact upon the associated floral and faunal composition.

Evaluation: Since the proposed project action does not required additional forest land from the protected forest no direct impact of loss of forest biodiversity likely to occur

6.3.2 Clearing of vegetation cover in other land use of mine lease – core zone

Land clearing and removal of vegetation cover in other land uses and land cover within the core zone likely to have the following direct/primary impacts.

Impact 3. Clearing of vegetation cover, especially larger tree species (canopy cover) and shrub species (above ground cover) in the land use of core zone

Evaluation: Though, the proposed lease area fall under the land use category of waste land, the Aniali **lease (16.21ha)** – core zone dominated with thorny tree species. This top canopy vegetation (tree cover) had reported only 3 small and 6

larger tree species. The ground cover dominate with 4 shrub and 3 under shrub with overall floral species richness of only 35 species and predominately domination of 13 herbs (**Table 5.2**). Therefore clearing of vegetating for mining will have moderate impact on floral diversity of mine pit, however it need to be compensated with extensive multi species plantation program (**See Section 7.3.2 and Chapter7)**

Impact 4. ***Impact on faunal groups (herpetofauna, terrestrial avifauna and mammals) reported in other land uses/habitats of mine lease area (core zone).***

Evaluation: Aniali mine lease area (16.21ha) reported low species richness of herpetofauna (0 amphibian 3 reptiles), aquatic birds (1 species) terrestrial birds (15 species) and 6 mammals (**Table 6.1**).

Since 10 km radius of Buffer zone and extensive area beyond the buffer zone abide similar land use pattern/habitat types, the faunal species reported within the core zone may disperse to adjacent habitats. Therefore, the above discussed impact on faunal diversity may be at minimal level and short term. However, appropriate mitigatory measures have been suggested to improve the vegetation cover and to minimize the impacts on floral (**Chapter 7**). Further, planting diverse plant species expected to bring back these faunal species during post mining phase.

Table: 6.1: Species richness of major faunal groups in Aniali Mine lease area (16.21 ha) – Core zone

S.No	Faunal groups	No of Species reported
1	Amphibian	0
2	Reptile	3
3	Terrestrial birds	15
4	Aquatic birds	1
5	Mammals	6

Impact 5. Clearing of vegetation from the lease area likely to increase grazing pressure in the adjacent sanctuary area by the local livestock population.

Evaluation: Status of ground fodder species showed record of only 6 grass, 13 herbs and 7 shrub (4 shrub and 3 under shrub) in the core zone which formed only 20.47% of species reported from the overall study area which reported 137 species (**Table 6.2**). In addition comparison of ground fodder species richness with the sanctuary

area showed the core zone support overall 3.69% of fodder species of the sanctuary area and grass species (6 species) formed only 7.69% of the total 78 grass species reported from the sanctuary (**Table 6.3**). Further the core zone fall under the waste land as per the Government revenue records (**Refer 7/12 document attached**), due to domination of Prosopis tree with lantana and Acacia auriculata shrub, the low ground fodder species richness reported very low. The existing fodder resource may not provide enough fodder biomass to support the local livestock.

In addition the buffer zone land use pattern showed 20,122.82 ha of area under the agriculture land (**Table 3.1**) which may produce lots of agriculture residue for the local livestock. The existing low fodder species richness, low biomass production in the core zone and availability of crop residue indicate that, loss of waste land for mining will not have any significant grazing pressure on the sanctuary area located 3.92 km far from the lease area. However, considering the Naliyadhar Reserved forest located in the close vicinity of 0.11km, it has been suggested to develop grass fodder in the mined out area (flat areas) during post mining phase as an additional habitat improvement activity (**see chapter 7**)

Table 6.2: Status of ground fodder species in the study area

Life Form	CZ	Buffer Zone			OBZ	SA
		BIS	BNRF	BOS		
Grass	6	12	13	13	21	21
Herb	13	38	26	34	67	70
Shrub	4	17	12	10	23	23
Under Shrub	3	7	7	6	13	13
Total	26	74	58	63	124	127
R%	**20.47**	**58.26**	**45.66**	**49.60**	**97.63**	

CZ = Core Zone, BOS = Buffer zone outside Sanctuary, BIS = Buffer zone inside Sanctuary, OBZ= Overall Buffer Zone, SA = Study Area, R% = Relative Per cent

Table 6.3 Comparative status of Ground fodder species of Aniali (16.21 ha) Mine lease area with BWS

Life Form	ACZ	BWS*	R%
Grass	6	78	7.69
Herb	13	459	2.83
Shrub	4	102	3.92
Under Shrub	3	64	4.68
TOTAL	26	703	3.69

ACZ = Aniali Core Zone, BWS = Barda Wildlife Sanctuary
BMS* Source: GEER &GFD 2002

6.3.3 Impact on aquatic ecosystem and biodiversity

Excavation of minerals within any natural water bodies and major rivers and diversion of natural flow expected to have primary and secondary impacts on aquatic ecosystems in term of:

Impact 6. Change the physical structure of water bodies, change in water flow and overall impact on hydrological regime.

Impact 7. Reduce the fresh water runoff into downstream resources

Impact 8. Disturbance to aquatic ecosystem in turn affect the aquatic flora and fauna.

Evaluation: There is no perennial surface watercourse (river, major streams) or surface water body (pond and natural depression) within the leasehold area. Absence of natural and perennial water resources showed no direct impact on surface water due to proposed project.

Impact 9. Disturbance to aquatic ecosystem in the sanctuary area

Evaluation: The mining site is located in the foothill of Barda sanctuary and therefore the natural runoff water flow from the sanctuary to towards the mine site and main land of the foothill. Further, the Khambhaliya dam reported within the buffer zones are located in the hilly tracts of Barda sanctuary in the higher elevation and with the distance 7.0 km far from mining site. Other two bodies located in the mainland such as the Main river is located 5.6 km while the Bileshwari River (branch of Minsar river) situated 4.87 km away from the site (**Table 6.4**). In addition these water bodies are highly seasonal and not linked through any natural water course with the mine lease. Due to this strategic location of the mining site in the foothills of the Sanctuary, and natural isolation not expected to have the above said impacts.

Table 6.4: location of aquatic ecosystem from Aniali Mine Lease (16.21 ha) Area.

S.No	Name of the water body/wetland	Distance from the Mining site
	Inside Sanctuary	
1	Khambhaliya Dam	7.0 km
	Outside Sanctuary – Main Land	
2	Minsar River	5.6 km
3	Bileshwari River	4.87

6.3.4 Impact on hydrological regime of both ground and surface water sources of the main land

Excavation of deeper mine pits likely to disturb the ground water resources and also contaminate the natural water bodies due to runoff from the mine pit and mine dumps to the adjacent water bodies.

Impact 10. Disturbance to the surface and ground water resources

Evaluation - Surface water: This small extent of area of core zone not having any natural water and permanent bodies (Village pond, Talav and Small dam) and water courses (rivers and major streams). Therefore excavation of mineral due to proposed project will not have the impact of disturbance to physical structure and change in water course of surface water resources.

Evaluation- Ground water: The proposed mine pit will be depressed by 7.75 m, over an area of 1.433 ha. Ground water table in the region is 20 meter depth from the surface. Even at the ultimate stage the pit level will be 12.25 m above the groundwater level. Since the excavation of mineral is at sub-surface level it will not affect the ground water table which is lining at safer depth and therefore the proposed mining will not disturb the ground water resource.

Impact 11. Contamination of surface and ground water resources

Evaluation: It is understood that limestone has very low solubility in water. However, to identify the possibility of waterlogged limestone pits leaching pollutants into the groundwater, a Toxicity Characteristic Leachate Procedure (TCLP) study was carried out on the limestone. Test results confirmed that pollutants leached from the limestone are at levels much below the limits mandated for these pollutants to be classified as hazardous. Refer **Annexure 6.1** for details.

low solubility nature of limestone, pollutant levels (below mandated limits) and management plant to use excess water (filtering, storing and using it for greenbelt development) clearly signify the above predicted impact (**Impact 11**) of contamination of surface and ground water resources will be very negligible.

Impact 12. Use of water resources from any natural water bodies for project related activities will create resource crunch for the dependent faunal species and local people

Evaluation: The Aniali mine plans to abstract water from nearby privately owned dug well located near Aniali mine lease area. The projected water requirements for the mine site are likely to be in the range of 30 kld. The major areas of water consumption are dust suppression (14.1 KLD), for domestic purposes (1.8 KLD) and green belt development (14.1 KLD - **Figure 2.1.)** Most of the water consumption proposed will be for dust suppression. It is to be noted that due to non-mechanical nature of mining in this lease the dust suppression will be low. In this context, minimal water requirement and conservative use of water, and use of water from their own resources and without depend on any natural water bodies envisages the project is free from the above said impact (**Impact 12**).

Impact 13. Development of new surface water resources which can act as an additional aquatic habitat.

The proposed mine pit will be depressed by 7.75 m, over an area of 1.433 ha and during the end of the mining operations a sizeable area of will remain a void, which will be developed as a mine pit reservoir. As per the fifth year mine plan a total area of 9.06 ha will be developed as mine pit (**Table 2.2**). Therefore the development of mine pit reservoirs will have some positive impacts (**Impact 13**) by recharging the ground water table and likely to support more water birds and amphibian species as an additional man-made wetland.

6.3.5 Establishment of overburden dumps and impact on land resource

One of impacts one would expect from the mining activity is dumping of mine waste into excess land area and create over burden which would affect the land resources.

Impact 14. Overburden require additional land area

Impact 15. Rain washed waste water runoff from the dumps will contaminate the land resource

Impact 16. Establishment of dump or over burden create visual intrusion

Evaluation: The nature of mineral deposition at sub-surface level and its quality in the mine lease not likely to generation any extra mine waste dumps or overburdens. No overburden or mine reject generation is anticipated during the mining operations. It is clear that, the proposed site land use showed no land allotted for dumping site (**Table 2.2**). This is so because the entire mined out material of this mine will be transported to the TCL' Chemical Plant and Cement Plant at Mithapur regularly. Therefore impacts (**14,15and16**) like requirement of additional land, water contamination due to rain water runoff from the dumps and visual intrusion are not likely occur.

6.3.6 Effects of noise due to drilling, blasting and vehicular movements on faunal groups

Noise generated due to drilling and instantaneous blasting will also affect the normal Behavioral patterns of the major faunal groups inhabits in the vicinity.

Impact 17. Change the normal behavior of restriction of movements, feeding and resting activities of major faunal groups of the sanctuary area

Evaluation: Noise pollution is mainly due to operation of blast hole drilling, blasting and occasional plying trucks. These activities will not cause any problem to the inhabitants of this area because there is no human settlement in close proximity to the lease area. Noise modeling has been carried out considering blasting and compressor operation.

For hemispherical sound wave propagation through homogeneous loss free medium, one can estimate noise levels at various locations at different sources using model based on first principle. Modeling has been carried out using CPCB Noise Algorithm.

The modeling results showed that, Barda Wildlife Sanctuary lying at the distance of 3.92 km from nearest pit area will receive a cumulative noise level of 47.2 dB (A) due to vehicular movement and loading equipments. The anticipated short duration impulse noise from blasting at the distance of 3.9 km from the lease boundary

receives noise level of 50.70 dB (A). The same for the Bordi village distanced 2.23 km expected to receive noise due to compressor and impulse noise will be 51.3 and 55.26 dB (A) respectively (**Table 6.5 & 6.6**).

Table 6.5: Continuous Noise Source Impacts Modeling

Location	Distance (m) from the Lease Boundary	Direction	Anticipated Noise level due to Vehicular Movement & Loading equipment, dB(A)	Anticipated Noise level due to Compressor, dB(A)	Cumulative noise level, dB (A), Day
Bordi	2230	N	18.03	23.03	51.3
Barda Wildlife Santuary	3920	N	13.13	18.13	47.2

Source: Kadam Environnemental Consultants/TCL Report

Table 6.6: Short Duration Impulse Noise Source Modeling

Location	Distance (m) from the Lease Boundary	Direction	Anticipated noise level due to Blasting, dB(A), Day, Few seconds	Existing Noise level dB(A) (Day)	Cumulative Noise level (few seconds only), dB(A)
Bordi	2230	N	73.03	51.3	**55.26**
Barda Wildlife Santuary	3920	N	68.13	47.2	**50.70**

Blasting will be carried out once in a day, for very small duration, i.e. for few seconds only, during which the Barda Wildlife Sanctuary lying at the distance of 3.92 km from lease area will receive a noise level of 50.70 dB (A).

This study reported 15 bird species (both terrestrial and aquatic) and only 6 mammal fauna in the core zone, out of 111 and 14 species of these groups reported for entire study area respectively (**Table 6.7**). The avifauna and mammalian fauna of the core zone contributes only 9.15 and 28.57% of the total list of the adjacent sanctuary area which reported 164 bird and 21 mammalian fauna (GEER & GFD 2002) respectively. Further these species include only common species like Nilgai, jackal, and Indian hare, which are very common species found throughout the study area including agricultural habitats and none of them fall under threatened

species category (**Refer Table 5.17**). Avifauna of the core zone is dominated by common species like Red vented bulbul (29 birds), Indian robin (18 birds) and Purple sunbird (11 birds) and this list of core zone not represented any threatened bird species (**Annexure 2**).

Blasting activity related to mining will be carried out once in a day with fixed time period for very small duration of an hour. Adaptation of fixed and instantaneous blasting practice and low birds and very low mammalian species richness and distant location of 3.9 km no significant impact on the faunal species of sanctuary area is visualized however, due to proximity of the Naliyadhar Reserved forest the expected impact will be moderate level. Further during blasting, all precautions will be taken for minimizing noise and vibration like optimum charge per delay, various controlled blasting techniques etc. Muffling will be adopted to reduce the impacts of blasting. All PPE's will be provided to the persons working in the area during the blasting (**See Section 7.3.8 and Table 7.4 and Chapter 7**). Adopting technical interventions to reduce the noise level will reduce the impact at minimal level on the faunal specie of Naliyadhar reserved forest located 0.11 km from the mine lease.

Table 6.7: Status of Major faunal groups in Aniali Mine Lease (16.21ha) Study Area

Habitats	CZ	Buffer Zone			OBZ	SA
		BIS	BNRF	BOS		
Birds	16	82	51	55	114	115
Mammals	7	8	9	9	11	**11**

CZ=Core Zone, BIS = Buffer zone Inside Sanctuary, BNRF= Buffer Zone Naliyadhar Reserve Forest, BOS = Buffer zone outside Sanctuary, OBZ= Overall Buffer Zone, SA=Study Area

It is well known fact that many plant species can control dust, noise and gaseous emission and act as Bio-filter. Therefore extensive green belt development in and around the mine area can further reduce the impact and will also provide habitat for the improvement of biological diversity during post mining phase(**See Section 7.3.8 , and Table 7.3 in Chapter 7**). The mined out areas specifically deeper excavations and waste boulders are likely to provide additional micro habitats like den and resting sites for the mammalian fauna during post operational phase.

6.3.7 Changes in ambient air quality and impact upon vegetation due to mining associated activities and dust emission

The major sources of dust pollution from the mining activities are blasting, excavation, loading and unloading of materials, heavy vehicle movement for transportation of raw materials and other machinery involved.

***Impact 18. Velocity of particles spread into the atmosphere (*blasting)**

Evaluation: The velocity of particles spread into the atmosphere due to blasting was observed during blasting. The data was analyzed and the same was presented. The results explain that the velocity of the particle is the function of its weight. The blasting was designed and executed in a way to minimize the spread of particles into the atmosphere. The particles were ranging from less than 10 kg to min of 30 gms size and they attained an average velocity of 6 to 12 m /sec. The observed values are exactly as per the design of the blast and within the designed limits for mine and the blast **(Table 6.8 & 6.9).**

Table 6.8: The broad parameters of blasting operations

S. No.	Parameters	Value
1	Spacing	9 ft
2	Burden	9 ft
3	Depth of Hole	12 to 18
4	Hole Diameter	100 mm
5	Detonators	TLD (25 ms) & DTH (450 ms) [These are shock tube detonators]
6	Hole to Hole Delay Timing	475 ms
7	Stemming	35 % of Hole depth
8	No. of Holes In a blast	35 to 58
9	Column Charge	Ammonium Nitrate Fuel Oil
10	Booster charge	Kelvex-600 (water gel explosive) 25 %
11	Column Charge	Ammonium Nitrate Fuel Oil (ANFO) 75%.

Table 6.9: Data observed after blasting

S. No.	Lime stone particles	
	Weight	Velocity
1	>1000 gm to < 10,000 gm	- 12 m./sec.
2	>100 gm to < 1,000 gm	
3	>100 gm to < 30 gram	

Impact 19: These activities likely to increase the dust emission pollutants which will have impact on vegetation cover

Impact 20: Impact on vegetation will induce habitat degradation and thereby affect the associated fauna in the project area.

Here, three activities have been considered for dispersion modeling to assess the ambient air quality:

- Mining operation
- DG set operation
- Vehicular Movements (On unpaved roads).

Evaluation: The Cumulative impact on existing and proposed ambient air quality for SPM[5] at selected stations due to different mine related activities are discussed below:

Particulate Matter:

The impact due to mining operation is negligible beyond 1 km distance in all directions.

1. The maximum 24 hour average GLC within the study area, due to emission from mining operation is estimated to be **6.05 (µg/m³)**. This GLC is expected to occur at a distance of 2**00 m** from the source towards the **East** direction within the lease area.
2. The maximum 24 hour average GLC within the study area, due to emission from Mining machineries/ compressors/ DG set is estimated to be **0.04µg/m³** particulate matter respectively. These GLCs are expected to occur at a distance of **100**m from the source towards the East direction.
3. The maximum 24 hour average GLC within the study area, due to emission from Vehicular movement (line source) is estimated to be **3.95 µg/m³** particulate matters respectively. These GLCs are expected to occur at a distance of **300** m from the source towards the **East** direction.
4. Barda wildlife Sanctuary lying at the distance of 3920 meter (North) from lease area has predicated increase in SPM found to be negligible.
5. The nearest Village is Bordi at a distance of 2230 meter in North direction has found in increase in SPM around Nil

[5] The levels for NO_X and SO_2 are marginal and have not been incorporated in the modeling as already discussed.

Gaseous Emissions:

The compressor/ mining machineries will also generate some amount of SO_2 and NO_x but as the quantity of diesel consumption is very less, it will not have any adverse impact on the present environment.

Thus it can be concluded that the impact on ambient air quality due to proposed activities will be within acceptable norms. The results of the modeling exercise are presented in **Annexure 6.2., 6.3., 6.4., & 6.5 and Figure 6.1 & 6.2**

However, considering the floral species richness of the core zone (35 species and diversity H 2.84), the sanctuary area (116 species and diversity H' 3.42) and the Naliyadhar reserved forest (88 species and diversity 3.50) (**Table 6.10**) it is suggested to develop shelter belt with selective species which control dust efficiently. This shelterbelt will also improve the faunal diversity and maintain the overall biological diversity in the vicinity of the project area.

Table 6.10: Status of flora in the study area of Aniali mine lease Study Area (16.21)

Parameter/ Group	CZ	Buffer Zone			OBZ	SA
		BIS	BNRF	BOS		
Overall Species Richness	35	116	88	117	209	212
Relative %	16.50	54.71	41.50	55.18	98.58	100.00
Diversity 'H	2.84	3.42	3.50	3.76	4.00	3.97

CZ=Core Zone, BIS = Buffer zone Inside Sanctuary, BNRF= Buffer Zone Naliyadhar Reserve Forest, BOS = Buffer zone outside Sanctuary, OBZ= Overall Buffer Zone, SA=Study Area

6.3.8 Impacts of vehicle movement on faunal groups – vehicle movements

One of the likely impacts that would affect the lower group of animal species is road mortality due to heavy vehicle movements.

Impact 21. Development of additional road facilities and change of habitat and biota status in the mainland.

Impact 22. Development of additional roads and cutting across the sanctuary area will disturbance to the flora and fauna of the protected area.

Impact 23. Increasing vehicle pressure in the existing roads due to transporting of raw materials from the mining area to Chemical plant at Mithapur likely to disturb faunal species.

Evaluation: The proposed mining activities do not involve development of any additional roads neither in the main land nor in the sanctuary area. It is proposed to use **existing** road network. Existing vehicular traffic density as per traffic survey (Aniali to Vadvala) is given in **Table 6.11.** It is anticipated that only 30 truck trips will be generated every day for the complete logistic requirements of the site and considering maximum annual production.

The above details clearly indicate that, there is no any additional land from the main land and or from sanctuary area is required and thereby avoided the impact (**21 and 22**) on flora and fauna of any potential habitats and sanctuary area.

6.3.8. Impacts of vehicle movement on faunal groups - 10 Km tar road Aniali To Vadvala NH

Table 6.11: Existing Vehicular traffic

Type of Vehicle	Existing			Additional Traffic due to proposed Mining Operations
	From Aniali to Vadvala	From Vadvala to Aniali	Total	
Two wheelers	170	65	235	20
Three wheelers	37	22	59	4
Car/Jeeps	22	17	39	2
Truck/Buses	77	64	141	30
Non motorable vehicles	33	28	61	0

Source: Source: Kadam Environnemental Consultants/TCL Report

Based on site observations, it is found that existing traffic on haul roads is negligible / non-existent. An identical number of vehicles as mentioned in Column 5 of Table 6.11 will be generated due to the proposed mining operations along the existing road. These increase 30 vehicles likely to minimal impact of road mortality mainly on faunal groups (Herpetofauna and Mammals) reported in the buffer zone of the outside sanctuary area.

However, status of herpetofauna and mammalian fauna reported in the buffer zone outside the sanctuary showed record of 5 herpetofauna and 11 mammalian species respectively (**Table 6.12**). Though, species richness of BOS seems to be moderate level, abundance status of these faunal groups are very low and further the expected increase of vehicle pressure only 30, hence impact on these faunal groups may be at minimal level (**Impact 23**). Proper transport management system from the TCL authorities like awareness and strict instruction to the transportation

team will not give any chances of such impact.

Table 6.12: Status of herpetofauna and mammalian fauna reported in Aniali (16.21ha) Study area

Taxonomic Status	CZ	Buffer Zone			OBZ	SA
		BIS	BNRF	BOS		
No of Herpetofauna species	3	10	2	5	13	**13**
No of Mammalian faunal species	7	8	9	9	11	**11**

(No of species reported based on direct sightings is given in parenthesis), BOS = Buffer zone outside Sanctuary, BIS = Buffer zone inside Sanctuary, OBZ = Overall Buffer Zone.

6.3.9 Impact to threatened floral species

Clearing of vegetation within the core zone area for the project implementation may affect the threatened floral species found within it.

Impact 24. If any threatened plant species found in the study area they may be affected by reducing their population status.

Evaluation: Status of threatened plant species in the study area showed record of only one species that is *Commiphora* wightii (WCMC 1994). Out of 113 plants counted from the sample plots of the study area, the core zone reported 15 plants (**Table 5. 18**) Hence clearing of vegetation in the core zone will have the minimal impact of loss of some plants and this need to be compensated through plantation activity.

Impact 25. Mining activity may have indirect impact on threatened plants found outside mine lease area – Sanctuary area

Evaluation: Floral survey in the sanctuary and Naliyadhar Reserved forest reported 57 and 23 *Commiphora* wightii within the sample plots in these forest areas (**Table 5.18**). Out of 113 plants reported only 18 were come from the buffer zone out side the sanctuary. Further the Sanctuary located 3.92 km far from the mining site and Naliyadhar reserved forest 0.11 km. Hence, the impact in the form of deposition of dust emission on the vegetation covers along the boundary of sanctuary not likely to occur and the same may be moderate for the Naliyadhar RF.

Though it is a threatened species it species showed wider distribution within arid and

semi-arid tracks and reported from Saurashtra – Byet Island, Dwarka, Kota, Rozi, Balachri, Kileshwar, Barda Hills, Viramgam to Rajkot, Coastal Scrub forest of Jamnagar, Junagadh, and throughout Banaskantha and Kachchh Districts (Sabnis and Rao 1983, Hocking 1993 and Bhatt 1993). This species being hardy in nature it is threatened due to over exploitation for medicinal use (Brandis 1974 and Shah 1978) and not due to other natural disturbance. However, being a threatened species, planting of *Commiphora* wightii under afforestation program within the mine lease area is proposed.

6.3.10 Impact to threatened faunal species

Presence of any threatened faunal species in the study area likely to impact due to project related activities in the form of:

Impact 26. Disturbance to specific habitat of specific habitat of threatened fauna.

Impact 27. Habitat degradation, fragmentation and impact on threatened faunal population; herpetofauna, avifauna and mammalian fauna.

Evaluation – herpetofauna: Status of threatened herpetofauna showed out of 13 species reported during the study period no threatened amphibian and reptile species found in the area sampled. Though, Mugger crocodiles and Indian flap-shell turtles found in the water bodies of the Barda sanctuary area and the Khambhaliya dam said to support 5-8 crocodiles (GEER & SFD 2002), no crocodiles and turtles were sighted during the study (Table 5.18). Further the Khambhaliya dam and Minsar river are also located 7- 5.6 km far from the project site (**Table 6.4**). Absence of these threatened species from the area samples and location of the water bodies far from the project site envisage no impact on these water bodies and associated faunal species.

Evaluation-Birds: Status of avifauna reported 115 species in the study area with 83 terrestrial and 32 aquatic species. However, this list include only the schedule I species of Indian Peafowl (*Pavo cristatus)* from the terrestrial habitat. Out of 34 peafowls reported from the study area no birds were recorded from the core zone. Added, it is found common in Gujarat state and an estimate showed that around 30,000 peafowls were counted in nearby Gir Sanctuary and National park (Singh

2001). Further it is a species use wider habitat types like, waste land, scrub forest, agriculture area and even human habitation.

Since abundant population in the local area and record of only 7 and 12 birds from the sanctuary and NRF and their distant location (4.21km) not likely to have severe impact in the form of dust emission on their habitat and noise impacts on this threatened avifauna.

Evaluation- Mammalian fauna:

Survey of mammalian fauna identified four Leopard (*Panthera pardus*) pug marks in two locations, two within the sanctuary and two in Naliyadhar reserved forest overlapping with the buffer zone of the study area (**Table 5.8**). Even though, Barda Sanctuary said to have four endangered mammalian fauna, none of them reported from the core zone. Since the proposed project activity does not require any forest land and the sanctuary located more than 3.29 km away from the mining site no impact in the form of loss of habitat and other impacts habitat degradation due to noise and dust emission were predicted on threatened mammalian fauna *(*(**Impact 25 &26**). Since the Naliyadhar reserved forest is located close to the mining site (0.11km) dust emission and noise problem may have moderate level of impact on this mammalian fauna. Therefore the suggested mitigatory measure will likely to bring down this impact.

Overall evaluation: The proposed blasting techniques to excavate the mineral resources and associated impacts of noise, and dust were scientifically modeled, results were analyzed and revealed to cause very moderate impact on sanctuary area and associated flora and fauna as well as other areas.

However, in order to maintain the ecological integrity of the Sanctuary area and Naliyadhar reserved forest and associated biodiversity and to support the scientific long term conservation approach of the State forest department plans for the area, it is suggested that TCL shall adopt extensive aforestation program all along the boundary of the mine lease area running close to the sanctuary boundary and NRF. In addition habitat restoration program will also ensure the enhancement of

ambient air quality of the project area and also will support diverse faunal groups.

Impact 28. Impact on highly endangered species – Tiger and Elephant

Evaluation: Gujarat state does not provide habitat for Tiger and elephant and therefore these species do not exist within the state. This clearly vouches for no issue on impact status.

Impact 29; Impact on Turtle Nesting Beaches

Evaluation: Porbandar coast reported nesting beaches of Olive ridley and Green turtles and monitoring of three nesting beaches for different periods showed low density of 4-5 nests/km and these beaches are also located minimum distance of 22.0 to maximum of 32.5 km from the project site (**Table 5.19**). Location of these nesting beaches far from the mining site and not connected through any natural water course indicates that, they are free from the project related impacts.

6.3.11 Influx of labour force and increasing pressure on the local natural resources

Mining activity needed larger labour force to involve in other non-technical activities. These, labours may depend on the forest area for their stay (land) and fuel wood requirement and construction materials (small poles) for temporary sheds.

Impact 30: Clearing of land and vegetation cover for labour settlements
Impact 31: Cutting of wooden poles from the forest area for the construction temporary sheds,
Imapct 32: Cutting of trees from the sanctuary to meet their fuel wood demand

Evaluation: The proposed mining operation required 51 technical staffs and it is expected that a maximum additional 99 persons will be kept on contract basis for undertaking the mining operations. Even though, around 150 people needed for this mining operation, only 100 people are likely to stay at the mining site (**Refer Table 2.9 &2.10**) and their dependency on the forest resource may have moderate level of impact due to their requirement like fire wood and wood materials for temporary sheds. Though the mine lease far from the sanctuary area (3.92 km) and their fuel wood requirements can be manage by mainly depending on *Prosopis juliflora* and

Lantana (woody shrub) which are invasive weed species, location of Naliyadhar RF within 0.11 km providing proper basic amenities by the TCL can completely avoid the above said impacts on Naliyadhar Reserved forest (**30, 31&32**).

6.3.12. Location of proposed mine lease and its impact on the behavior and peculiarities of wildlife movements

Impact 33. Location of mine lease in the mid of forested habitat which are acting as connection corridor likely to prevent the normal behavior and movement of wildlife

Evaluation /Mine location: The proposed **Aniali mine lease area (16.21 ha)** fall under the land use category of Government waste land and part of survey 207/P under the revenue limit of Aniali village and located 3.92 km far from the Barda Wildlife Sanctuary in the eastern side while 0.11km on the north east of Naliyadhar Reserved forest. This mine lease does not located in the mid and or between any two potential forests habitats.

Wildlife – Mammalian faunal status: During the biodiversity status assessment study, within the study area (10 km radius) reported 12 species of mammalian fauna out of 21 species reported in the sanctuary (**Table 6.13**) and the core zone recorded only 6 species which are very common.

Distribution: Though, the sanctuary provide habitat for diverse mammalian fauna only species like Nilgai, Wild boar, Common mongoose, Jackal, Indian hare, Five-striped palm squirrel and house rat were found abundant (**Table 6.13**). These species were also commonly found outside the sanctuary and use diverse habitats like; Prosopis thickets, waste lands with thorny scrub, agricultural field and vegetation along the agricultural hedges and close to human habitations. Small Indian civet, wolf, Indian fox, Ratel, Jungle cat, Pale hedgehog and common langur are rare while Leopard and Grey musk shrew uncommon and they restricted to the forest habitat of the sanctuary area. Barda Wildlife sanctuary is an isolated, dense and intact forested habitat and predominately undulating terrain. This sanctuary also surrounded by agriculture and human habitation and made it an isolated forest ecosystem. Since the Naliyadhar reserved forest is separated only by the Aditiyana Bhanvad road animal movements between these forest habitats takes place

regularly and only common species move out the sanctuary and reserved forest and use the other adjacent habitats.

Table 6.13: Status of Mammalian from in the study area of Aniali mine lease (16.21ha) Area of TCL and Barda wildlife Sanctuary Area

S. No	Species Name	Common Name	BWLS – GEER & GFD 2002		SA
			SR	Status	SR
1	*Boselaphus tragocamelus*	Nilgai	*	Abundant	*
2	*Sus acrofa*	Wild boar	*	Abundant	*
3	*Viverricula indica*	Small Indian Civet	*	Rare	-
4	*Herpestes edwardsi*	Common Mongoose	*	Abundant	*
5	*Hyaena hyaena*	Striped Hyena	*	Common	*
6	*Canis lupus*	Indian Wolf	*	Rare	-
7	*Canis aureus*	Jackal	*	Abundant	*
8	*Vulpus bengalensis*	Indian Fox	*	Rare	-
9	*Mellivora capensis*	Ratel	*	Rare	-
10	*Panthera pardus*	Leopard	*	Uncommon	*
11	*Felis chaus*	Jungle Cat	*		*
12	*Lepus nigricollis*	Indian Hare	*	Abundant	*
13	*Funambulus pennanti*	Five-striped Palm Squirrel	*	Abundant	*
14	*Hystrix indica*	Porcupine	*	Common	*
15	*Mus platythrix*	Spiny Field Mouse	*	Common	-
16	*Rattus rattus*	House Rat	*	Common	*
17	*Manis crassicaudata*	Pangolin	*		-
18	*Suncus murinus*	Grey Musk Shrew	*	Uncommon	-
19	*Paraechinus micropus*	Pale Hedgehog	*	Rare	-
20		Pale Indian gerbil	*		*
21	*Pteropus giganteus*	Indian Flying Fox	*	Common	-
22	*Presbytis entellus*	Common Langur	*	Rare	-

SA; Study area, BWLS; Species Reported in BWL Sanctuary area (GEER &GFD, 2002), *; present of animals, - ; Absence of animals, SR- Species Reported

Forest corridor: There are four reserved forests are located in the eastern side of the sanctuary and the distance varied from minimum of 0.55 to maximum of12.31 km from the proposed Aniali **(16.21ha**) mine lease area (**Table 6.14**). Further, they are isolated from the sanctuary due to agriculture and human habitat and not connected through any forest corridors. Further the proposed mine lease also not positioned between and mid of any of these forest area.

Table 6.14: Details of Location of Reserved forest located in and around the Aniali Mine lease (16.21) area – TCL

S.No	Name of the Reserved Forest	Location/direction	Distance from the mine lease
1	Naliyadhar Reserved Forest	South west	0.11
2	Jamboda Reserved Forest	East	2.70
3	Khageshri Reserved Forest	East	8.20
4	Dudhiya Reserved Forest	East	12.31

Animal Population and movements: Among the 21 mammal species found in the sanctuary area, Nilgai (Bluebull) and Wild boar are the two major ungulates while leopard is the larger cat inhabits this sanctuary. Among these species, as on 2001 census around 21 leopards are estimated in the sanctuary they were mostly confined to sanctuary area due to good protection, dense and undisturbed vegetation cover, diverse habitats types, availability of man-made water resources (dams) and prey base (GEER and GFD 2002 and Singh 2001).

This sanctuary also estimated 440 Nilgai (1997-98) within it and a total of 66 wild boars were sighted during the biodiversity study in this sanctuary (GEER and GFD 200). These are the only two species show wider movements and mainly preferred to use agriculture habitat and take shelter in *Prosopis* thickets and any *Acacia senegal* patches outside the sanctuary area. However, they do not have any regular and specific mass migratory and movement routes. Overall, the above discussed issues clearly indicate the following results.

- The proposed mine lease is a waste land, located in the south –east of Barda Wildlife sanctuary.
- The sanctuary is predominated by hilly terrain and isolated by agriculture and human habitations not connected with any other protected area and large extent of reserved forest through forest corridor
- The nearest reserved forests to the Barda Wildlife Sanctuary are located only in the eastern side and far from the sanctuary and they were also isolated by agriculture habitats, villages, roads and ephemerals rivers.
- Only common species were found outside the sanctuary specifically in the agricultural habitats and waste lands with scrub vegetation.

- These common species also do not show any specific spatial and temporal movement pattern with larger herds, due to wider availability of agriculture habitat around the sanctuary which they preferred to use.
- Added the proposed mine lease located just outside the NRF in the north-east and movement of common species from this RF may take place in different directions to move into adjacent agricultural habitats.

Overall due to the above discussed ecological and environmental setup of the Barda Sanctuary and the area in and around, the proposed mining activity will not have any significant impact on the normal behavior of the movements of wildlife of the sanctuary.

CHAPTER 7: MITIGATION & ENVIRONMENTAL MANAGEMENT PLAN

7.1 MITIGATION

"Mitigation Measures," refer to action that can be implemented to minimize the magnitude of the project related detrimental impacts on different physical, biological and social environments of the project area. Mitigation can carry on along three possible courses of actions, either by changing (1) at source, (2) path (3) and at the receiving end.

One of the operating principals in Environmental Impact Assessment is the Environmental Management Plan (EMP). EMP is an appropriate follow-up process which involved monitoring, management, and evaluation that are based on the significance of potential effects. It also provides opportunity for making future improvements in project related activities. Further it is a follow up activity of the EIA study in order to improve the ecological and environmental integrity in and around the proposed project area.

Based on the present study it is very clear that the prevailing proposed **Aniali (16.21 ha)** mine project locations, associated project activities impacted upon some biological attributes which area at local, shorter period and magnitude of low to moderate levels.

Overall, the present impact statement mainly revealed that the problems are related to air pollution, which is pertaining to dust, gaseous and noise, mainly due the mineral extraction and transportation. Even though, the study on the existing status and predicted likely impacts on ambient air quality are at moderate level which are inevitable in mining industry, it is very crucial to minimize and manage the level of air components within the project environ for a longer period. Keeping this in mind the following mitigations have been suggested under environmental management plan which are more of Eco-management in addition to technical interventions.

7.2 ECO – MANAGEMENT

There are many scientific studies discussed the performance specific plant species at population and species level which can be related to pollution (Mansfield, 1976., Sanders 1976., Scholz, 1981 and Garsad and Rutter 1982). Therefore, plant species act as bio-monitoring agent to monitor the air environment as well as to keep and maintain the project environ healthy. The two areas of air pollution by gases and by dust need to be urgently attended to, using plants. Such treatments have numerous benefits, especially social and ecological (Chapherkar 1994).

Chaphekar (1994) discussed the anatomical and morphological characters and their role in efficient dust capturing such as; bushy plant, with dorsi-ventrally exposed foliage, strong petioles with broad laminas, bearing stomata on lower and hairs on upper epidermal surface are the best. Further, he suggested that the tree species selected must be the ones that can grow between five and twenty meters height, grown well above the ground and separate from each other to facilitate maximum interface between gases and foliage.

Giridhar and Chaphekar (1983) stated that whether the leaves are small or big, the total leaf area has to be large for effective absorption of gases. Martin and Barber (1971) opine that, plant of such green belts, within their tolerant limits, can remove up to 70% of gaseous pollution from ambient air. Fine dust getting trapped on different parts of plant as described by Das (1981), indicate need of plants with leaves having hairy epidermal surfaces.

With the above understanding of the role of plant species as bio-filter to control air pollution, appropriate plant species (mainly tree species) have been suggested conceding the area/site requirements and needed performance of specific species.

Since the proposed project site located in the close vicinity of protected forest-Barda wildlife sanctuary, while, suggesting mitigatory measures care has been taken to improve the overall biological diversity of the project environ.

7.3 MITIGATORY MEASURES

The planning and arrangements of leveling the land after the mining is completed

Post operational Land use Plan:

Post mining land use area in ha covering pits, plantation and infrastructure is as follow. Environment Management Plan is a part of approved mining plan. The details of land use are as below **Table 7.1**:

Table 7.1. Details of the Post Operational Land use Plan

Land use as per Mine Closure Plan	**At end of mining activity**
Mined out Area	1.433 Ha
Area for Plantation	0.5 Ha
Infrastructure	0.49 Ha

Year wise progressive land use plan

Year wise mining plan	**Mined out Area in Hect.**
1st Year	0.106
2nd Year	0.79
3rd Year	0.107
4th Year	0.22
5th Year	0.21
Total	1.433
Area for Plantation in Hect.	
1st Year	0.1
2nd Year	0.1
3rd Year	0.1
4th Year	0.1
5th Year	0.1
Total	0.5
Area of Infrastructure in Hect.	
1st Year	0.29
2nd Year	0.2
3rd Year	0
4th Year	0
5th Year	0
Total	0.49

In addition to the above pre-planned post operational land use plan, the following mitigatory measures have been suggested based on the survey and status of the biological components to improve the quality of the project environ and biological diversity in the vicinity of the proposed mine project area.

7.3.1 Conversion of forest habitats and impact on biodiversity

(Impact 1&2) The proposed mine lease area (core zone) fall under the land use of waste land (**refer Table 3.1.**) and thereby no designated protected forest land existing within it. Therefore the proposed project activities will not have any impacts like loss of true forest habitat and associated floral and faunal diversity.

7.3.2 Plantation to improve of vegetation cover and biodiversity

(Impact 3 &4). Despite the fact that, the proposed mine lease area not having true forest habitat, clearing of vegetation (mainly tree species) from the waste land of the lease area likely to have impact on floral composition at local level. In order to compensate the loss of vegetation cover, it is suggested to carry out extensive afforestation program mainly in mine lease area earmarked for plantation program by the IBM in different phases (**Table 7.2**). This habitat improvement program would ensure the faunal species (3 herpetofauna, 15 terrestrial birds, and 6 mammals) to re-colonies and improve the abundance status in the core zone.

The list of plant species suggested includes the following criteria.

- A total of 33 plant species were suggested and they have been selected from the list of wild and common tree species reported from the study area and estimated comparatively high density to ensure the survival rate
- Tree species which are tall and bearing larger canopy cover and leaf area were included for improving the ambient air quality by controlling the dust.
- Tree species of different size classes (small, medium and larger) were suggested to maintain the different canopy levels at vertical profile and thereby improve the foliage height diversity to attract more bird species.
- Some fruit trees were in the selection list to attract specifically frugivore birds of the study area.
- Wild species were suggested to provide habitat for faunal species, increase the species diversity and maintain the naturalness.
- A total of 22 Species with fodder use values (Rating assigned 1-10) also suggested according to Hocking (1993) and local use.

- Though 33 tree species have been given in the list, based on the availability of tree saplings and considering its species characteristic 15-20 species can be consider for plantation.
- *Commiphora wightii* is a threatened plant species of the study area included in the list to improve the local abundance status.

Table 7.2: List of plant species suggested to plant and improve vegetation cover in and around the mine pits – Aniali mine lease (16.21 ha)

S.No	Species name	Local name	Sp C	FDSp	FSp
1	*Acacia leucopholea*	Harmo baval	WT	6	
2	*Acacia nilotica*	Deshi Baval, Bavar Kalo	WT, ST	7	
3	*Acacia planifrons*	Chhatario Baval	WT-ST		
4	*Acacia senegal*	Kher	WT, ST	5	
5	*Aegle marmelos*	Billi Patra			
6	*Albizzia lebbek*	Shiras	WT	4	
7	*Azadirachta indica*	Limbdo, Neem	CT, MT	6	*
8	*Balanities aegyptia*	Hingar, Ingoriyo		6	
9	*Bauhinia purpurea*	Kanchner	WT, MT		
10	*Bauhinia racemosa*	Asundro	WT, MT	8	
11	*Butea monosperma*	Palas, Kesudo	WT-ST	4	
12	*Commiphora wightii*	Gugal	WT-ST	7 **	
13	*Derris indica*		WT-LT		
14	*Diospyros melanoxylon*	Bidi Patha,	ST	4	
15	*Ficus amplissima*		CT-LT		*
16	*Ficus benghalensis*	Vad	CT-LT	6	*
17	*Ficus racemosa*	Piparo	CT-LT		*
18	*Ficus religiosa*	Umaro	CT-LT	7	*
19	*Helicteres isora*	Maradsing		LH	
20	*Holarrhena antidysenterica*	Indrajav	WT-MT		
21	*Holoptelea integrifolian*	Kanjai, Kanjo, Papada	WT-LT	3	
22	*Leucaena leucocephala*	Lios bavar,	CT-MT	10	
23	*Moringa oleifera*	Mitho saragvo	CT-ST	7	
24	*Magnifera indica*	Ambo, Aam	CT-LT		*
25	*Mitragyna parvifolia*	Kadamb	WT-MT	LH	
26	*Pithecellobium dulce*	Jangali jalabi	CT-LT	8	*
27	*Prosopis cineraria*	Khijaro, Shami		LH	
28	*Salvadora oleoides*	Khari Pelu		4	
29	*Syzygium cumini*	Jambu	WT-LT	7	*
30	*Tamarindus indica*	Ambali, Emali	WT-LT	8	*
31	*Terminalia belerica*	Bhoda	WT, LT	4	
32	*Wrightia tinctoria*	Runchallodudhlo	WT, ST	5	
33	*Zizyphus mauritiana*	Bordi	WT WS	6	
	Total No of Species			**33**	**9**

Sp C = Species Characters: SH=Shrub; WT sp= Wild Tree species; CT sp= Common Tree species; FT = Fruit Tree; ST = Small Tree; LT = Large Tree and MT = Medium Tree. FDsp = Fodder species, Numbers denote the fodder value (1-10 Ratings – higher number better quality for that use compared to other tree species), LHF= locally high fodder value ** Threatened Species

Land reclamation plan need to be implemented simultaneously with mining activities as per mining plan.

7.3.3 Grass plot development to increase the fodder availability

(**Impact 5**): In order to improve the fodder availability some of the grass species suggested to grow (**Table 7.3**) within the plantation area proposed by the IBM as silvopastural adaptation in the initial phase. Wherever, mining is completed, within that area (preferably flat terrain) these grass species can also grown simply sowing grass seeds in pellet form after plowing the at sub-surface level before the onset of monsoon season in phase manner. This can provide fodder for the local livestock and thereby reduce grazing pressure in Naliyadhar Reserved Forest area.

Table 7.3: List of grass species suggested to develop grass plots- Aniali Mine lease (16.21ha)

S.No.	Grass Species	Local Name	M - L Saline
1	*Apluda mutica*		
2	*Cenchrus biflorus* +	Dhaman	*
3	*Cenchrus ciliaris*	Jhinu Dhamnu	
4	*Cenchrus setigerus*	Dhaman Ghas, Dhamnu	
5	*Chloris barbata*	Siyar Puchh	*
6	*Chloris tenelia* Roxb. +		
7	*Chrysopogon fulvus* +		
8	*Cymbopogon martini*+	Kuyad	*
9	*Cynodon dactylon*	Dhrab	
10	*Desmostachya bipinnata*	Darab	
11	*Dendrocalamus strictus*	Bamboo	
12	*Dactyloctenium aegypticum*		
13	*Dichanthium annulatum*	Jinjavo	*
14	*Eleusine compressa*	Madhanu	*
15	*Eragrostis ciliaris*	Murmur	*
16	*Eragrostis Poaeoides*	-	*
17	*Eragrostis tenella*	Kalavo,Limor	*
18	*Eragrostis unioloides* +		
19	*Heteropogon contortus*+	Kagadiu,Sukhli	
20	*Sporobolus helvolus* +		
21	*Sporobolus marginatus*+	Dhrabad	*
22	*Urochondra setulosus* +	Khariyu Gas	*

*** Saline tolerant species, + species not reported in the area sampled and suggested as additional species**

- A total of 22 grass species were suggested to develop grass plot within the area mined out. Of that, 13 species reported within the area sampled and rest 9 species added to increase the species richness and also development option
- Among the species 10 species are salinity resistance and thereby suit to the local environmental condition and act as promising species.
- In addition, among the 33 tree species suggested to plant under habitat improvement program 22 are used as fodder species (Hocking 1993) and therefore this mitigatory measure will provide significant fodder resource to the local live stock and thereby minimize the grazing pressure in the sanctuary area and adjacent Naliyadhar Reserved forest due to conversion of waste land for the excavation of mineral resource.

7.3.4 Disturbance to the aquatic ecosystem and biodiversity- Mine lease area

(**Impact 6, 7 & 8**) Absence of permanent and larger extent of natural water bodies (perennial rivers, streams and lakes) within the proposed mine lease area, impacts like loss of potential aquatic habitats, associated aquatic fauna (mainly aquatic bird species) are not likely to happen.

7.3.5 Disturbance to the aquatic ecosystem of the Sanctuary area

(**Impact 9**) Bothe the water bodies Khambhalia and Minsar River identified within 10 km radius of the proposed project sites area located far from the mining site (7-5.6 km **refer Table 6.3**). Further the Khambhaliya dam water located in the sanctuary area situated in the upper reaches of the Barad hills, hence it is totally free from the project related impacts and hence no any mitigation need to be adopted.

7.3.6 Impact on ground and surface water resources - Mainland

The proposed ultimate mine pit depth is 7.75 mt deep which is well above the ground water resources (20.0 mt). The existing small seasonal water courses are also not joining /connected with any other perennial water resources of main land. The mined out limestone and mine waste will not contain any hazardous toxicity contents. No storm water runoff is anticipated from mine pits and worst come

situation of heavy downpour, mine water will be collected in soak pits and get filtered. Due to these reasons, the impacts of contamination of surface and ground water resources (**Impact 10, 11 &12**) are not visualized.

7.3.7 Creation of external dumps and impact on land resources

Though, the proposed mining activity does not generate any external dumps of mine waste due quality of limestone and its nature of deposition, it needed place to store the useable mineral temporarily as mineral dumps. In order to avoid the additional place requirements (**Impact 14),** runoff contamination (**Impact 15**) and visual intrusion (**impact16**) which are not significant impacts, the following mitigatory measures are suggested to free from these minor disturbances:

- Excavated usable mineral should be stored within the area earmarked for storing without taking additional land area
- Select the area within the mine pit to control the runoff water during rainy season
- Keep the mineral dumps with limited height not exceeding the height of the adjacent vegetation cover to avoid visual intrusions.

7.3.8. Effects of noise due to drilling, blasting and vehicular movement on faunal groups

The estimated cumulative noise level generated due to continuous drilling and vehicular movement was 51.3 and 55.26 dB (A) for the Aniali village and Sanctuary area respectively. Short Duration Impulse Noise Source due to blasting will be 47.2 dB (A) for villages, while 50.07 dB (A) for sanctuary (**Table 6.5 & 6.5**). Since the sanctuary located far from the project the impact will be Negligible. Whereas in case of Naliyadhar reserved forest it will have moderate disturbance due its close proximity.

*I*n spite of adopting some controlled blasting techniques and precautionary measurements, this noise pollution likely to have very minimal impact on sanctuary and moderate level on Naliyadhar reserved forest. However, this can be further

minimized using some biological interventions. Extensive afforestation program with appropriate plant species can take care of the impact on normal behavior of faunal groups (**Impact 17**) of project environment as well as sanctuary area.

- The plants species listed in **Table 7.4** perform vital role in control noise pollution due to their thick and fleshy leaves and vibrating nature (Saxena 1991). A total of 18 tree species have been identified and suggested to grow to control noise level generated due to drilling and blasting activities

- These species area very common species, locally available and reported in the study area and thereby ensure the high survival rate.

- Among these 7 species (*Albizia lebbeck, Azardirachta indica, Ficus religiosa, Melia azedarch, Phoenix dactylifera, Polyanthia longifolia and Terminallia arjuna)* can perform the bio-filter action to absorb So_2 emission also.

- Therefore those species listed below (**Table 7.4**) are suggested to grow specifically along the mine lease boundary as an additional shelter belt plantation.

- In addition, following the afforestation programs suggested above will also provide habitat for many faunal groups and improve the overall faunal diversity in and around the project area.

Table 7.4: List of plant species suggested to control Noise pollution and absorb gas ($S0^2$ emission)

S.No	Scientific Name	Common & Local Name	Performance	
			CN	OGE
1	*Aegle marmelos*	Billi Patra	*	
2	*Albizia lebbeck*	Siris, Karo Sirish	*	+
3	*Azardirachta indica*	Neem	*	+
4	*Butea monosperma*	Palas, Kesudo	*	
5	*Derris indica*	Karanj	*	
6	*Diospyros melanoxylon*	Bidi Patha, Bidije Panjo Zad,	*	
7	*Ficus benghalensis*	Banyan, Vad	*	
8	*Ficus religiosa*	Peepal, , Piplo	*	+

S.No	Scientific Name	Common & Local Name	Performance	
			CN	OGE
9	*Ficus racemosa*	Piparo	*	
10	*Melia azedarch*	Melia, Bakani Nim	*	+
11	*Phoenix dactylifera*	Khajoor	*	+
12	*Polyanthia longifolia*	Ashoka, Asopalav	*	+
13	*Salvadora oleoides*	Piludi, Mithi	*	
14	*Salvadora persica*	Pilu-Khari	*	
15	*Syzygium cumini*	Jamun, Jambu	*	
16	*Tamarindus indica*	Ambali Jo Zad, Ambali, Emali	*	
17	*Terminallia arjuna*	Arjun Sadad	*	+
18	*Terminalia belerica*	Behda	*	
	Total species		**18**	**7**

*** CN –Control Noise level, OGE – Absorb Gas emission (+ So_2), Source of Plant Species: (Sexena 1991)**

In addition to the above given mitigatory measures, other technical interventions will be followed by the TCL authorities to control the noise pollution due to different sources are given in following **Table 7.5.**

Table 7.5: Details of technical mitigatory measures to minimize the impact of noise

Source of noise	Mitigatory Measures – technical
1. Generation of Noise due to movement of vehicles and equipments.	• Ensuring all machines used for site clearing are well maintained and regularly serviced. • The vehicles used will be with the standard limiting noise output.
2. Generation of noise during blast hole drilling	• TCL is already adopting innovative approaches of using improvised plant and machinery design with in-built mechanism to reduce sound emissions like improved silencers, mufflers and closed noise generating parts. • Specifically, noise from compressors will be minimized by sound maintenance of the equipment and by providing enclosures.
3. Generation of noise pollution during crushing operation.	• Regular and proper maintenance of noise generating machinery including the transport vehicles and belt conveyors to maintain noise levels. • Provision would be made for noise absorbing pads at foundations of vibrating equipment to reduce noise emissions.
4. Generation niose due to blasting	• Adoption of suitable explosive charge and short delay detonators, adequate stemming of holes at collar zone and avoiding blasting on foggy days, at night times and at the time of high wind

Source of noise	Mitigatory Measures – technical
	speeds. • Restricting blasting to a particular time of the day i.e. during lunch hours, so that humans (other than authorized persons) are away during the blasting. • Restricted blasting hour ensure the movements of faunal groups rest of day and night hours • Reducing ground vibrations by controlling charge per hole as well as charge per round of hole. • Adopting muffling (i.e. covering the blast holes by sand bags) when the distance from important features/ ecologically sensitive area is less than 500m.

7.3.9 Dust emission due mining related activities

The maximum 24 hour average GLC within the study area, due to emission from mining operation is estimated to be **6.05 (µg/m³)**. This GLC is expected to occur at a distance of 2**00 m** from the source towards the **East** direction within the lease area. Barda wildlife Sanctuary lying at the distance of 3920 meter (North) from lease area has predicated increase in SPM found to be negligible.

The nearest Village is Bordi at a distance of 2230 meter in North direction has found in increase in SPM around Nil. Though, the estimated dust emission will be very minimal it is suggested to adopt bio-filter mitigatory measures to avoid the impact on vegetation cover of the sanctuary area and Naliyadhar Reserved forest and dependent faunal species (**Impact 18 & 19**).

- The following list of plant species suggested includes trees species of wild, common and species of ornamental values. The level of dust control efficiency of these species ranges from minimum of 6.12% by *Accacia nelotica* to maximum of 35.01% by *Holoiptelea integrifolia*.
- The area of plantation suggested mainly identified focused on four locations: mine boundary towards sanctuary side, towards main land side, along the road side where the vehicle pressure likely to increase during the mining activities and mine lease office and close to labour's settlements (**Table 7.6**).

- In each location, a wider range plant species from 12-17 species were suggested to maintain the floral diversity and improve the survival rate.
- Among the location identified, location 1&2 include mine boundaries to avoid dust emission into sanctuary and towards the village side respectively. The species list includes predominately wild and few common tree species with high rate of dust control efficiency (*Cassia fistula-23.03%, Butea monosperma-24.44%, Azardirachta indica-25.54. Polyalthia longifolia- 29.84%, Terminalia catappa -30.12%, Terminalia arjuna -30.54%. Melia azedarch-31.77% Phoenix dactylifera, 32.07%,Holoptelea integrifolia 35.01%)*. **Table 7.6**.
- Location 3 to control the dust generated due to vehicle movement in the cart or haul roads within the mining area which are likely to generate dust during the operational phase of the proposed project. Most of the species suggested are common tree species.
- Location 4&5 include the area of mine office and labour settlements. 12 tree species are recommended to protect the people working in the mining activity and some species are mainly bearing fruit and ornamental species to improve the aesthetic value
- *Ficus benghalensis, Annona squamosa, Mangifera indica, Ficus religiosa, Syzygium cumini and Manilkara zapota* are fruit bearing species can support frugivorus bird species.

Table 7.6: List of Plant Species to Control Dust (Particulate matter) in and Around the Project area – Aniali Mine Lease (16.21 ha).

SNo	Scientific Name	Common & Local Name	%of DC	Location			
				1	2	3	4 & 5
1	*Accacia nelotica*	Babul, Deshi Baval,	6.12	*			
2	*Ficus benghalensis*	Banyan, Vad	7.72	*	*	*	*
3	*Leucaena leucocephala*	Shoe Babool, Liso bavar	11.24		*		
4	*Annona squamosa*	Sugar apple, Jamfal	12.09		*	*	*
5	*Mangifera indica*	Mango, Aam	12.25		*	*	*
6	*Ficus religiosa*	Peepal, Piparo, Piplo	12.94	*	*	*	*
7	*Syzygium cumini*	Jamun, Jambu	14.39	*	*		*
8	*Tectona grandis*	Teak, Sag, Sagado	14.94	*			
13	*Manilkara zapota* - +	Chikkoo	16.39				*
9	*Dalbergia sissoo* +	Shesham	17.02	*			
10	*Delonix regia*	Gulmohar	18.05		*	*	*
15	*Albizia lebbeck*	Siris, Karo Sirish	18.3	*		*	

SNo	Scientific Name	Common & Local Name	%of DC	Location			
				1	2	3	4 & 5
16	*Ixora parviflora* +	Torch Tree	18.45	*		*	
17	*Bauhinia variegata* - +	Kanchnar	18.58	*			
18	*Aegle marmelos*	Bel, Bili Patra, Bili	18.9	*		*	
19	*Pithecolobium dule*	Jangali jalabi	19.21		*	*	
12	*Hibiscus rosa- sinensis(Sh)*+	Gurhal, Jasund	21.09				*
11	*Bougainvilliea glavra(St)* +	Bougainvilliea, Boganvel	21.35				*
20	*Cassia fistula*	Amaltas	23.03	*	*	*	*
21	*Butea monosperma*	Palas, Kesudo	24.44	*	*	*	
22	*Azardirachta indica*	Neem	25.54	*		*	
14	*Polyalthia longifolia*	Ashoka, Asopalav	29.84			*	*
23	*Termanilia catappa*	Desi Badam	30.12		*		*
24	*Terminalia arjuna*	Arjun Sadad	30.54	*		*	
25	*Melia azedarch* - +	Melia, Bakani Nim	31.77	*	*	*	
26	*Phoenix dactylifera* - +	Khajoor	32.07	*			
27	*Holoptelea integrifolia*	Kanjo, Papada	35.01	*	*	*	
	Total			**17**	**13**	**16**	**12**

Locations: 1- mine lease boundary towards sanctuary side, 2- Mine lease boundary towards main land. 3- Haul roads within the mining area, 4- Area around mine office., 5 – Close to labour's settlements, + - species reported locally, %DC – Percent of Dust Control efficiency

In addition to the plantation program some of technical management interventions will be adopted by the TCL authorities is given in **Table 7.7**.

Table 7.7: Details of technical mitigatory measures to minimize the impact of Dust emission.

Source of dust emission	Mitigatory Measures – technical
1.Dust emission particularly due to the site clearing and related vehicular movement	• Provision of spraying water to reduce dust emission on roads • Ensuring all machines used for site clearing are well maintained and regularly serviced to mini-mize emissions in the air. • Equipment used should have sharp bit and tools.
2.Generation of air emissions during blast hole drilling	• Sharp drill bits will be used for drilling holes • Wet drilling method will be used • Driller will be provided all PPE's like dust masks • Use Ultra-low Sulphur HSD for operating compressors used in blast hole drilling
3.Loading of limestone in tipper trucks will create dust emissions	• Sprinkling water on muck pile may reduce air pollution. • Loading material in dumpers at optimum height to reduce dust blow
4.Generation of air emission during crushing operation.	• Water sprinkling system will be provided to check any fugitive emissions from the crushing

Source of dust emission	Mitigatory Measures – technical
	operation.
5. Transportation activity will increase the traffic in the study area and on haul roads	• All vehicles will be tested for Pollution under Control (PUC) certificate.

7.3.10 Vehicle movements and associated impacts

The proposed mining activity do not involved development of any additional rode within the sanctuary area and in the main land therefore loss of vegetation and faunal groups were not envisaged due to this proposed project (**Impact 20 & 21**).

However, the expected cumulative increase in vehicle pressure (30 **trucks trips/day** from the proposed mining site to TCL at Mithapur may have very minimal impact due to increase of very few vehicles and low species richness and abundance of faunal group in Buffer zone outside sanctuary. Even though, this can be bring it to zero level through adopting the following mitigations at the management level (**Impact 23**).

- Covering the loaded trucks to prevent dust pollution
- Regular water spraying on haulage roads during transportation of material by water sprinklers
- Leveled roads with less number of turns to reduce air emission
- All the mineral transporters should be given strict instruction regarding speed limit while moving in the area with dense vegetation cover
- If necessary proper sigh boards need be placed wherever the roads cutting across any reserved forest or open scrub forest habitats.

7.3.11 Impact on threatened plant

Commiphora wightii is a threatened tree species reported in the sanctuary area (57 pants) and Naliyadhar Reserved forest (23 plants) and 15 individuals reported in core zone. It is one of ten top dominating tree species of the sanctuary area and showed healthy population status (GRRE & GSDF 2002).

This species showed wider distribution (Sabnis and Rao 1983, Hocking 1993 and Bhatt 1993) and very hardy in nature it is threatened due to over exploitation for medicinal

use (Brandis 1974 and Shah 1978). Therefore loss of few plants due to clearing of the mine lease area will not have severe impact (Impact 25 &26). Being a threatened species in order to maintain the population status of the region the following measures are suggested (**Impact 25 &26**).

- *Commiphora wightii* being a threatened flora of the study area in it is suggested to include this plant in habitat improvement and plant within the area prescribed by the IBM.
- This plant can be regenerated by planting cuttings from the mother plant of 30 cm long and 2-3 cm dia are put in nursery bed at the depths of 15-20 cm. After one year, the sproutings are suitable to shift into specific site which will give 70-75% success.
- In addition this plant can also be planted in and around the mine lease and main office gardens.

7.3.12 Impact on threatened fauna

Herpetofauna: In the study area 13 species of herpetofauna were reported of that, of that none of the species come under threatened group. Though crocodiles are other threatened fauna present in some of the water bodies of the sanctuary area, during our survey in Khambhalia dam none of these species encountered. In addition Minsar River also located safer distance from the mine lease and hence no impacts visualized and mitiogatory measures have been discussed.

Avifauna: The study area reported 34 Indian Peafowls but no birds reported from the core zone. Though 7 and 12 birds were reported from the BIS and BNRF due to its abundant, wider distribution and inhabiting diverse habitat types, the impact due to mine related activities may be very minimal due their distant location. Restoration of mining site with suggested tree species may increase this species abundance in the project environ during post operation phase.

Mammalian Fauna: Record of Leopard pug marks in four locations within the sanctuary and Reserved forest area showed its restriction to undisturbed forest habitat. In addition to that, the sanctuary also located more than 3.0 km away from the proposed mining site. Even though, Naliyadhar reserved forest located close to

the project site, the availability of large extent of well protected forest habitat in the Barda Sanctuary on the western side and easy movements of faunal species between these wilderness areas the proposed mining project not likely to threat the survival of this species in terms of loss of habitat.

The adopted blasting technique to excavate mineral resource and associated noise, dust emission related to mining activities assessed to have moderate level impact on flora and fauna. In the absence of conversion of forest land for proposed mining activities and adopting all the mitigatory measures suggested for habitat improvement program, shelter belt development to control noise and dust emission would ensure to minimize the above discussed likely impacts. Further this management plans would facilitate these threatened species to use the mined out area in the post mining phase.

Sea Turtle nesting beaches: Though, Porbandar coast reported few sporadic nesting beaches they are located safer distance from the proposed mine lease area. Further the project activity do not have any venture in the coastal habitat and therefore the proposed mining project has been evaluated as impact free (Imapct 28 &29) on this endangered turtle species and their habitat.

7.3.13 Biotic pressure from labour force

The proposed mining activity plan to engage **100** people as non-technical works and they are likely to stay at mining site. One of the inevitable impacts related to mining is use of basic natural resources from the nearby project environment by the labours like; water, fuel wood, land for their shelter. Sudden influx of labour and extensive use local resources will create resource crunch problem to the local people as well as other fauna species of the project area. In order to avoid these issues the following managerial options are suggested:

- Possibly involve local people to avoid pressure on the natural resources.
- In case of involving outside labour force they need to be provided safer shelter and drinking water by the TCL authorities and thereby avoid depending on the forest resources for the construction of shelters. .

- The people should be allowed to use the wood materials removed from the mine lease area under the ground clearing activity.
- Strict instruction should be given to them not to cut trees from the nearby forest/sanctuary area for their use.
- People should keep under strict vigilance to watch not to indulge in killing and hunting of any animals in and around the project area.

7.3.14 Animal movement

The strategic location of mine lease area in the south- eastern and north-eastern sides and out sides of sanctuary area and of Naliyadhar Reserved forests respectively and absence of any connecting corridor between these wilderness areas, this Aniali mine lease project (**16.21 ha**) not likely to change the normal movement behavior of the existing wildlife of Barda Sanctuary and the Naliyadhar Reserved forest (**Impact 33**).

Further above suggested extensive and different types of plantation activities to control noise and dust emission and plantation for habitat improvement will increase the vegetation cover and diversify of floral species in the post operational phased and ensure the faunal groups to use these mined out areas in future.

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Annexure

Annexure 1: Checklist and Abundance (no of plants in the area sampled) of Plant Species Reported in Aniali Limestone Mine lease (16.21 ha) Study Area of TCL

S. No.	Family & Species	Local Name	Life form	CZ	BZ			OBZ	SA	SRBS
					BIS	BNRF	BOS			
1	**Acanthaceae**									
1	*Andrographis paniculata* (Burn.f) Wall		Herb	0	0	2	0	2	2	*
2	*Astrecantha longifolia* Nees		Herb	0	3	0	0	3	3	
3	*Barleria prionitis* L. var. *prionitis*	Kantashelio	Shrub	0	1	10	0	11	11	*
4	*Blepharis repens* (Vahl) Roth	Haran Charo, Zinku Utingan	Herb	0	21	6	4	31	31	*
5	*Blepharis linariaefolia* Pers.	-	Herb	0	2	7	0	9	9	
6	*Dipteracanthus patulus* (Jacq.) Nees	-	Herb	0	37	19	27	83	83	*
7	*Elytraria acualis* (L.f.) Lindau	Pat Pathari	Herb	0	36	0	0	36	36	*
8	*Justicia procumbens* L.	-	Herb	5	109	66	5	180	185	*
9	*Justicia simplex* D.Don,.	Kari Andhedi, Kali Kariatu	Herb	3	18	0	0	18	21	*
10	*Lepidagathis trinervis* Wall.	Haran Cahro	Herb	11	39	28	10	77	88	*
11	*Neuracanthus trinervius* Wt.	Ganthera	Herb	0	5	0	0	5	5	*
12	*Peristrophe bicalyculata* (Retz.) Nees	Kari Adhedi, Adhedi, Lisi Adhedi	Herb	0	6	10	0	16	16	*
2	**Amaranthaceae**									
13	*Achyranthes aspera* L. var. *argentea* Hook. f.	Andhedi, Anghedo	Herb	0	0	0	4	4	4	*
14	*Amaranthus viridis* L.	Tandaljo	Herb	0	0	0	6	6	6	*
15	*Pupalia lappacea* (L.) Juss.	Zipto Safed	Under Shrub	0	2	0	0	2	2	*
3	**Ancardiaceae**									
16	*Magnifera indica* L.	Ambo	Tree	0	0	0	31	31	31	*
4	**Annonaceae**									
17	*Annona squamosa* L.	Sitafal	Small Tree	0	0	0	9	9	9	*
18	*Annona reticulate* L.	-	Tree	0	0	0	1	1	1	*
19	*Polyalthia longifolia (Sonn.) Thw.*	Ashok	Tree	0	0	0	5	5	5	*
5	**Apocynaceae**									
20	*Carissa congesta* Wt.	Karmada	Tree	2	27	11	0	38	40	*
21	*Catharanthus roseus (L.)G.Don.Gen.Syst.*	Sadafuli	Under Shrub	0	0	0	4	4	4	*
22	*Holarrhena antidysenterica* (Heyne ex Roth) Wall.	Indrajav	Small Tree	0	15	1	0	16	16	*

S. No.	Family & Species	Local Name	Life form	CZ	BZ			OBZ	SA	SRBS
					BIS	BNRF	BOS			
23	*Wrightia tinctoria* R.Br.	Dudhio	Tree	0	2	2	0	4	4	*
6	**Arecaceae**									
24	*Areca catechu L.*	-	Tree	0	0	0	5	5	5	
25	*Cocus nucifera* L.	Narial	Tree	0	0	0	66	66	66	*
26	*Phoenix sylvestris* (L.) Roxb.	Khejur	Tree	0	0	0	9	9	9	*
7	**Asclepiadaceae**									
27	*Calotropis procera* (Ait.) R. Br.	Ankado	Shrub	0	0	0	12	12	12	*
28	*Pentatropis spiralis* (Forsk.) Decne	-	Climber	0	14	8	3	25	25	*
29	*Pergularia daemia* (Forsk.) Chiov.	Chamar Dudheli	Twiner	0	2	0	0	2	2	*
30	*Wattakaka volubilis* (Linn.)	Padalbel,Dang dodhi	Shrub	0	0	2	0	2	2	
8	**Asteraceae**									
31	Asteraceae sp.	-	Herb	0	2	0	0	2	2	*
32	*Blainvillea acmella* (L.) Philip.	Dhlufuladu	Herb	0	0	3	5	8	8	*
33	*Blumea* sp.	-	Herb	0	0	1	0	1	1	*
34	*Echinops echinatus* Roxb.	Utkanto	Under Shrub	36	0	0	58	58	94	*
35	*Eclipta prostrata* (L.) L. Mant.	Bhangaro	Herb	0	4	0	3	7	7	*
36	*Launaea procumbens* (Roxb) Ram.& Raj.	Moti Bhoyan Patri	Herb	0	0	0	3	3	3	
37	*Launaea resedifolia* (L.) Druce	-	Herb	0	0	0	8	8	8	*
38	*Parthenium hysterophorus* L.	Congres Gas	Herb	0	0	0	5	5	5	*
39	*Pulicaria wightiana* (DC.) Cl.	Sonfulki, Sisoria	Herb	0	142	19	0	161	161	*
40	*Sonchus asper* Hill.	Son chudi	Herb	0	0	0	8	8	8	
41	*Tridax procumbens* L.	Pardeshi Bhangro, Kaliyu Khor	Herb	25	15	1	26	42	67	*
42	*Vernonia cinerea* (L.) Less.	Sahdevi	Herb	0	54	18	43	115	115	*
43	*Vernonia cinerascens Sch.-Bip.*	Vadi Sadedi	Under Shrub	0	0	2	0	2	2	*
44	*Xanthium strumarium* L.	Gadariyun	Herb	0	2	0	0	2	2	*
9	**Balanitaceae**									
45	*Balanities aegyptia* (Linn.)	Hingor, Ingoriyo	Small Tree	30	14	70	7	91	121	*
10	**Bombacaceae**									
46	*Bombax malabaricum* DC.		Tree	0	0	0	4	4	4	*
11	**Boraginaceae**									
47	*Heliotropium indicum* L.	Hathi Sundho	Herb	0	0	0	6	6	6	*

S. No.	Family & Species	Local Name	Life form	CZ	BZ			OBZ	SA	SRBS
					BIS	BNRF	BOS			
48	*Heliotropium ovalifolium* Forsk.	Velalun Hathi Sundho	Herb	0	0	0	19	19	19	*
12	**Brassicaceae**									
49	*Farsetia jacquemontii* Hk.f. &Th.	-	Herb	0	1	0	0	1	1	
13	**Burseraceae**									
50	*Commiphora wightii* (Arn.) Bhandari	Gugal	Small Tree	15	57	23	18	98	113	*
14	**Caesalpiniaceae**									
51	*Bauhinia purpurea* L.	Kanchner	Tree	0	8	2	0	10	10	*
52	*Bauhinia racemosa* L.	Asundro	Small Tree	0	3	2	0	5	5	*
53	*Cassia auriculata* L.	Aval	Shrub	109	60	27	112	199	308	*
54	*Cassia pumilla* Lam.	Nani Chimed , Bethi Chimed	Herb	0	2	0	3	5	5	*
55	*Cassia tora* Linn.	Kunwario	Herb	2	35	26	11	72	74	*
56	*Medicago lupulina* L.		Herb	0	0	0	4	4	4	
57	*Tamarindus indica* L.	Ambali	Tree	0	2	0	1	3	3	*
15	**Capparaceae**									
58	*Capparis decidua* (Forsk.) Edgew.	Kerdo,Kera	Shrub	34	2	10	50	62	96	*
59	*Capparis sepiaria* L.	Kanther	Straggling Shrub	0	3	8	0	11	11	*
60	*Maerua oblongifolia* (Foeak.) A. Rich.	Hemkand	Shrub	0	1	19	1	21	21	*
16	**Caricaceae**									
61	*Carica papaya* L.	Pappaya	Tree	0	0	0	8	8	8	*
17	**Celastreceae**									
62	*Maytenus emarginata* (Willd.) D. Hou	Vicklo	Shrub	0	2	33	0	35	35	*
18	**Combretaceae**									
63	*Terminalia belerica* (Gaertn.) Roxb.	Behda	Tree	0	1	0	0	1	1	*
64	*Terminalia catappa* L.	Deshi Badam	Tree	0	0	0	4	4	4	*
19	**Commelinaceae**									
65	*Commelina diffusa* Burm.f.Fi.	Shihmuliu	Herb	0	0	0	13	13	13	*
66	*Commelina benghalensis* L.	Moti shumliyu	Herb	0	0	1	0	1	1	*
20	**Convolvulaceae**									
67	*Convolvulus arvensis* L.	Nerivel	Herb	0	0	3	0	3	3	*
68	*Evolvulus alsinoides* (L.) L. var. alsinoides	Kari Sankhavail	Herb	0	25	0	0	25	25	*
69	*Ipomoea pes-tigridis* L.	Vad padi	Twiner	0	0	0	2	2	2	*
70	*Merremia tridentata* (L.) Hall.f.subsp. *Tridentata*	Topriyal, Bhinigario	Herb	0	10	0	0	10	10	
71	*Rivea hypocrateriformis* Choisy	Fang	Climber	0	4	2	0	6	6	*
21	**Cyperaceae**									

S. No.	Family & Species	Local Name	Life form	CZ	BZ			OBZ	SA	SRBS
					BIS	BNRF	BOS			
72	*Cyperus rotundus* L. subsp. *rotundus*	Moth, Chido	Sedge	0	10	0	75	85	85	*
73	*Cyperus alopecuroides* Rottb.		Sedge	0	0	0	14	14	14	
74	*Cyperus* sp.	-	Sedge	0	4	0	0	4	4	*
75	*Scirpus lateriflorus* Gmel.		Sedge	0	0	0	1	1	1	
22	**Ebenaceae**									
76	*Diospyros melanoxylon* Roxb.	Timbaru	Tree	0	12	0	0	12	12	*
23	**Ehretiaceae**									
77	*Cordia dichotoma* Forst.	Vad Gundo	Tree	0	0	0	7	7	7	*
78	*Cordia gharaf* (Forsk.) E.&.A.	Nana Gunda, Liar Gundi	Tree	0	0	0	23	23	23	*
79	*Cordia perrottrii* Wight	-	Small Tree	0	5	1	0	6	6	*
80	*Ehretia aspera* Roxb.	Nani vadhawrdi	Tree	0	14	2	0	16	16	*
24	**Elatinaceae**									
81	*Bergia ammannioides* Roxb.ex Roth .	Jal Ukharad	*Herb*	2	0	0	0	0	2	*
25	**Euphorbiaceae**									
82	*Dalechampia scandens* L. var. *cordofana*	-	Twiner	0	8	13	0	21	21	*
83	*Euphorbia hirta* L.	Vadi Dudheli, Kalu Ganthiu	Herb	4	0	0	32	32	36	*
84	*Euphorbia neriifolia* L.	Thor	Shrub	0	42	0	0	42	42	*
85	*Euphorbia caducifolia* Hains.	Danda Thor	Shrub	0	54	30	0	84	84	
86	*Kirganelia reticulata* (Poir.) Baill.	Kamboi	Shrub	0	2	0	5	7	7	
87	*Phyllanthus fraternus* Webst.	Kharedi, Bhonya Amli	Herb	0	3	0	3	6	6	*
88	*Phyllanthus maderaspatensis L.*	Kharedi, Bhonya Amli	Herb	0	0	0	3	3	3	*
89	*Ricinus communis* L.		Herb	0	0	0	10	10	10	*
90	*Securinega virosa* (Roxb.ex Willd.) Pax & Hoffm	Pichrun, Safedfali	Straggling Shrub	0	3	0	2	5	5	
26	**Fabaceae**									
91	*Abrus precatorius* L.	Chanothi	Twiner	0	2	0	0	2	2	*
92	*Alysicarpus monilifer* (L.) DC. var. *monilifer*	Nano Sanervo,	Herb	0	0	2	0	2	2	*
93	*Butea monosperma* (Lamk.)Tauh	Kesudo	Tree	0	0	0	3	3	3	*
94	*Clitora ternatea* L.	Gaeni, Bibari, Gokarn	Climber	0	12	2	4	18	18	*
95	*Delonix regia* (Boj.)	Gulmohar	Tree	0	4	0	0	4	4	*
96	*Derris indica* (Lam.) Bennet	Karanj	Tree	0	0	0	1	1	1	*
97	*Goniogyna hirta* (Willd.) Ali	-	Herb	0	7	0	0	7	7	*

S. No.	Family & Species	Local Name	Life form	CZ	BZ			OBZ	SA	SRBS
					BIS	BNRF	BOS			
98	*Indigofera cordifolia* L.	Pat Gari	Herb	150	142	0	11	153	303	*
99	*Indigofera oblongifolia* Forsk.	Zil	Shrub	18	0	0	16	16	34	*
100	*Indigofera tinctoria* L.	Gali	Under Shrub	0	0	20	0	20	20	*
101	*Rhynchosia minima* (L.) DC. var. *minima*	Nahni Kamal Vel, Daria Vel	Climber	0	12	7	0	19	19	*
102	*Tephrosia villosa* (L.) Pers.	Runchhalo sa	Herb	0	5	0	0	5	5	*
103	*Trifolium repens* L.	-	Herb	0	18	0	0	18	18	
27	**Gentianaceae**									
104	*Enicostema axillare* (Lamk.) Roynal	Mamejavo	Herb	0	134	93	0	227	227	*
28	**Lamiaceae**									
105	*Hyptis suaveolens* (L.)	-	Herb	0	4	0	0	4	4	*
106	*Leucas aspera* (Willd.) Spr.	Kubo	Herb	0	16	0	0	16	16	*
107	*Ocimum gratissimum* L.	Vadi Tulsi	Herb	44	1	2	2	5	49	*
108	*Leucas lavandulaefolia Rees*	Kubo Zina pan no	Herb	0	0	0	3	3	3	*
29	**Liliaceae**									
109	*Aloe barbadensis Mill.*		Shrub	0	0	0	3	3	3	*
110	*Dipcadi montanum* (Dalz.) Baker.	Jangali Dungari	Herb	1	0	14	5	19	20	
111	*Asparagus racemosus* Willd. var. *javanicus* (Kunth) Baker	Akal Kandha ni Val	Shrub	0	3	2	0	5	5	*
30	**Lythraceae**									
112	*Ammannia baccifera* L.	Jal Agio	Herb	0	2	0	0	2	2	*
31	**Malvaceae**									
113	*Abutilon indicum* (L.) Sw.	Khapat	Under Shrub	0	0	0	1	1	1	*
114	*Abutilon ramosum Guill.,Perr.et A. Rich.*	-	Under Shrub	0	0	0	10	10	10	*
115	*Hibiscus ovalifolius* (Forsk.) Vahl	Chanak,Bhindo	Under Shrub	0	10	3	0	13	13	*
116	*Thespesia populnea (L.)Sol.ex. Corr.*	Paras Piplo	Tree	0	0	0	3	3	3	*
117	*Pavonia zeylanica* Cav.	-	Herb	0	1	0	0	1	1	*
118	*Sida cordata* (Burm. f.) Borss	Bhoy Bala	Herb	0	21	17	0	38	38	*
32	**Meliaceae**									
119	*Azadirachta indica* A. Juss.	Limdo	Tree	2	5	11	29	45	47	*
33	**Menispermaceae**									
120	*Cocculus hirsutus* (L.) Diels	Gandhari,Vevdi	Straggling Shrub	0	0	13	10	23	23	*
121	*Cocculus pendulus* (Forst.) Diels	Valur,Parwatti	Straggling Shrub	0	0	0	3	3	3	*

S. No.	Family & Species	Local Name	Life form	CZ	BZ			OBZ	SA	SRBS
					BIS	BNRF	BOS			
122	*Tinospora cordifolia (Willd.)*	Gulvel	Twiner	0	0	2	1	3	3	*
34	**Mimosaceae**									
123	*Acacia leucopholea* Willld.	Harmo baval	Tree	0	23	9	0	32	32	*
124	*Acacia nilotica* (L.) Del. Sub sp. *indica* (Bth.) Brenan	Deshi Baval	Tree	53	42	23	31	96	149	*
125	*Acacia planifrons* Koen.ex Wt.	Chhatario Baval	Tree	0	4	5	0	9	9	*
126	*Acacia senegal* Willd.	Kher	Tree	1	404	330	6	740	741	*
127	*Albizia lebbeck* Benth.	Karo Sirish	Tree	0	0	0	3	3	3	*
128	*Dichrostachya cinerea* (L.)W.& A.	Madhad	Shrub	0	2	8	0	10	10	*
129	*Leucaena latisiliqua (L.) Wt.& Arn.*	Pardeshi baval	Tree	0	0	0	4	4	4	*
130	*Leucaena leucocephala* (Lam.)	Pardeshi baval	Tree	0	2	0	0	2	2	*
131	*Pithecellobium dulce* (Roxb.) Bth.	Goras Amali	Tree	0	0	0	21	21	21	*
132	*Prosopis cineraria* (L.) Druce	Khijado, Shami	Tree	0	0	0	3	3	3	*
133	*Prosopis juliflora* (Sw.) DC.	Gando Baval	Small Tree	47	0	5	141	146	193	*
35	**Molluginiaceae**									
134	*Mollugo pentaphylla L.*	-	Herb	0	0	0	13	13	13	*
135	Molluginiaceae sp.	-	Herb	12	0	0	0	0	12	
36	**Moraceae**									
136	*Ficus benghalensis* L.	Vad	Tree	4	0	0	21	21	25	*
137	*Ficus racemosa* L.	Umaro	Tree	0	1	0	6	7	7	*
138	*Ficus microcarpa* L. f.	Prag vad	Tree	0	0	0	5	5	5	*
139	*Ficus amplissima* Sm.		Tree	0	0	0	2	2	2	
37	**Moringaceae**									
140	*Moringa oleifera* Lam.	Mitho Saragvo	Tree	0	0	0	5	5	5	*
38	**Musaceae**									
141	*Musa paradisiaca* L.	Kera	Small Tree	0	0	0	3	3	3	*
39	**Myrtaceae**									
142	*Eucalyptus globulus* Labill.	Nilgiri	Tree	0	0	0	12	12	12	*
143	*Psidium guajava* L.	Jayphal	Tree	0	1	0	14	15	15	*
144	*Syzygium cumini* (L.) Skells	Jambu	Tree	0	0	0	8	8	8	*
40	**Nyctaginaceae**									
145	*Boerhavia diffusa* L.	Satodi	Herb	0	0	10	0	10	10	*
146	*Bougainvillea glabra* Choisy	-	Shrub	0	0	0	5	5	5	
147	*Commicarpus verticillatus* (Poir.)		Herb	0	0	1	0	1	1	

S. No.	Family & Species	Local Name	Life form	CZ	BZ			OBZ	SA	SRBS
					BIS	BNRF	BOS			
	Standl.									
41	**Periplocaceae**									
148	*Hemidesmus indicus* (L.) Schult.	Dudheli	Twiner	0	6	0	0	6	6	*
149	*Periploca aphylla* Decne	Singdio , Rati - Khip	Under Shrub	0	1	0	0	1	1	*
42	**Plumbaginaceae**									
150	*Dyerophytum indicum* (Gibs. Ex Wt.) O. Ktze.		Under Shrub	0	2	16	0	18	18	*
151	*Plumbago Zeylanica* L.	Chitrak	Under Shrub	2	1	10	0	11	13	*
43	**Poaceae**									
152	*Apluda mutica* L.	-	Grass	0	280	0	15	295	295	*
153	*Aristida adscensionis* L. subsp. *adscensionis*	Laso Lampdo	Grass	214	804	97	137	1038	1252	*
154	*Aristida funiculata* Trin. & Rupr.	Lampdu	Grass	45	379	204	0	583	628	*
155	*Bothriochloa pertusa* (L.)A. Camus	Zenzvo	Grass	0	0	95	6	101	101	*
156	*Cenchrus ciliaris* L.	Dhaman, Jhinu Dhamnu	Grass	0	31	0	0	31	31	*
157	*Cenchrus setigerus* Vahl	Dhaman Ghas, Dhamnu	Grass	0	0	2	13	15	15	*
158	*Chloris barbata* Sw.	Siyar Puchh	Grass	4	0	14	9	23	27	*
159	*Cynodon dactylon* (L.) Pers.	Dhrab	Grass	0	97	7	376	480	480	*
160	*Dactyloctenium aegypticum* (L.) P. Beauv.	-	Grass	0	0	0	12	12	12	*
161	*Dendrocalamus strictus* Nees	-	Grass	0	0	5	4	9	9	*
162	*Desmostachya bipinnata* (L.) Stapf	Darab	Grass	0	0	0	23	23	23	*
163	*Dichanthium annulatum* (Forak.) Stapf	Jinjavo	Grass	0	32	5	48	85	85	
164	*Dinebra retroflexa* (Vahl) Panz	-	Grass	0	0	0	6	6	6	*
165	*Eleusine compressa* (Forsk.) Aschers. & Schweinf.	-	Grass	0	0	17	34	51	51	*
166	*Elyonurus royleanus* Nees ex A. Rich.	-	Grass	0	25	0	0	25	25	
167	*Eragrostis ciliaris* (L.) R.Br. var.*ciliaris*	Murmur	Grass	79	0	38	0	38	117	*
168	*Eragrostis Poaeoides P. Beauv.*	-	Grass	43	224	17	0	241	284	
169	*Eragrostis tenella* (L.)Beauv ex Roem & Schult	Kalavo,Limor	Grass	0	18	7	0	25	25	*
170	*Melanocenchrus jacquemontii* J. & S.	-	Grass	0	59	25	0	84	84	*

S. No.	Family & Species	Local Name	Life form	CZ	BZ			OBZ	SA	SRBS
					BIS	BNRF	BOS			
171	*Panicum* sp.	-	Grass	0	2	0	15	17	17	*
172	UI Grass	-	Grass	8	3	0	0	3	11	*
44	**Punicaceae**									
173	*Punica granatum* L.	Dadam	Small Tree	0	0	0	6	6	6	*
45	**Rhamnaceae**									
174	*Zizyphus glaberrima* Sant.	-	Small Tree	0	1	0	0	1	1	*
175	*Zizyphus nummularia* (Burm. F.) W. & A.	Chani Bor	Under Shrub	157	80	61	111	252	409	*
176	*Zizyphus mauritiana* Lam.	Bordi	Tree	0	0	0	7	7	7	*
177	*Zizyphus xylopyrus* Willd.	Ghot Bor, Ghat Bor	Small Tree	0	22	1	2	25	25	*
46	**Rubiaceae**									
178	*Borreria articularis* (L.f.) F.N. Will.	Ganthiyu	Herb	0	11	11	0	22	22	*
179	*Borreria stricta* (L.f.)	-	Herb	50	89	56	0	145	195	*
180	*Gardenia recinifera* Roxb.	Dikamari	Small Tree	0	1	0	0	1	1	*
181	*Ixora arborea* Roxb.ex Sm.in Rees,	Naveri	Small Tree	0	8	0	0	8	8	*
182	*Mitragyna parvifolia* Korth.	Kadamb	Tree	0	9	1	0	10	10	*
183	*Morinda tomentosa* Heyne ex Roth.	Aal	Tree	0	1	0	0	1	1	*
184	*xeromphis spinosa* (Thunb.)	Mindhol	Shrub	0	5	7	0	12	12	*
47	**Rutaceae**									
185	*Aegle marmelos* (L.) Corr.		Small Tree	0	0	0	1	1	1	*
186	*Citrus limon* (L.) Burm. f.	Limbu	Small Tree	0	0	0	5	5	5	*
187	*Murraya koenigii (L.)*	Mitho Limbado, Kadi Patta	Small Tree	0	0	0	2	2	2	*
48	**Salvadoraceae**									
188	*Salvadora persica* L.	Pilu	Tree	0	0	0	2	2	2	
189	*Salvadora oleoides* Decne.	Pilu	Tree	1	0	7	0	7	8	*
49	**Sapindaceae**									
190	*Cardiospermum halicacabum* L.	-	Herb	0	1	0	0	1	1	*
50	**Sapotaceae**									
191	*Manilcara hexandra* (Roxb.)Dubard	Rayan	Tree	0	14	9	2	25	25	*
192	*Manilkara zapota* (L.) van Royen	Chiku	Tree	0	0	0	17	17	17	*
51	**Solanaceae**									
193	*Physalis minima* L.	Popti	Herb	0	0	0	1	1	1	*
194	*Solanum sp.*		Herb	0	0	0	1	1	1	*

S. No.	Family & Species	Local Name	Life form	CZ	BZ			OBZ	SA	SRBS
					BIS	BNRF	BOS			
52	**Sterculiaceae**									
195	*Helicteres isora* L.	Maradsing	Tree	0	18	0	0	18	18	*
196	*Melhania futteyporensis* Munro ex Masters var. *futteyporensis*	Adbau Khpat	Tree	0	0	6	0	6	6	*
53	**Tiliaceae**									
197	*Corchorus aestuans* L.	Chunch	Herb	0	8	0	0	8	8	*
198	*Corchorus capsularis* L.	Bor Chhunchi	Herb	0	0	0	47	47	47	
199	*Corchorus depressus* (L.) Stocks	Bahuphali	Herb	0	0	18	79	97	97	*
200	*Grewia damine* Sm.	Sisoti	Shrub	0	1	0	0	1	1	*
201	*Grewia flavescens* juss.	-	Shrub	0	2	0	0	2	2	*
202	*Grewia tenax* (Forsk.) Fiori	Gangeti	Under Shrub	0	53	5	3	61	61	*
203	*Grewia tiliaefolia* Vahlvar.tiliaefolia	Dhaman	Shrub	0	1	0	0	1	1	*
204	*Grewia villosa* Willd.	-	Shrub	0	5	0	0	5	5	*
205	*Triumfetta pentandra A.Rich*	Jipto	Herb	0	0	0	4	4	4	*
206	*Triumfetta rotundifolia* Lam.	Gol Zipti	Herb	0	2	2	0	4	4	*
54	**Ulmaceae**									
207	*Holoptelea integrifolian* (Rox.)Planch.	Kanaji Kanjo, Papada	Tree	0	7	7	0	14	14	*
55	**Verbenaceae**									
208	*Clerodendrum multiflorum* (Burm.f.)	Arni	Small Tree	0	0	2	0	2	2	*
209	*Clerodendrum phlomidis* L.	Arni	Shrub	0	0	0	4	4	4	*
210	*Lantana camara* auct. Non L. var. *aculeata* (L.) Mold.	Indradhanu	Shrub	66	100	126	44	270	336	*
211	*Premna resinosa* Schau	-	Shrub	0	84	7	0	91	91	
212	*IU herb*		Herb	12	0	0	0	0	12	

CZ = Core Zone, BIS = Buffer zone Inside Sanctuary, BNRF = Buffer Zone Naliyadhar Reserved Forest, BOS = Buffer zone Outside Sanctuary, OBZ= Overall Buffer Zone, SA= Study Area , SRBS – Species Reported Barda Sanctuary.

Annexure 2: Checklist and Abundance (Density/km2) of Terrestrial Avifauna Recorded in Aniali Limestone Mine lease (16.21 ha) Study Area of TCL

S. No	Scietific Name/Family	Common Name	MS	FS	CZ	BZ			OBZ	SA
						BIS	BNRF	BOS		
1	**Phasianidae**									
1	*Francolinus pondicerianus*	Grey Francolin	R	G		(19)90	(10)48	(20)111	(49)80	(49)72
2	*Pavo cristatus*	Indian Peafowl	R	O		(7) 33	(12)57	(15) 83	(34)56	(34)50
3	*Perdicula asiatica*	Jungle Bush-Quail	R	G				(3) 17	(3) 5	(3) 4
2	**Turnicidae**									
4	*Turnix sylvatica*	Small Buttonquail	R	G		(7) 33	(1) 5		(8) 13	(8) 12
3	**Megalaimidae**									
5	*Megalaima haemacephala*	Coppersmith Barbet	R	F		(2) 10		(3) 17	(5) 8	(5) 7
4	**Upupidae**									
6	*Upupa epops*	Common Hoopoe	WV	I		(3) 14	(1) 5		(4) 7	(4) 6
5	**Coraciidae**									
7	*Coracias benghalensis*	Indian Roller	R	I		(1) 5			(1) 2	(1) 1
6	**Meropidae**									
8	*Merops orientalis*	Green Bee-eater	R	I		(18)86	(11)52	(6) 33	(35)57	(35)51
7	**Cuculidae**									
9	*Eudynamys scolopacea*	Asian Koel	R	F		(2) 10		(25)139	(27)44	(27)40
8	**Centropodidae**									
10	*Centropus sinensis*	Greater Coucal	R	O	(1) 14	(2) 10	(5) 24	(5) 28	(12)20	(13)19
9	**Psittacidae**									
11	*Psittacula krameri*	Rose-ringed Parakeet	R	F		(4) 19	(2) 10	(25)139	(31)51	(31)46
10	**Apodidae**									
12	*Apus affinis*	House Swift	R	I		(6) 29		(8) 44	(14)23	(14)21
11	**Strigidae**									
13	*Athene brama*	Spotted Owlet	R	C				(1) 6	(1) 2	(1) 1
12	**Columbidae**									
14	*Columba livia*	Rock Pigeon	R	G		(3) 14	(6) 29	(128) 711	(137) 225	(137) 201
15	*Streptopelia senegalensis*	Laughing Dove	R	G	(6)86	(11)52	(13)62	(9) 50	(33)54	(39)57
16	*Streptopelia decaocto*	Eurasian Collared Dove	R	G	(3)43	(4) 19	(14)67	(11) 61	(29)48	(32)47
13	**Pteroclidae**									
17	*Pterocles indicus*	Painted Sangrouse	R	H			(2) 10		(2) 3	(2) 3
18	*Pterocles exustus*	Chesnut-bellied Sangrouse	R	H			(12)57	(4) 22	(16)26	(16)24
14	**Burhinidae**									
19	*Burhinus oedicnemus*	Eurasian Thick-knee	R	C			(3) 14		(3) 5	(3) 4

S. No	Scietific Name/Family	Common Name	MS	FS	CZ	BZ			OBZ	SA
						BIS	BNRF	BOS		
15	**Charadriidae**									
20	*Vanellus malabaricus*	Yellow-wattled Lapwing	R	O				(1) 6	(1) 2	(1) 1
16	**Accipitridae**									
21	*Pernis ptilorhyncus*	Oriental Honey buzzard	R	C				(3) 17	(3) 5	(3) 4
22	*Milvus migrans*	Black Kite	R	C			(1) 5		(1) 2	(1) 1
23	*Elanus caerulus*	Black-shouldered Kite	R	C				(1) 6	(1) 2	(1) 1
24	*Accipiter badius*	Shikhra	R	C		(3) 14	(1) 5		(4) 7	(4) 6
25	*Aquila rapax*	Tawny Eagle	R	C		(2) 10			(2) 3	(2) 3
26	*Hieraaetus fasciatus*	Bonnelli's Eagle	R	C		(2) 10			(2) 3	(2) 3
17	**Lanidae**									
27	*Lanius cristatus*	Brown Shrike	WV	C		(3) 14			(3) 5	(3) 4
28	*Lanius vittatus*	Bay-backed Shrike	R	C		(1) 5	(1) 5	(1) 6	(3) 5	(3) 4
29	*Lanius schach*	Long-tailed Shrike	R	C		(2) 10			(2) 3	(2) 3
18	**Corvidae**									
30	*Dendrocitta vagabunda*	Rufous Treepie	R	O		(8) 38	(1) 5	(3) 17	(12)20	(12)18
31	*Corvus splendens*	House Crow	R	O			(1) 5		(1) 2	(1) 1
32	*Corvus macrorhynchos*	Large-billed Crow	R	O				(1) 6	(1) 2	(1) 1
33	*Pericrocotus cinnamomeus*	Small Minivet	R	I		(1) 5			(1) 2	(1) 1
34	*Rhipidura aureola*	White-browed Fantail	R	I			(2) 10		(2) 3	(2) 3
35	*Coracina melanoptera*	Black-headed Cuckooshrike	R	I			(1) 5		(1) 2	(1) 1
36	*Dicrurus macrocerus*	Black Drongo	R	I	(3)43	(3) 14		(12) 67	(15)25	(18)26
37	*Terpsiphone paradisi*	Asian Paradise - Flycatcher	R	I		(1) 5			(1) 2	(1) 1
38	*Aegithina tiphia*	Common Iora	R	I		(19)90	(16)76	(2) 11	(37)61	(37)54
39	*Aegithina nigrolutea*	Marshall's Iora	R	I		(2) 10			(2) 3	(2) 3
19	**Muscicapidae**									
40	*Muscicapa muttui*	Red-throated Flycatcher	WV	I		(2) 10			(2) 3	(2) 3
41	*Muscicapa dauurica*	Brown-breasted Flycatcher	WV	I		(3) 14			(3) 5	(3) 4
42	*Cyornis tickelliae*	Tickell's Blue-Flycatcher	R	I		(1) 5			(1) 2	(1) 1
43	*Copsychus saularis*	Oriental Magpie Robin	R	I				(3) 17	(3) 5	(3) 4
44	*Saxicoloides fulicata*	Indian Robin	R	I	(18) 257	(26) 124	(30) 143	(13) 72	(69) 113	(87) 128
45	*Phoenicurus*	Black Redstart	WV	I		2	(7) 33		(9) 15	(9) 13

S. No	Scietific Name/Family	Common Name	MS	FS	CZ	BZ			OBZ	SA
						BIS	BNRF	BOS		
	onchruros									
46	*Saxicola torquata*	Common Stonechat	WV	I		1			(1) 2	(1) 1
47	*Cercomela fusca*	Brown Rock-chat	R	I				(1) 6	(1) 2	(1) 1
20	**Sturnidae**									
48	*Sternus roseus*	Rosy Starling	WV	O			(8) 38		(8) 13	(8) 12
49	*Sternus pagodarus*	Brahminy Starling	R	O				(4) 22	(4) 7	(4) 6
50	*Acridotheres tristis*	Common Myna	R	O	(2)29		(6) 29	(48)267	(54)89	(56)82
21	**Hirundinidae**									
51	*Hirundo concolor*	Dusky crag-Martin	R	I		(3) 14			(3) 5	(3) 4
22	**Pycnonotidae**									
52	*Pycnonotus cafer*	Red-vented Bulbul	R	O	(29) 414	(136) 648	(127) 605	(54) 300	(317) 520	(346) 509
23	**Cysticolidae**									
53	*Prinia buchanani*	Rufous-fronted Prinia	R	O		(6) 29	(1) 5	(2) 11	(9) 15	(9) 13
54	*Prinia hodgsonii*	Grey-breasted Prinia	R	O		(2) 10	(1) 5		(3) 5	(3) 4
55	*Prinia inornata*	Plain Prinia	R	O		(1) 5	(10)48	(4) 22	(15)25	(15)22
56	*Prinia sylvatica*	Jungle Prinia	R	O	(1)14		(20)95	(1) 6	(21)34	(22)32
57	*Cisticola juncidis*	Zitting Cisticola	R	I				(3) 17	(3) 5	(3) 4
24	**Zosteropidae**									
58	*Zosterops palpebrosus*	Oriental White - eye	R	I		(2) 10			(2) 3	(2) 3
25	**Sylvidae**									
59	*Sylvia curruca*	Lesser Whitethroat	WV	I		(2) 10	(9) 43		(11)18	(11)16
60	*Orthotomus sutorius*	Common Tailorbird	R	I		(21)100	(19)90	(5) 28	(45)74	(45)66
61	*Phylloscopus collybita*	Common Chiffchaff	WV	I			(2) 10		(2) 3	(2) 3
62	*Acrocephalus stentoreus*	Clamorous Reed Warbler	WV	I		(3) 14	(1) 5		(4) 7	(4) 6
63	*Hippolais caligata*	Booted Warbler	WV	I		(19) 90	(34)162		(53)87	(53)78
64	*Acrocephalus agricola*	Paddyfield Warbler	WV	I		(39)186	(13) 62		(52)85	(52)76
65	*Turdoides caudatus*	Common Babbler	R	O		(6) 29	(6) 29	(20)111	(32)52	(32)47
66	*Turdoides subrufus*	Jungle Babbler	R	O		(5) 24	(6) 29	(12) 67	(23)38	(23)34
67	*Turdoides malcolmi*	Large Grey Babbler	R	O	(1)14	(14) 67	(13) 62	(51) 283	(78) 128	(79) 116
68	*Dumetia hyperythra*	Tawny-bellied Babbler	R	O	(2)29					(2) 3
26	**Alaudidae**									
69	*Eremopterix grisea*	Ashy - crowned Sparrow Lark	R	O		(8) 38		(17) 94	(25) 41	(25) 37
70	*Calandrella brachydactyla*	greater short toed Lark	WV	O		(12) 57	(2) 10	(7) 39	(21)34	(21)31

S. No	Scietific Name/Family	Common Name	MS	FS	CZ	BZ			OBZ	SA
						BIS	BNRF	BOS		
71	*Galerida cristata*	Crested Lark	R	O	(1)14			(3) 17	(3) 5	(4) 6
72	*Galerida deva*	Syke' Lark	R	O				(1) 6	(1) 2	(1) 1
73	*Ammomanes phoenicurus*	Rufous-tailed Lark	R	O		(3) 14			(3) 5	(3) 4
74	*Mirafra erythroptera*	Indian Bush Lark	R	O	(1)14			(3) 17	(3) 5	(4) 6
75	*Mirafra cantillans*	Singing Bushlark	R	O				(3) 17	(3) 5	(3) 4
27	**Nectarinidae**									
76	*Nectarinia asiatica*	Purple Sunbird	R	N	(11) 157	(4) 19	(24) 114	(27) 150	(55) 90	(66) 97
77	*Dicaeum agile*	Thick-billed Flowerpecker	R	F			(3) 14		(3) 5	(3) 4
28	**Passeridae**									
78	*Passer domesticus*	House Sparrow	R	G				(10) 56	(10)16	(10)15
79	*Anthus rufulus*	Paddyfield Pipit	R	I				(1) 6	(1) 2	(1) 1
80	*Anthus campustris*	Tawny Pipit	WV	I		(1) 5			(1) 2	(1) 1
81	*Anthus trivialis*	Tree Pipit	WV	I		(1) 5			(1) 2	(1) 1
82	*Ploceus philippinus*	Baya Weaver	R	G		(1) 5		(9) 50	(10)16	(10)15
83	*Lonchura malabarica*	Indian Silverbill	R	G	(2)29	(2) 10	(1) 5	(1) 6	(4) 7	(6) 9
	Total				**(81) 1157**	**(462) 2200**	**(459) 2186**	**(590) 3278**	**(1511) 2477**	**(1592) 2341**

MS=Migratory Status, FS=Foraging Status, CZ=Core Zone, BZ=Buffer Zone, BIS = Buffer zone Inside Sanctuary, BNRF= Buffer Zone Naliyadhar Reserve Forest, BOS = Buffer zone outside Sanctuary, OBZ= Overall Buffer Zone, SA=Study Area, Actual number in parenthesis, R=Resident, WV-Winter Visitor, G=Granivore, I=Insectivore, C=Carnivore, O=Omnivore, F=Frugivore, N=Nectarivore, H=Herbivore

Annexure 3: Checklist and Abundance (Density/km2) of Aquatic Avifauna Recorded in Aniali Limestone Mine lease (16.21 ha) Study Area of TCL.

S. No	Scietific Name/Family	Common Name	MS	FS	CZ	BZ			OBZ	SA
						BIS	BRF	BOS		
1	**Dendrocygnidae**									
1	*Dendrocygna javanica*	Lesser Whistling Duck	R	H		(5) 24			(5) 8	(5) 7
2	**Anatidae**									
2	*Anas poecilorhyncha*	Spot billed Duck	R	H		(3) 14			(3) 5	(3) 4
3	*Anas acuta*	Northern Pintail	W V	H		(4) 19			(4) 7	(4) 6
4	*Anas strepera*	Gadwall	W V	H		(4) 19			(4) 7	(4) 6
3	**Alcedinidae**									
5	*Alcede atthis*	Small Blue Kingfisher	R	P		(1) 5			(1) 2	(1) 1
4	**Dacelonidae**									
6	*Halcyon smyrensis*	White-throated Kingfisher	R	P		(2) 10	(1) 5	(1) 6	(4) 7	(4) 6
5	**Cerylidae**									
7	*Ceryle rudis*	Pied Kingfisher	R	P		(1) 5			(1) 2	(1) 1
6	**Gruidae**									
8	*Grus grus*	Common Crane	W V			(51)243			(51)84	(51)75
7	**Rallidae**									
9	*Amaurornis phoenicurus*	White-breasted Waterhen	R	O				(1) 6	(1) 2	(1) 1
8	**Scolopacidae**									
10	*Tringa stagnatilis*	Marsh Sandpiper	W V	**C**		(1) 5			(1) 2	(1) 1
11	*Tringa ochropus*	Green Sandpiper	W V	**C**		(1) 5			(1) 2	(1) 1
12	*Actitis hypoleucos*	Common Sandpiper	R	**C**		(6) 29			(6) 10	(6) 9
9	**Charadriidae**									
13	*Himantopus himantopus*	Black- winged Stilt	R	C		(13) 62			(13) 21	(13) 19
14	*Charadrius dubius*	Little ringed plover	R	C		(3) 14			(3) 5	(3) 4
15	*Vanellus indicus*	Red-wattled Lapwing	R	O	(2)29	(12) 57	(2) 10	(17)94	(31)51	(33)49
10	**Laridae**									
16	*Sterna aurantia*	River Tern	R	P		(6) 29	(1) 5		(7) 11	(7) 10
11	**Phalacrocoracidae**									
17	*Phalacrocorax niger*	Little Cormorant	R	P		(1) 5			(1) 2	(1) 1
18	*Phalacrocorax fusccollis*	Indian Shang	R	P		(1) 5			(1) 2	(1) 1
19	*Phalacrocorax carbo*	Great Cormorant	R	P			(1) 5		(1) 2	(1) 1
12	**Ardeidae**									
20	*Ardeola grayii*	Indian Pond	R	O		(12) 57		(1) 6	(13)21	(13)19

S. No	Scietific Name/Family	Common Name	MS	FS	CZ	BZ			OBZ	SA
						BIS	BRF	BOS		
		Heron								
21	*Egretta gularis*	Western Reef Egret	R	C		(2) 10			(2) 3	(2) 3
22	*Egretta garzetta*	Little Egret	R	O		(7) 33	(3) 14		(10) 16	(10) 15
23	*Bubulcus ibis*	Cattle Egret	R	C		(30)143	(1) 5	(7) 39	(38)62	(38)56
24	*Mesophoyx intermedia*	Intermediate Egret	R	C		(2) 10	(2) 10		(4) 7	(4) 6
25	*Cosmerodius albus*	Great Egret	R	C			(1) 5		(1) 2	(1) 1
13	**Threskiornithidae**									
26	*Pseudibis papillosa*	Black Ibis	R	O		(11) 52		(4) 22	(15)25	(15)22
27	*Threskiornis melanocephalus*	Black-headed Ibis	R	O		(2) 10			(2) 3	(2) 3
14	**Ciconiidae**									
28	*Mycteria leucocephala*	Painted Stork	R	C		(2) 10			(2) 3	(2) 3
29	*Anastomus oscitans*	Asian Openbill	R	C		(3) 14			(3) 5	(3) 4
15	**Hirundinidae**									
30	*Hirundo smithii*	Wire-tailed Swallow	R	I				(2) 11	(2) 3	(2) 3
31	*Hirundo daurica*	Red-rumped Swallow	R	I	(1)14	(6) 29		(2) 11	(8) 13	(9) 13
16	**Passeridae**									
32	*Motacilla cinerea*	Grey Wagtail	WV	I	0	(1) 5			(1) 2	(1) 1
	Total				**(3) 43**	**(193) 919**	**(12) 57**	**(35) 194**	**(240) 393**	**(243) 357**

MS=Migratory Status, FS=Foraging Status, CZ=Core Zone, BZ=Buffer Zone, BIS = Buffer zone Inside Sanctuary, BNRF= Buffer Zone Naliyadhar Reserve Forest, BOS = Buffer zone outside Sanctuary, OBZ= Overall Buffer Zone, SA=Study Area, Actual number in parenthesis, R=Resident, WV-Winter Visitor, I=Insectivore, C=Carnivore, O=Omnivore, H=Herbivore, P=Piscivore

Annexure.4. List of Amphibians Reported in Barda Wildlife Sanctuary and Aniali Limestone Mine lease (16.21 7ha) Study area with their Conservation status

S.No.	**Species name**	**Common name**	**SA**	**BSR**	**SS**	***CS***	
						CAMP 1998 IUCN 2000	Anon 1972
1	*Bufo melanosticus*	Common Asia toad	-	*	*A*	VU	_
2	*Bufo stomaticus*	Marbled toad	-	*	UC	LR-nt	_
3	*Microhyla ornata*	Ornate narrow-mouthed frog	-	*		LR-lc	_
4	*Euphlictis cyanphylictis*	Indian skittering frog	*	*	*A*	LR-nt	Sch-IV
5	*Hoplobarahus tigerinus*	Indian bull frog	*	*	C	VU	Sch-IV
6	*Fejevarya limnocharis*	Cricket frog	*	*		*VU*	Sch-IV
7	*Fejevarya Sp*	Unidentified	-	*			_
8	*Polypedates Sp*	Unidentified	-	*			_

Source: Anon. 1972. The Wildlife (Protection) Act, 1972. Ammended 1991. Natraj Publication, Dehra Dun. 154 p.

Molur S and S Walker (eds). 1998. Report of the Workshop " Conservation Assessment and Management Plan – CAMP for amphibians of India, (BCPP - Endangered Species Project, Zoo Outreach Organisation, Conservation Breeding Specialist Group, India, Coimbatore, India, 93 P.

IUCN 2000. Red List of Threatened Species. Species Survival Commission (SSC) IUCN, Gland, Switzerland.

SA- Study Area, BSR-Sanctuary Report, SS- Sighting status in Sanctuary, CS – Conservation Status, A-Abundant, C-Common, UC – Uncommon,

Annexure 5: List of Reptiles Reported in Barda Wildlife Sanctuary and Aniali Limestone Mine lease (16.21 7ha) Study area of with their Conservation status

S.No	Species name	Common name	SA	BSR	SS	CS	
						CAMP 1998 IUCN 2000	Anon 1972
1	*Crocodylus palustris*	Mugger or Marsh Crocodile	-	*	C	VU	Sch-I
2	*Geochelone elegans*	Indian Star tortoise	-	*	UC	VU	Sch-II
3	*Lissemys punctata*	Indian flapshell turtle	-	*	C	LR-nt	Sch-I
4	*Eublepharis macularius*	Common leopard gecko	-	*	UC	LR-lc	-
5	*Hemidactylus brookii*	Brook's gecko	-			LR-lc	-
6	*Hemidactylus flaviviridis*	Yellow-green house gecko	*	*	C	LR-lc	-
7	*Hemidactylus maculatus*	Rock gecko	*				
8	*Cyrtopodion Sp?*		*	-			-
9	*Calotes versicolar*	Indian garden lizard	*	*	AB	LR-nt	-
10	*Calotes Sp?*	unidentified	*	-			
11	*Sitana ponticeriana*	Fan-throated lizard	*	*	AB	LR-lc	-
12	*Lygosoma punctatus*	Spotted Supple skink	-	*	C	LR-lc	-
13	*Mabuya carinata*	Keeled grass skink	*	*	C	LR-nt	-
14	*Mabuya macularia*	Common bronze-back skink	*	*	UC	LR-lc	-
15	*Ophisops jerdoni*	Snake eye skink	-	*	C	DD	-
16	*Chamaeleo zeylanicus*	Indian Chamaeleaon	-	*	R	VU	-
17	*Varanus bengalensis*	Bengal monitor	*	*	C	VU	Sch-II
18	*Ramphotyplops braminus*	Braminy worm snake	-	*	C	LR-nt	Sch-IV
19	*Erix conicus*	Common sand boa	-	*	R	LR-nt	Sch-IV
20	*Erix johnii*	Reed sand boa	-	*	R	LR-lc	Sch-IV
21	*Python molurus*	Indian rock python	-	*	R	LR-nt	Sch-IV
22	*Elaphe helena*	Indian trinket snake	-	*	UC	LR-nt	Sch-IV
23	*Lycodan aulicus*	Common wolf snake	-	*	UC	LR-lc	Sch-IV
24	*Ptyas mucosa*	Indian rat snake	-	*	C	LR-nt	Sch-II
25	*Xenochorphis piscator*	Checkered keelback	-	*	C	LR-lc	Sch-II
26	*Sibynophis subpunctatus*	Dumerilsblack-heated snake	-	*	R	LR-nt	Sch-IV
27	*Naja naja*	Spectacled cobra	-	*	C	LR-nt	Sch-II
28	*Echis carinatus*	Indian saw scaled viper	*	*	C	LR-nt	Sch-IV
29	*Daboia russelli*	Russel's viper	-	*	UC	LR-nt	Sch-II

Source: **Anon. 1972.** The Wildlife (Protection) Act, 1972. Ammended 1991. Natraj Publication, Dehra Dun. 154 p.

IUCN 2000. Red List of Threatened Species. Species Survival Commission (SSC) IUCN, Gland, Switzerland.

Molur S and S Walker (eds). 1998. Report of the Workshop " Conservation Assessment and Management Plan – CAMP for Reptiles of India, (BCPP - Endangered Species Project, Zoo Outreach Organisation, Conservation Breeding Specialist Group, India, Coimbatore, India, 175 P.

SA: Study area, BSR: Barda Sanctuary Report, SS; Sighting Status in Sanctuary Status, CS conservation status, AB-Abundant, C-Common, UC – Uncommon, R-Rare

Annexure 6: List of Terrestrial Bird Reported in Barda Wildlife Sanctuary and in the Study Area of Aniali mine lease (16.21 ha) of TCL with their Conservation status

S.No	Scientific Name	Common Name	BWSR @	Wildlife Act Schedule	SA
1	**Phasianidae**				
1	*Francolinus pondicerianus*	Grey Francolin	* (A)		*
2	*Pavo cristatus*	Indian Peafowl	* (A)	I	*
3	*Perdicula asiatica*	Jungle Bush-Quail	* (UC)		*
2	**Turnicidae**				
4	*Turnix sylvatica*	Small Buttonquail	* (C)	IV	*
5	*Turnix suscitator*	Barred Buttonquail	* (R)	IV	
3	**Picidae**				
6	*Jynx torquilla*	Eurasian Wryneck	* (R)		
7	*Dendrocopos maharattensis*	Yellow-crowned Woodpecker	* (UC)	IV	
4	**Megalaimidae**				
8	*Megalaima haemacephala*	Coppersmith Barbet	* (C)	IV	*
5	**Upupidae**				
9	*Upupa epops*	Common Hoopoe	* (C)		*
6	**Coraciidae**				
10	*Ciracias benghalensis*	Indian Roller	* (C)	IV	*
7	**Meropidae**				
11	*Merops orientalis*	Green Bee-eater	* (C)		*
12	*Merops Persicus*	Blue-cheeked Bee-eater	* (R)		
8	**Cuculidae**				
13	*Eudynamys scolopacea*	Asian Koel	* (C)	IV	*
14	*Clamator jacobinus*	Pied Cuckoo	* (C)	IV	
15	*Phaenicophaeus leschenaultii*	Sirkeer Malkhoha	* (R)	IV	
9	**Centropodidae**				
16	*Centropus sinensis*	Greater Coucal	* (UC)	IV	*
10	**Psittacidae**				
17	*Psittacula krameri*	Rose-ringed Parakeet	* (C)	IV	*
18	*Psittacula cyanocephala*	Plum-headed Parakeet	* (C)	IV	
11	**Apodidae**				
19	*Apus affinis*	House Swift	* (UC)		*
12	**Strigidae**				
20	*Bubo bubo*	Eurasian Eagle-Owl	* (R)	IV	
21	*Ketupa zeylonensis*	Brown Fish-Owl	* (R)	IV	
22	*Athene brama*	Spotted Owlet	* (UC)	IV	*
13	**Caprimulgidae**				
23	*Caprimulgus asiaticus*	Indian Nightjar	* (UC)	IV	
14	**Columbidae**				
24	*Columba livia*	Rock Pigeon	* (A)		*
25	*Streptopelia chinensis*	Spotted- Dove	* (C)	IV	
26	*Streptopelia senegalensis*	Laughing Dove	* (A)	IV	*
27	*Streptopelia decaocto*	Eurasian Collared Dove	* (C)	IV	*
28	*Streptopelia tranquebarica*	Red collared Dove	* (C)	IV	
29	*Treron phoenicoptera*	Yellow-legged Green- Pigeon	* (UC)	IV	
15	**Pteroclidae**				
30	*Pterocles indicus*	Painted Sangrouse	* (C)	IV	*

S.No	Scientific Name	Common Name	BWSR @	Wildlife Act Schedule	SA
31	*Pterocles exustus*	Chesnut-bellied Sangrouse			*
16	**Burhinidae**				
32	*Burhinus oedicnemus*	Eurasian Thick-knee	*(R)	IV	*
17	**Charadridae**				
33	*Vanellus malabaricus*	Yellow-wattled Lapwing	* (C)	IV	*
18	**Accipitridae**				
34	*Pandion haliaetus*	Osprey	* (R)	I	
35	*Pernis ptilorhyncus*	Oriental Honey-Buzzard	* (UC)		*
36	*Neophron percnopterus*	Egyptian Valture	* (R)	IV	
37	*Gyps bengalensis*	Indian White-backed Vulture	* (R)	IV	
38	*Spilornis cheela*	Crested Serpent Eagle	* (R)		
39	*Circus macrourus*	Pallid Harrier	* (R)		
40	*Milvus migrans*	Black Kite		IV	*
41	*Elanus caerulus*	Black-shouldered Kite	* (R)		*
42	*Accipiter badius*	Shikhra	* (UC)		*
43	*Circaetus gallicus*	Short-toed Snake –Eagle	* (R)		
44	*Accipiter nisus*	Eurasian Sparrow hawk	* (R)	I	
45	*Aquila sp*	Spotted Eagle	* (R)		
46	*Aquila heliaca*	Imperial Eagle	* (R)		
47	*Aquila rapax*	Tawny Eagle			*
48	*Hieraaetus fasciatus*	Bonnelli's Eagle			*
49	*Hieraaetus pennatus*	Booted Eagle	* (R)		
50	*Spizaetus cirrhatus*	Changeable Hawk-Eagle	* (R)		
19	**Falconidae**				
51	*Falco tinnunculus*	Common Kestrel	* (R)		
52	*Falco Subbuteo*	Northern Hobby	* (C)		
20	**Pittidae**				
53	*Pitta brachyura*	Indian Pitta	* (R)		
21	**Lanidae**				
54	*Lanius collurio*	Red-backed Shrike	* (R)		
55	*Lanius isabellinus*	Rufous-tailed Shrike	* (R)		
56	*Lanius excubitor*	Great Grey Shrike	* (UC)		
57	*Lanius cristatus*	Brown Shrike			*
58	*Lanius vittatus*	Bay-backed Shrike	* (UC)		*
59	*Lanius schach*	Long-tailed Shrike	* (C)		*
22	**Corvidae**				
60	*Dendrocitta vagabunda*	Rufous Treepie	* (C)	IV	*
61	*Corvus splendens*	House Crow	* (C)	IV	*
62	*Corvus macrorhynchos*	Large-billed Crow			*
63	*Pericrocotus cinnamomeus*	Small Minivet			*
64	*Oriolus oriolus*	Eurasian Golden Oriole	* (C)	IV	
65	*Coracina macei*	Large Cuckoo-shrike	* (R)		
66	*Rhipidura aureola*	White-browed Fantail	* (UC)		*
67	*Coracina melanoptera*	Black-headed Cuckooshrike	* (R)		*
68	*Dicrurus macrocercus*	Black Drongo	* (C)	IV	*
69	*Dicrurus caerulescens*	White-bellied Drongo	* (R)	IV	
70	*Terpsiphone paradise*	Asian Paradise - Flycatcher	* (C)	IV	*
71	*Aegithina tiphia*	Common Iora	* (C)	IV	*
72	*Aegithina nigrolurea*	Marshall' Iora			*

S.No	Scientific Name	Common Name	BWSR @	Wildlife Act Schedule	SA
73	*Tephrodornis pondicerianus*	Lesser Woodshrike	* (R)	IV	
23	**Muscicapidae**				
74	*Monticola solitarius*	Blue Rock-Thrush	* (R)	IV	
75	*Muscicapa striata*	Spotted Flycatcher	* (C)	IV	
76	*Eumyias thalassina*	Verditer Flycatcher	* (R)	IV	
77	*Muscicapa muttui*	Red-throated Flycatcher			*
78	*Muscicapa dauurica*	Brown-breasted Flycatcher			*
79	*Cyornis tickelliae*	Tickell's Blue-Flycatcher	* (UC)	IV	*
80	*Cercotrichas galactotes*	Rufus-tailed Scrub-Robin	* (R)		
81	*Saxicoloides fulicata*	Indian Robin	* (A)		*
82	*Copsychus saularis*	Oriental Magpie Robin	* (UC)		*
83	*Phoenicurus onchruros*	Black Redstart	* (C)		*
84	*Saxicola torquata*	Common Stonechat	* (R)		*
85	*Cercomela fusca*	Brown Rock-chat			*
86	*Oenanthe picata*	Variable Wheatear	* (R)		
87	*Oenanthe isabellina*	Isabelline Wheatear	* (R)		
24	**Sturnidae**				
88	*Sternus roseus*	Rosy Starling	* (A)	IV	*
89	*Sternus pagodarus*	Brahminy Starling	* (C)	IV	*
90	*Acridotheres tristis*	Common Myna	* (A)	IV	*
91	*Acridotheres ginginias*	Bank Myna	* (R)	IV	
25	**Paridae**				
92	*Parus major*	Great Tit	* (UC)	IV	
26	**Hirundinidae**				
93	*Hirundo concolor*	Dusky crag-Martin	* (C)		*
94	*Hirundo rustica*	Barn Swallow	* (UC)		
95	*Hirundo daurica*	Red-rumped Swallow	* (UC)		
27	**Pycnonotidae**				
96	*Pycnonotus cafer*	Red-vented Bulbul	* (A)	IV	*
28	**Cysticolidae**				
97	*Prinia hodgsonii*	Grey-breasted Prinia	* (C)		*
98	*Prinia gracilis*	Graceful Prinia	* (R)		
99	*Prinia buchanani*	Rufous-fronted Prinia	* (UC)		*
100	*Prinia inornata*	Plain Prinia	* (C)		*
101	*Prinia sylvatica*	Jungle Prinia		IV	*
102	*Prinia socialis*	Ashy Prinia	* (C)		
103	*Cisticola jundis*	Zitting Cisticola			*
29	**Zosteropidae**				
104	*Zosterops palpebrosus*	Oriental White-eye	*(C)		*
30	**Sylvidae**				
105	*Sylvia curruca*	Lesser Whitethroat	* (UC)	IV	*
106	*Orthotomus sutorius*	Common Tailorbird	* (C)		*
107	*Phylloscopus collybita*	Common Chiffchaff			*
108	*Phylloscopus reguloides*	Blyth's Leaf Warbler	* (R)		
109	*Hippolais caligata*	Booted Warbler			*
110	*Acrocephalus stentoreus*	Clamorous Reed Warbler			*
111	*Acrocephalus agricola*	Paddyfield Warbler			*
112	*Turdoides caudatus*	Common Babbler	* (C)	IV	*
113	*Turdoides subrufus*	Jungle Babbler	* (A)	IV	*

S.No	Scientific Name	Common Name	BWSR @	Wildlife Act Schedule	SA
114	*Turdoides malcolmi*	Large Grey Babbler	*** (C)**		*
115	*Turdoides earlei*	Striated Babbler	*** (C)**	**IV**	
116	*Dumetia hyperythra*	Tawny-bellied Babbler			*
31	**Alaudidae**				
117	*Mirafra erythroptera*	Red winged Bush-lark	*** (UC)**	**IV**	
118	*Eremopterix grisea*	Ashy - crowned Sparrow Lark	*** (C)**	**IV**	*
119	*Calandrella brachydactyla*	Greater short toed Lark	*** (UC)**	**IV**	*
120	*Galerida cristata*	Crested Lark	*** (UC)**	**IV**	*
121	*Galerida deva*	Sykes's Lark	*** (UC)**	**IV**	*
122	*Mirafra cantillans*	Singing Bushlark			*
123	*Mirafra erythroptera*	Indian Bush Lark	*** (UC)**	**IV**	*
124	*Ammomanes phoenicurus*	Rufous-tailed Lark			*
32	**Nectarinidae**				
125	*Nectarinia asiatica*	Purple Sunbird	*** (C)**	**IV**	*
126	*Diaceum agile*	Thick-billed Flowerpecker		**IV**	*
33	**Passeridae**				
127	*Passer domesticus*	House Sparrow	*** (C)**		*
128	*Petronia xanthocollis*	Chestnut-shouldered Petronia	*** (UC)**		
129	*Anthus campustris*	Tawny Pipit			*
130	*Anthus richardi*	Tree Pipit	*** (R)**	**IV**	*
131	*Anthus rufulus*	Paddyfield Pipit			*
132	*Ploceus philippinus*	Baya Weaver	*** (C)**	**IV**	*
133	*Lonchura malabarica*	Indian Silverbill	*** (A)**	**IV**	*
134	*Lonchura punctulata*	Scaly-breasted Munia	*** (UC)**	**IV**	
34	**Fringillidae**				
135	*Emberiza cia*	Rock Bunting	*** (C)**	**IV**	
136	*Emberiza buchanai*	Grey-necked Bunting	*** (C)**	**IV**	
137	*Emberiza striolata*	Striolated Bunting	*** (UC)**	**IV**	
			114		**83**

BWSR@: Source: GEER & GFD 2002. Ecological and Socio-Economic Study of Barda Wildlife Sanctuary. Final Report. Gujarat Ecological Education and Research (GEER) Foundation and Gujarat Forest Department. 271 PP
****** Reported Out off sample plot/area, A-Abundant, C-Common, UC – Uncommon, R-Rare

Annexure 7: List of Aquatic Bird Reported in Barda Wildlife Sanctuary and in the Study Area of Aniali mine lease (16.21 ha) of TCL with their Conservation status

S.No	Scientific Name	Common Name	BWSR @	Wildlife Act Schedule	SA
1	**Dendrocygnidae**				
1	*Dendrocygna javanica*	Lesser Whistling-Duck	*** (C)**	**IV**	*****
2	**Anatidae**				
2	*Anas poecilorhyncha*	Spot billed Duck	*** (C)**	**IV**	*****
3	*Anas acuta*	Northern Pintail		**IV**	*****
4	*Anas penelope*	Eurasian Wigeon	*** (C)**	**IV**	
5	*Anas strepera*	Gadwall		**IV**	*****
3	**Alcedinidae**				
6	*Alcede atthis*	Small Blue Kingfisher	*** (UC)**	**IV**	*****
4	**Dacelonidae**				
7	*Halcyon smyrensis*	White-throated Kingfisher	*** (C)**	**IV**	*****
5	**Cerylidae**				
8	*Ceryle rudis*	Pied Kingfisher	*** (C)**	**IV**	*****
6	**Gruidae**				
9	*Grus virgo*	Demoiselle Crane	*** (UC)**	**IV**	
10	*Grus grus*	Common Crane			*****
7	**Rallidae**				
11	*Amaurornis phoenicurus*	White-breasted Waterhen	*** (C)**		*****
8	**Scolopacidae**				
12	*Gallinago gallinago*	Common Snipe	*** (R)**	**IV**	
13	*Limosa limosa*	Black-tailed Godwit	*** (C)**	**IV**	
14	*Tringa erythropus*	Spotted Redshank	*** (R)**	**IV**	
15	*Tringa totanus*	Common Redshank	*** (UC)**	**IV**	
16	*Tranga glareola*	Wood Sandpiper	*** (R)**	**IV**	
17	*Actitis hypoleucos*	Common Sandpiper	*** (C)**	**IV**	*****
18	*Tringa stagnatilis*	Marsh Sandpiper	*** (UC)**	**IV**	*****
19	*Tringa ochropus*	Green Sandpiper	*** (UC)**	**IV**	*****
20	*Calidris minuta*	Little Stint	*** (UC)**		
21	*Calidris termminckii*	Temminck's Stint	*** (UC)**		
22	*Calidris alpine*	Dunlin	*** (R)**		
23	*Philomachus pugnax*	Ruff	*** (C)**		
9	**Rostratulidae**				
24	*Rostratula benghalensis*	Greater Painted-Snipe	*** (R)**		
10	**Jacanidae**				
25	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	*** (R)**		
11	**Burhinidae**				
26	*Burhinus oedicnemus*	Stone - Curlew	*** (R)**	**IV**	
27	*Esacus recurvirostris*	Great Thick-knee	*** (UC)**	**IV**	
12	**Charadriidae**				
28	*Himantopus himantopus*	Black- winged Stilt	*** (C)**	**IV**	*****
29	*Recurvirostra avosetta*	Pied Avocet	*** (R)**	**IV**	
30	*Charadrius dubius*	Little ringed Plover	*** (UC)**	**IV**	*****
31	*Chardrius alexandrines*	Kentish Plover	*** (UC)**	**IV**	
32	*Vanellus indicus*	Red-wattled Lapwing	*** (A)**		*****
33	*Vanellus malabaricus*	Yellow-wattled Lapwing	*** (C)**		
13	**Laridae**				

34	*Gelochelidon nilotica*	Gull-billed Tern	*** (UC)**		
35	*Sterna aurantia*	River Tern	*** (C)**		*
14	**Podicipedidae**				
36	*Tachypaptus ruficollis*	Little Grebe	*** (C)**	**IV**	
15	**Anhingidae**				
37	*Anhinga melanogaster*	Darter	*** (R)**	**IV**	
16	**Phalacrocoracidae**				
38	*Phalacrocorax niger*	Little Cormorant	*** (A)**	**IV**	*
39	*Phalacrocorax fuscicollis*	Indian Shang			*
40	*Phalacrocorax carbo*	Great Cormorant			*
17	**Ardeidae**				
41	*Ardeola grayii*	Indian Pond Heron	*** (A)**	**IV**	*
42	*Bubulcus ibis*	Cattle Egret	*** (C)**	**IV**	*
43	*Egretta garzetta*	Little Egret	*** (C)**	**IV**	*
44	*Mesophoyx intermedia*	Median (intermediate) Egret	*** (C)**	**IV**	*
45	*Cosmerodius albus*	Great Egret			*
46	*Egretta gularis*	Western Reef-Egret	*** (UC)**	**IV**	*
47	*Ardea cinerea*	Grey Heron	*** (UC)**	**IV**	
48	*Nycticorax nycticorax*	Black-crowned Night Heron	*** (R)**	**IV**	
49	*Botaurus stellaris*	Great Bitten	*** (R)**	**IV**	
18	**Phoenicopteridae**				
50	Phoenicopterus minor	Lesser Flamingo	*** (R)**	**IV**	
19	**Threskiornithidae**				
51	*Pseudibis papillosa*	Black Ibis	*** (C)**	**IV**	*
52	*Plegadis falcinellus*	Glossy Ibis	*** (UC)**	**IV**	
53	*Threskiornis melanocephalus*	Black-headed Ibis			*
54	*Platalea leucorodia*	Eurasian Spoonbill	*** (UC)**	**I**	
20	**Ciconiidae**				
55	*Mycteria leucocephala*	Painted Stork	*** (UC)**	**IV**	*
56	*Anastomus oscitans*	Asian Openbill	*** (UC)**	**IV**	*
57	*Ciconia nigra*	Black Stork	*** (UC)**	**IV**	
21	**Hirundinidae**				
58	*Hirundo smithii*	Wire-tailed Swallow	*** (UC)**		*
59	*Hirundo daurica*	Red-rumped Swallow	*** (UC)**		*
22	**Passeridae**				
60	*Motacilla maderapatensis*	White-browed Wagtail	*** (UC)**		
61	*Motacilla alba*	White Wagtail	*** (UC)**		
62	*Motacilla flava*	Yellow Wagtail	*** (R)**		
63	*Motacilla cinerea*	Grey Wagtail	*** (C)**		*
	Total		**56**		**32**

BWSR@: Source: GEER & GFD 2002. Ecological and Socio-Economic Study of Barda Wildlife Sanctuary. Final Report. Gujarat Ecological Education and Research (GEER) Foundation and Gujarat Forest Department. 271 PP
****** Reported Out off sample plot/area ,A-Abundant, C-Common, UC – Uncommon, R-Rare

Annexure 8: List of Mammals Reported in Barda Wildlife Sanctuary and Aniali Limestone Mine lease (16.21 ha) with their Conservation status

Sl.No	Species name	Common name	SA	BSR	SS	CS	
						CAMP 1998 IUCN 2000	Anon 1972
1	*Boselaphus tragocamelus*	Nilgai	*	*	A	LR-cd	Sch.III
2	*Sus acrofa*	Wild boar	*	*	A	LR-	Sch.III
3	*Viverricula indica*	Small Indian Civet	-	*	R	LR-nt(CAMP)	Sch.II
4	*Herpestes edwardsi*	Common Mongoose	*	*	A	LR-lc	Sch.IV
5	*Hyaena hyaena*	Striped Hyena	*	*	C	LR-nt	Sch.III
6	*Canis lupus*	Indian Wolf	-	*	R	LR-nt	Sch.I
7	*Canis aureus*	Jackal	*	*	A	LR-lc	Sch.II
8	*Vulpus bengalensis*	Indian Fox	-	*	R	LR-nt	Sch.II
9	*Mellivora capensis*	Ratel	-	*	R	LR-nt(CAMP)	Sch.I
10	*Panthera pardus*	Leopard	*	*	UC	VU	Sch.I
11	*Felis chaus*	Jungle Cat	*	*		LR-nt(CAMP)	Sch-II
12	*Lepus nigricollis*	Indian Hare	*	*	A	LR-lc	Sch.IV
13	*Funambulus pennanti*	Five-striped Palm Squirrel	*	*	A	LR-lc	Sch.IV
14	*Hystrix indica*	Porcupie	*	*	C	LR-lc	Sch.IV
15	*Mus platythrix*	Spiny Field Mouse	-	*	C	LR-lc	Sch.IV
16	*Rattus rattus*	House Rat	*	*	C	LR-lc	Sch.IV
17	*Manis crassicaudata*	Pangolin	-	*		LR-nt	Sch.I
18	*Suncus murinus*	Grey Musk Shrew	-	*	UC	LR-lc	
19	*Paraechinus micropus*	Pale Hedgehog	-	*	R	LR-lc	Sch.IV
20		Pale Indian gerbil	-	*			
21	*Pteropus giganteus*	Indian Flying Fox	-	*	C	LR-nt	
22	*Presbytis entellus*	Common Langur	-	*	R	LR-nt	Sch.II

Source: **Anon. 1972.** The Wildlife (Protection) Act, 1972. Ammended 1991. Natraj Publication, Dehra Dun. 154 p.
IUCN 2000. Red List of Threatened Species. Species Survival Commission (SSC) IUCN, Gland, Switzerland.

Molur S and S Walker (eds). 1998. Report of the Workshop "Conservation Assessment and Management Plan – CAMP for Mammals of India, (BCPP - Endangered Species Project, Zoo Outreach Organisation, Conservation Breeding Specialist Group, India, Coimbatore, India, 176 P.

SA: Study area, BSR: Sanctuary Report, SS; Sanctuary Status , CS conservation status, A-Abundant, C-Common, UC – Uncommon, R-Rare

Annexure 6.1 : Leachate Analysis of Limestone

S.No.	Parameter	Results	Units	Toxic characteristic and regulatory levels[6]	IS 10500 Standard Limits for drinking water	
					Desirable	Permissible
	pH	7.23	-	-	6.5-8.5	6.5-8.5
	Alkalinity	380	mg/l	-	200	600
	Mercury	Nil	mg/l	0.2	0.001	
	Lead	Nil	mg/l	5.0	0.05	NS
	Cadmium	0.045	mg/l	1.0	0.01	
	Chromium (Hexavalent)	Nil	mg/l	-	0.05	
	Total Chromium	Nil	mg/l	5.0		
	Arsenic	0.027	mg/l	5.0	0.05	NS

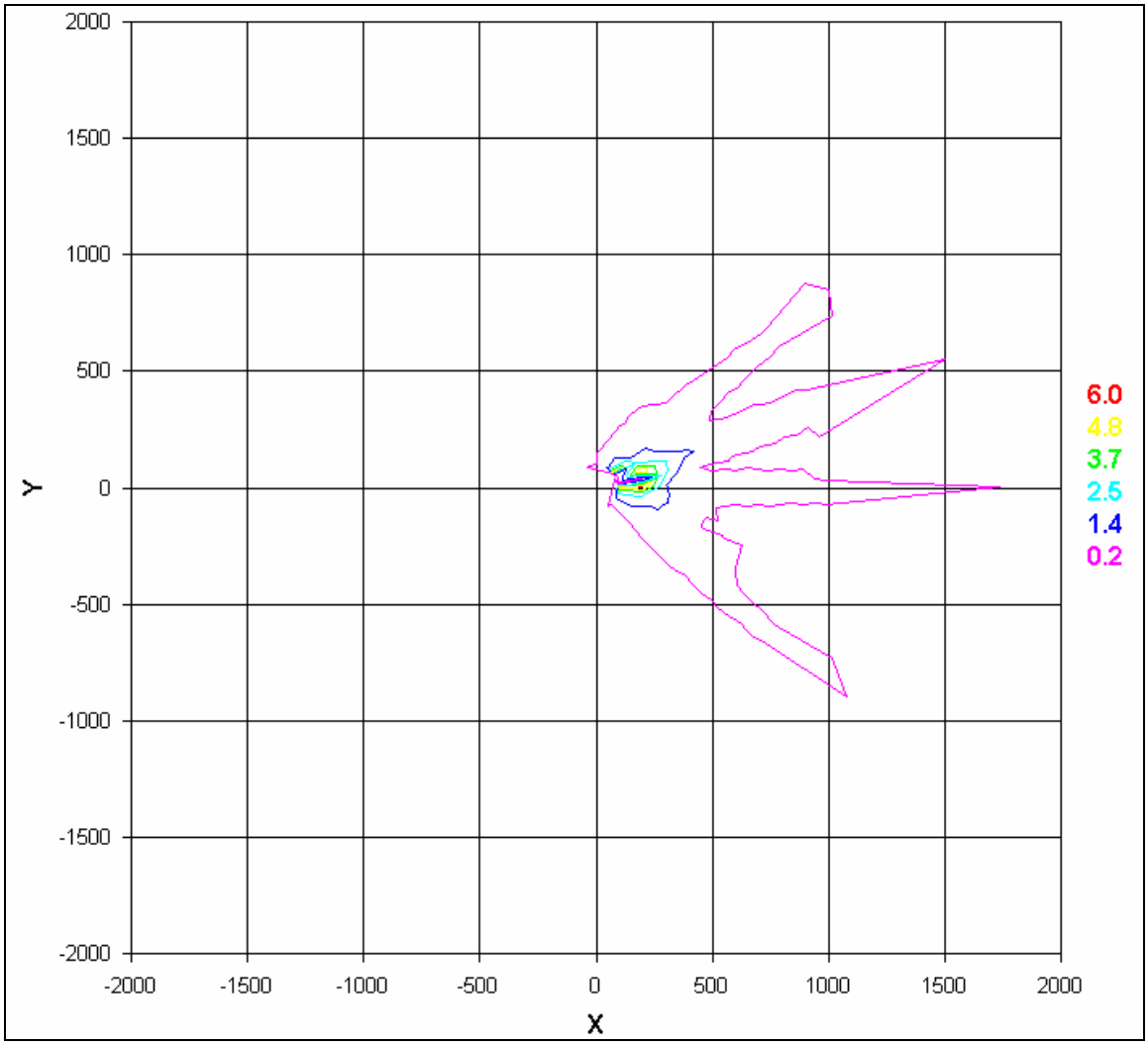
[6] Source: Soild waste and emergency response (5305 W), EPA 530-K-05-012 September 2005, USEPA

Annexure 6.2. 24 hr average GLC of SPM (µg/m3) – Dispersion Modelling of Excavation Operations

Direction (Degrees)	Distance (metres)														
	100	200	300	400	500	600	700	800	900	1000	2000	3000	4000	5000	10000
0	0.15	0.08	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.00
10	0.30	0.16	0.11	0.09	0.07	0.06	0.06	0.05	0.05	0.04	0.00	0.00	0.00	0.00	0.00
20	0.58	0.26	0.16	0.12	0.10	0.08	0.05	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00
30	1.09	0.36	0.25	0.20	0.12	0.10	0.09	0.08	0.07	0.07	0.01	0.00	0.00	0.00	0.00
40	2.36	0.73	0.39	0.25	0.18	0.14	0.07	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00
50	5.15	1.26	0.83	0.63	0.50	0.43	0.38	0.34	0.30	0.27	0.05	0.01	0.00	0.00	0.00
60	0.00	2.65	1.40	0.90	0.45	0.10	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
70	0.00	5.88	2.80	1.55	1.16	0.89	0.70	0.55	0.45	0.37	0.09	0.04	0.02	0.02	0.00
80	0.00	0.00	2.81	0.37	0.08	0.04	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
90	5.59	**6.05**	1.43	0.87	0.68	0.57	0.48	0.42	0.38	0.34	0.15	0.09	0.06	0.04	0.02
100	3.07	2.63	1.51	0.53	0.25	0.08	0.03	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
110	1.98	1.52	1.22	0.70	0.15	0.14	0.14	0.14	0.14	0.13	0.07	0.03	0.02	0.01	0.00
120	1.10	1.12	0.88	0.67	0.55	0.42	0.19	0.05	0.01	0.01	0.00	0.00	0.00	0.00	0.00
130	0.34	0.43	0.46	0.46	0.41	0.36	0.33	0.31	0.29	0.27	0.10	0.03	0.01	0.00	0.00
140	0.16	0.11	0.09	0.07	0.06	0.05	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00
150	0.14	0.09	0.07	0.06	0.05	0.05	0.04	0.04	0.03	0.03	0.01	0.00	0.00	0.00	0.00
160	0.14	0.09	0.07	0.06	0.05	0.04	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.13	0.09	0.07	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00
180	0.07	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.00
190	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
210	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
220	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
240	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
250	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
260	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Direction (Degrees)	Distance (metres)														
	100	200	300	400	500	600	700	800	900	1000	2000	3000	4000	5000	10000
270	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
280	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
290	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
310	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
320	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
330	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
340	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
350	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 6.1: Concentration of PM due to emissions from mineral winning (2 km)



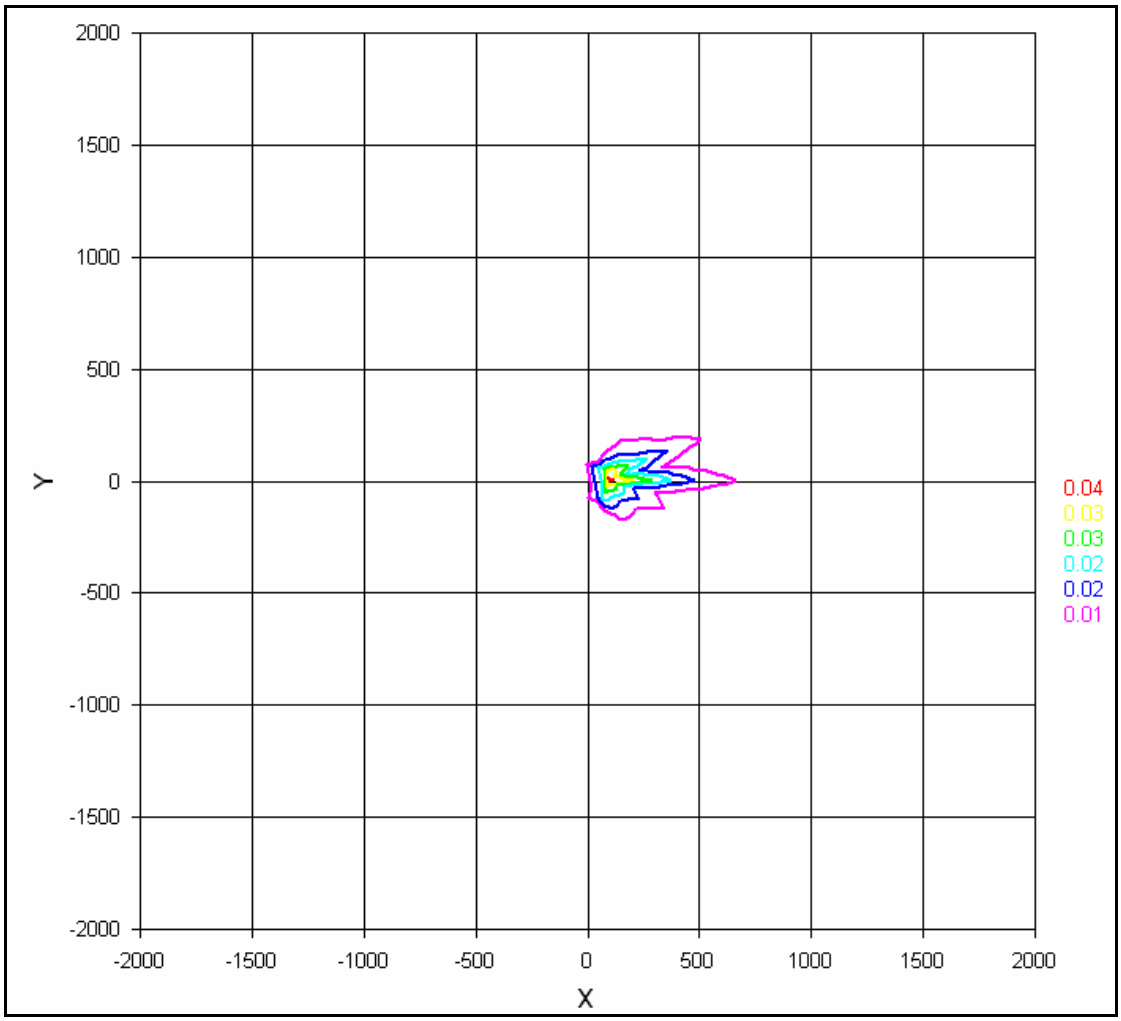
Annexure 6.3: 24 hr average GLC of PM (µg/m3)- Point source Dispersion Modelling

Direction (Degrees)	Distance (metres)														
	100	200	300	400	500	600	700	800	900	1000	2000	3000	4000	5000	10000
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60	0.03	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	0.04	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.04	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
100	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
110	0.03	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
120	0.03	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
130	0.03	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
140	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
150	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
160	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
170	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
210	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
220	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
230	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
240	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
250	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
260	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Direction (Degrees)	Distance (metres)														
	100	200	300	400	500	600	700	800	900	1000	2000	3000	4000	5000	10000
270	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
280	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
290	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
310	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
320	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
330	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
340	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
350	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Isopleth showing GLC of particulate matter for 2 km radius is provided in following

Figure 6.2: Concentration of PM due to emissions from DG set (2 km)



Annexure 6.4: Impacts due to Vehicular Activity Proposed

Direction (Degrees)	DISTANCE (metres)								
	100	200	300	400	500	600	700	800	900
0	0.19	0.12	0.09	0.06	0.05	0.04	0.03	0.02	0.02
10	0.23	0.15	0.10	0.07	0.06	0.04	0.04	0.03	0.03
20	0.24	0.15	0.10	0.07	0.05	0.04	0.04	0.03	0.02
30	0.26	0.17	0.10	0.06	0.05	0.04	0.02	0.01	0.01
40	0.28	0.18	0.11	0.07	0.05	0.03	0.02	0.02	0.02
50	0.32	0.21	0.14	0.11	0.09	0.08	0.06	0.06	0.05
60	0.39	0.25	0.18	0.15	0.12	0.09	0.08	0.06	0.04
70	0.79	0.52	0.40	0.33	0.28	0.25	0.22	0.20	0.18
80	1.69	1.13	0.86	0.71	0.56	0.29	0.10	0.04	0.02
90	2.70	3.54	**3.95**	2.43	1.17	0.73	0.51	0.39	0.30
100	1.80	1.28	1.00	0.82	0.56	0.30	0.11	0.04	0.02
110	1.07	0.74	0.56	0.40	0.34	0.26	0.21	0.19	0.18
120	0.88	0.58	0.43	0.23	0.13	0.11	0.09	0.08	0.05
130	0.76	0.49	0.36	0.22	0.13	0.10	0.07	0.06	0.06
140	0.68	0.43	0.32	0.16	0.12	0.07	0.06	0.05	0.04
150	0.61	0.38	0.28	0.19	0.11	0.09	0.07	0.05	0.05
160	0.50	0.30	0.20	0.16	0.09	0.07	0.06	0.05	0.04
170	0.45	0.27	0.19	0.15	0.12	0.08	0.06	0.05	0.05
180	0.43	0.26	0.18	0.11	0.10	0.08	0.07	0.05	0.04
190	0.41	0.25	0.18	0.12	0.08	0.07	0.06	0.05	0.05
200	0.37	0.23	0.17	0.14	0.10	0.07	0.05	0.04	0.04
210	0.38	0.24	0.18	0.15	0.13	0.11	0.09	0.07	0.05
220	0.35	0.23	0.18	0.15	0.13	0.11	0.10	0.09	0.09
230	0.20	0.11	0.08	0.05	0.02	0.01	0.01	0.01	0.01
240	0.18	0.12	0.09	0.07	0.06	0.05	0.04	0.03	0.03
250	0.08	0.05	0.03	0.02	0.02	0.02	0.01	0.01	0.01
260	0.13	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00
270	0.22	0.12	0.08	0.06	0.05	0.04	0.03	0.02	0.02
280	0.11	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.00
290	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01
300	0.13	0.08	0.06	0.05	0.04	0.03	0.03	0.02	0.02
310	0.12	0.07	0.05	0.03	0.01	0.00	0.00	0.00	0.00
320	0.10	0.06	0.04	0.03	0.03	0.03	0.02	0.02	0.02
330	0.10	0.06	0.04	0.04	0.03	0.02	0.02	0.02	0.01
340	0.15	0.10	0.07	0.06	0.05	0.03	0.02	0.02	0.02
350	0.17	0.11	0.08	0.06	0.03	0.03	0.02	0.02	0.02

It is observed from the results, due to proposed activities, there will be a marginal increase in the level of PM emission due to vehicles and consequent increase in ambient air.

Annexure 6.5: Existing and Proposed Level of SPM Concentration-Aniali (16.21 ha)

AAQM Station Code	Location	Type Of Landuse	Permitted SPM Concentration In Ambient Air (µg/Nm³)	Existing Average SPM Concentration In Ambient Air (µg/Nm³)	Additional SPM Concentration Due To Excavation, & DG Sets (µg/Nm³)	Additional SPM Concentration Due To Traffic (µg/Nm³)	Total (µg/Nm³	Predicted Average SPM Concentration In Ambient Air (µg/Nm³)	Predicted Increase In SPM Levels (%)	Remarks
A 1	At Site	Industrial	500	**178**	6.05	3.95	10.0	**188**	5.61	Within Norms
A 2	Ramghad Village	Residential	200	**136**	0.0	0.0	0.0	**136**	0.0	Within Norms
A 3	Bhod Village	Residential	200	**145**	0.0	0.0	0.0	**145**	0.0	Within Norms
A 4	SH-27	Others	200	**146**	0.0	0.0	0.0	**146**	0.0	Within Norms
A 5	Aniali Mine (15.99)	Industrial	500	**183**	0.0	0.0	0.0	**183**	0.0	Within Norms
A 6	Aniali Village	Residential	200	**129**	0.0	0.0	0.0	**129**	0.0	Within Norms
A 7	Sakhpur Village	Residential	200	**126**	0.0	0.0	0.0	**126**	0.0	Within Norms
A 8	Bordi Village	Residential	200	**126**	0.0	0.0	0.0	**126**	0.0	Within Norms
A 9	Daulatagadh Village	Residential	200	**129**	0.09	0.0	0.09	**129.09**	0.06	Within Norms

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LEGENDS

- STUDY AREA
- MINE AREA
- ROAD
- RAILWAY LINE
- DISTRICT BOUANDARY
- BWLS BOUNDARY
- NALIADHAR RF BOUNDARY
- JAMBUDA RF BOUNDARY
- WATER BODY

N W E S

SCALE

0 2 4 6 8KM

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E-mail: kadamenviro@kadamenviro.com

PROJECT: REIA & EMP FOR MINING PROJECT
ANIALI RANABORDI LIMESTONE MINE
AREA - 16.21 HECT

OWNER: M/S TATA CHEMICALS LIMITED
RANAVAV, DIST.-PORBANDAR(GUJARAT)

TITLE: Map showing LANDUSE/LANDCOVER in the study area

REVISION : 0	DRAWN BY : JBS	DRAWING NO
SCALE : As Shown	CHD BY : SP	3.3
DATE : 20/03/2006	APPROVED BY :	

SOURCE : IRS-P6 LISS-III Precision Geocoded Acquired on

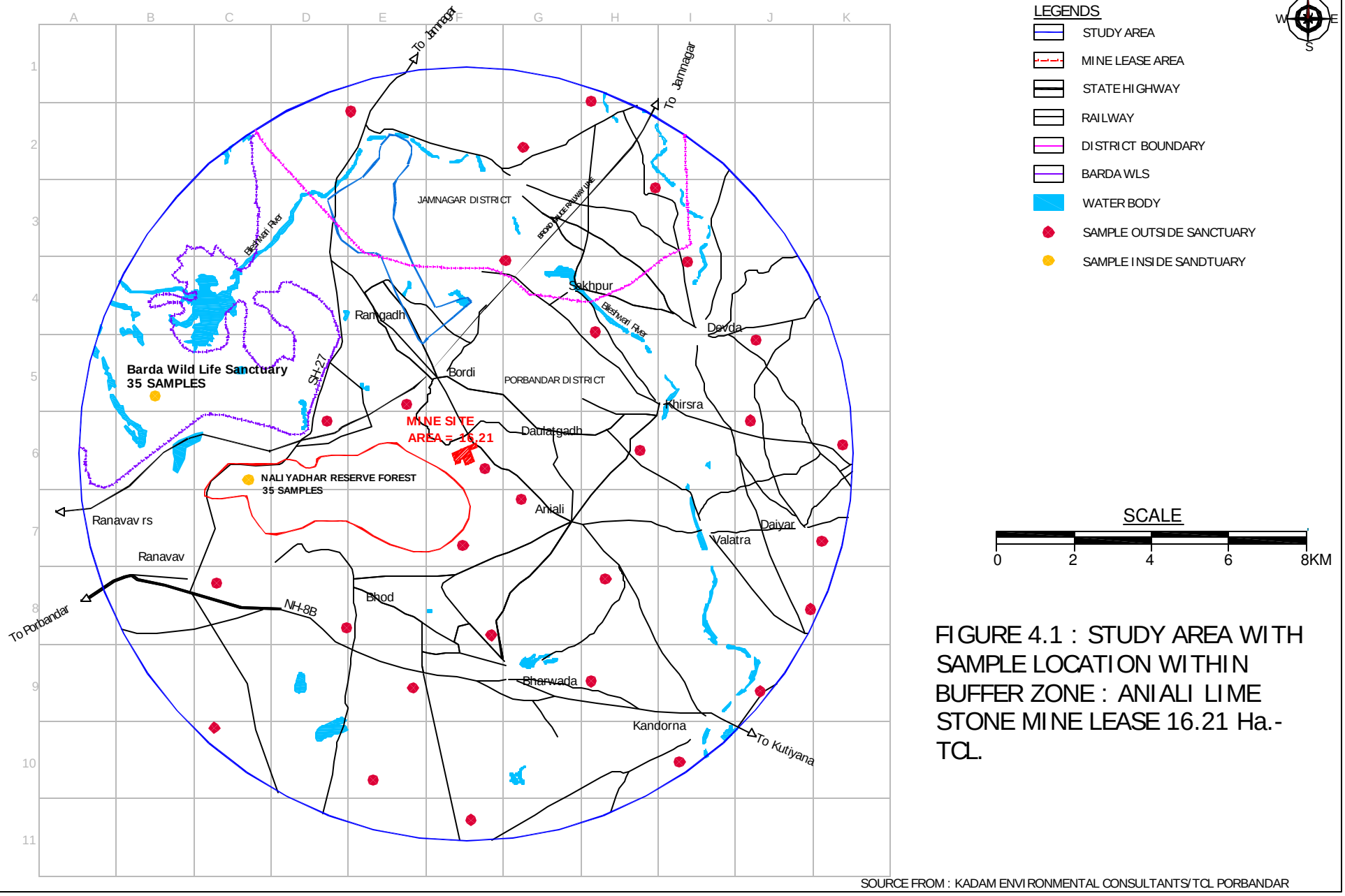
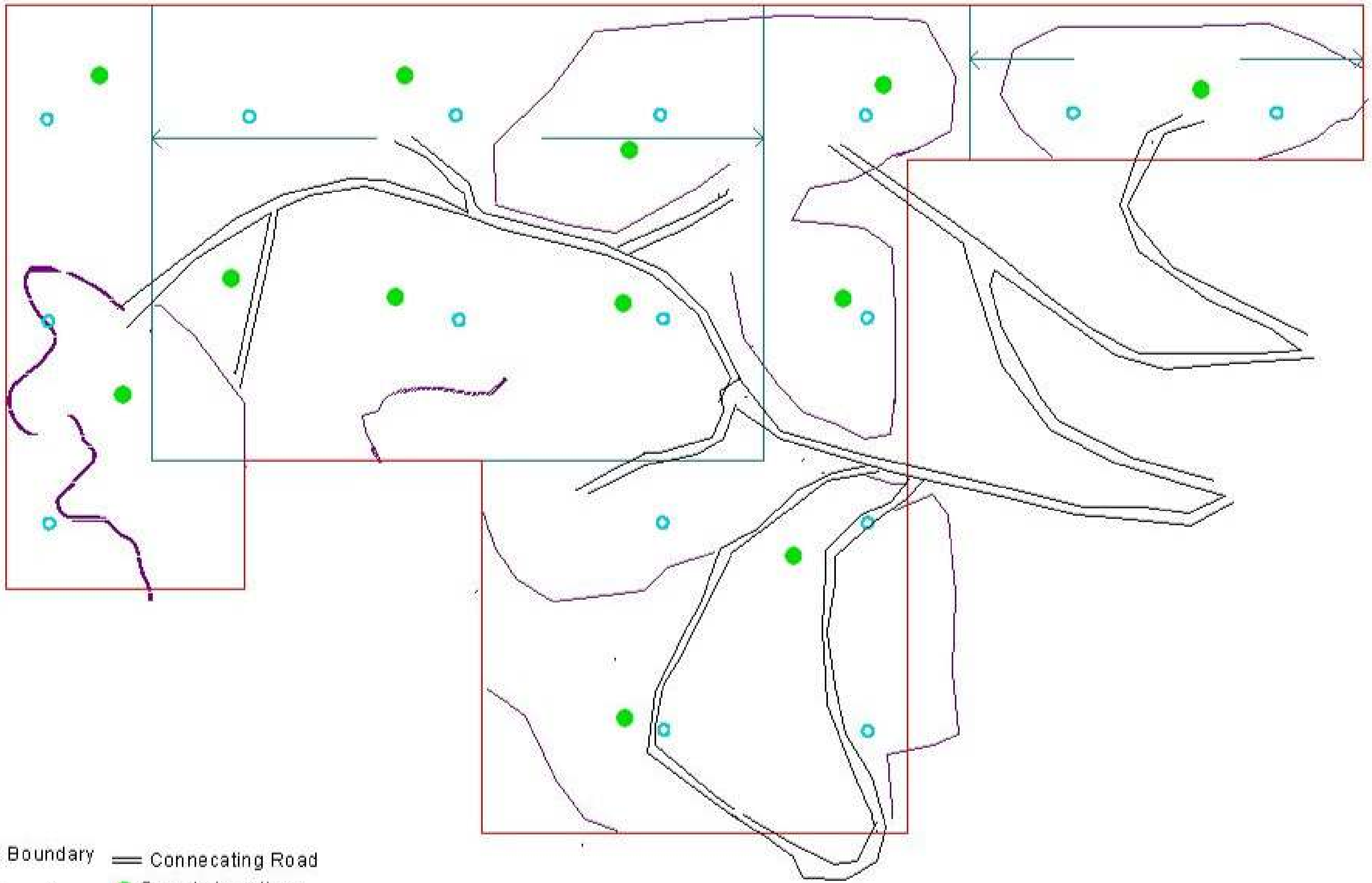

LEGENDS
STUDY AREA
MINE LEASE AREA
STATE HIGHWAY
RAILWAY
DISTRICT BOUNDARY
BARDA WLS
WATER BODY
SAMPLE OUTSIDE SANCTUARY
SAMPLE INSIDE SANDTUARY
N
S
E
W
SCALE
0
2
4
6
8KM
To Jamnagar
To Jamnagar
JAMNAGAR DISTRICT
Bhogat Pipeline
Bhogat Pipeline
Bhogat Pipeline

Figure 4.2: Sample Locations within The core zone: Aniali Limestone Mine Lease Area 16.21ha. - TCL



SOURCE From: KADAM Environmental Consultants/ TCL

Plate 1. Field Data collection

Field Data Collection & Major Habitats	
Agriculture habitat	Waste Land – Prosopis patch
Part of Naliyadhar RF	Part of Barda Sanctuary
Indirect Evidences	
Hyena Pellets	Leopard Pugmark
Porcupine Pellets	Wild boar

Plate 2. Faunal species of Study Area

Asian Koel

Wild boar

Common Garden Lizard

Indian Skittering Frog

Indian Hare

Pied Kingfisher

Indian Bull Frog

Jacakal

Common Crane

Indian Peafowl

FAUNAL DIVERSITY

Central Ground Water Authority
Ministry of Water Resources
Government of India

Annexure X

No. No.21-4(860)/WCR/CGWA/2011- 949 **Dated-** 27 JUL 2011

To,
Shri. R J Buch, Head- Safety, Health and Environment.
M/s Tata Chemicals Ltd.
Mithapur, Okhamandal,
Gujarat 361345

Sub: Request for Ground Water clearance in respect of M/s Tata Chemicals Ltd., for their proposed Limestone mines – Aniali Mining Lease (16.21 Hect) at Survey No. 207/P, village Aniali, Tehsil Ranavav, District Porbander, Gujarat -reg.

Sir,

The area where the project falls comes under semi-critical category as per the ground water assessment carried out by Central Ground Water Board. Since the total requirement of ground water is **30 m^3/day**, NOC is not required for ground water withdrawal from Central Ground Water Authority. However, to neutralize the adverse impact of ground water withdrawal that may arise on a long term basis, the industry/ project is advised to undertake the following measures:

1. Ground Water withdrawal shall not exceed the proposed quantity of **30 m^3/day**.
2. All abstraction structures should be fitted with water meter by the industry and monitoring of ground water abstraction to be undertaken accordingly on regular basis, at least once in a month. The data may be submitted on a yearly basis to the Regional Director, Central Ground Water Board, West Central Region, Ahmedabad for perusal and records.
3. The industry should adopt and implement artificial recharge measures/rain water harvesting measures for augmenting the ground water resources of the area as per the hydrogeological investigation.
4. The industry shall ensure proper conservation measures, recycling and reuse of waste water after adequate treatment.
5. The industry shall monitor the ambient ground water regime of the area through piezometers and submit the data on a yearly basis to the Regional Director, Central Ground Water Board, West Central Region, Ahmedabad for perusal and records.

Yours faithfully,

Regional Director
27/7/11

Copy for information to the:

1. The Member Secretary, Gujarat Pollution Control Board, Sector 10 A, Gandhinagar 362043, Gujarat, with a request to ensure that Rain Water Harvesting and Artificial Recharge methods are being implemented by the firm and the total quantity of ground water withdrawal is not exceeding **30 m^3/day**.
2. The Director, Ministry of Environment and Forests, Paryavaran Bhawan, CGO Complex, Lodhi Road, New Delhi 3. This has reference to your letter No. J-11015/471/2007-IA-II(M) dated 15.10.07.
3. Regional Director, Central Ground Water Board, West Central Region, Swaminarayan Arts College Building, Shahalam Toll Naka, Ahmedabad 380022, Gujarat. This has reference to your letter No. TS/8(9)/WCR/CGWB/759/ 825 dated 11.05 .11.
4. TS to Chairman, Central Ground Water Board, NH-IV, Faridabad.

Regional Director

16/11, Jamnagar House, Man Singh Road, New Delhi 110011
Tel: (011) 23381089, 23384973: Fax (011) 23386743 e-mail: tsmsml-cgwb@nic.in web site: http://cgwb.gov.in

Annexure XI

अनुमोदित
पत्र सं. 682 (23) ML437/2009
खा.नि.ख.स. (उ) उदय,
दिनांक 01/04/2015 के द्वारा

MINING PLAN

with

UNDER RULE 24 (A) OF M.C.R.1960 & 23 (B) OF M.C.D.R.1988.

For

ANIALI LIMESTONE MINE

NEAR VILLAGE – ANIALI, TALUKA – RANAVAV

DIST - PORBANDAR (GUJARAT)

LEASE AREA - 16.21 HECT. SURVEY NO. 207/(P) (NON FOREST)

First Mining Lease grant : from 29-10-1964 to 28-10-1984

First Renewal of M.L. : from 29-10-1984 to 28-10-2004

Second Renewal of M.L. applied : from 29-10-2004 to 28-04-2024

(MINING PLAN PERIOD: 2014-15 to 2018-19)

LESSEE

M/s TATA CHEMICALS LIMITED

P.O. – Mithapur: 361345,

Taluka – Okhamandal, Dist- Jamnagar, Gujarat

Phone: +91 2892 223792, 223793 Fax: +91 2892 223227

Email: sbhakta@tatachemicals.com

Approved

1/4/15

क्षेत्रीय खान नियन्त्रक

Regional Controller of Mines

भारतीय खान ब्यूरो, उदयपुर

Indian Bureau of Mines, UDAIPUR

Reg. No. IBM/437/2011

Mine Code No. 38 GUJ 08177

PREPARED BY

M/S UDAIPUR MIN - TECH PVT. LTD.

UDAIPUR - 313002 (RAJ.)

RQP NO.- RQP/UDP/354/2009/B, valid up to 20.8.2019

Phone No. & Fax No.(0294) 2489672 Email - ssbist@udrmintech.com

पंजीकृत / साधारण

भारत सरकार
खान मंत्रालय
भारतीय खान ब्यूरो
क्षेत्रीय खान नियंत्रक का कार्यालय

सं 682(23)(एम.पी.437) / 2008 खानिखस(उ)उदय

हिरणमगरी,सेक्टर 11,
उदयपुर (राज.)
दिनांक 01/04/2014

प्रेषित :– मेसर्स टाटा केमिकल्स लि.
पोस्ट– मिठापुर : 361345,
तहसील– ओखामंडल,
जिला– जामनगर (गुज.)

विषय :– खनिज रियायत नियमावली,1960 के नियम 24 एवं खनिज संरक्षण एवं विकास नियमावली, 1988 के नियम 23(B) के अंतर्गत पट्टा नवीनीकरण हेतु मेसर्स टाटा केमिकल्स लि. के पक्ष में प्रस्तुत निकट ग्राम अनियाली, तालुका– रानावाव, जिला– पोरबन्दर (गुज.) में स्थित अनियाली चूनापत्थर खान (सर्वे न. 207(पी), क्षेत्र 16.21 हेक्टेयर) की खनन योजना सह उत्तरोत्तर खान बंद करने की योजना का अनुमोदन।

संदर्भ :– 1. आपका पत्र दिनांक 09.12.2013।
2. इस कार्यालय का समसंख्यक पत्र दिनांक 10.12.2013 एवं 22.01.2014।
3. आपके आर.क्यू.पी. का पत्र दिनांक 10.02.2014।

महोदय,

खान व खनिज (विकास व विनियमन) अधिनियम,1957 की धारा 5 की उपधारा 2 के उपबंध (बी) सपठित भारत सरकार के आदेश क्रमाक एस.ओ.445(ई) दिनांक 28.4.1987 के द्वारा प्रदत्त अधिकारों का प्रयोग करते हुए मैं एतद्द्वारा उल्लेखित खनन योजना सह उत्तरोतर खान बन्द करने की योजना का अनुमोदन करता हूँ । यह अनुमोदन निम्नलिखित शर्तो के अधीन किया जाता है :–

1. इस खनन योजना सह उत्तरोतर खान बन्द करने की योजना का अनुमोदन केन्द्र सरकार अथवा अन्य किसी प्राधिकारी द्वारा खान पर समय– समय पर लागू किए गए कानूनों पर प्रतिकूल प्रभाव डाले बिना किया गया है ।
2. यह भी स्पष्ट किया जाता है कि इस खनन योजना सह उत्तरोतर खान बन्द करने की योजना के अनुमोदन में खान एवं खनिज (विकास और विनियमन) अधिनियम,1957 या खनिज रियायत नियमावली, 1960 या और किसी अन्य कानून जिनमें वन (संरक्षण)अधिनियम 1980, पर्यावरण संरक्षण अधिनियम,1986 सहित अन्य किन्हीं कानूनों के किसी अन्य प्रावधान की शर्तों के अनुसार किसी भी प्रकार से सरकार का अनुमोदन समाविष्ट नहीं हुआ है ।
3. इस खनन योजना सह उत्तरोतर खान बन्द करने की योजना का अनुमोदन किसी भी न्यायालय के सक्षम क्षेत्राधिकार के किसी आदेश या निर्देश पर प्रतिकूल प्रभाव डाले बिना किया गया है ।
4. खान अधिनियम 1952 के अंतर्गत खान को चालू करने की सूचना, खान प्रबंधक एवं अन्य वैधानिक नियुक्तियों को अधिसूचित करने सहित उक्त अधिनियम के सभी नियमों एवं उपनियमों की पालना की जाएगी ।
5. खनन योजना सह उत्तरोतर खान बन्द करने की योजना का निष्पादन/क्रियान्वयन, निषेधाज्ञाओं/अधिसूचनाओं, यदि कोई हो तो उनके हटने के अधीन होगा ।
6. खान अधिनियम के अंतर्गत अपेक्षित कोई सूचना/विषय वस्तु का संगुप्त रखना/छिपाना, यदि पाया जाता है और उसके सुधार हेतु कोई प्रस्ताव भी नहीं दिया जाता है तो खनन योजना का अनुमोदन तुरन्त प्रभाव से वापस लेना माना जाएगा ।

7. किसी भी स्तर पर, यदि यह पाया जाता है कि दस्तावेज में दी गई , उपलब्ध कराई गई सूचनाएं असत्य अथवा गलत ढंग से दर्शायी गई हैं, तो दस्तावेज का अनुमोदन तत्काल प्रभाव से निरस्त कर दिया जायेगा ।

8. यह अनुमोदन प्राप्त प्रस्ताव 2014–15 से 2018–19 में 4,32,727 टन उत्पादन के लिये दिया जाता है ।

9. खनन प्रस्ताव का क्रियान्वयन उस क्षेत्र के संबंधित भूमि मालिक से अनापत्ति प्राप्त कर ही किया जाएगा।

10. वित्तीय आश्वासन की अवधि 31.03.2019 को समाप्त हो रही है। अवधि समाप्ति की तिथि को अथवा उससे पहले नया वित्तीय आश्वासन खान मालिक द्वारा क्षेत्रीय खान नियंत्रक,भारतीय खान ब्यूरो, उदयपुर को प्रस्तुत किया जायेगा ।

11. मुख्य खान नियंत्रक के परिपत्र संख्या 2/2010 दिनांक 4.4.2010 एवम अनुपूरक दिनांक 21.09.2011 में उल्लेखित सभी प्रावधानों की अनुपालना छः माह में सुनिश्चित कर उससे सम्बंधित वांछित दस्तावेज/सूचना इस कार्यालय में प्रस्तुत करें ।

इस खनन योजना सह उत्तरोत्तर खान बन्द करने की योजना की एक प्रति खान पर पदस्थ खनन अभियन्ता को उपलब्ध कराई जाये जिससे प्रतिदिन का खनन इसके अनुरूप हो सके ।

संलग्न :– अनुमोदित खनन योजना सह उत्तरोत्तर खान बन्द करने की योजना की प्रति

भवदीय

1/4/14

(जे.आर.चौधरी)
क्षेत्रीय खान नियंत्रक
भारतीय खान ब्यूरो

Reg. No. 115
TATA CHEMICALS LTD.
RECEIVED
7 APR 2014
MITHAPUR-361 345.

TATA CHEMICALS LTD.
RECEIVED
Reg. No. 23
11 APR 2014
RANAVAV - QUARRY
360550

AUTHORISATION

I Shailendra Singh Bist, authorised signatory for M/S Udaipur Min-Tech Private Limited, Udaipur holding RQP Certificate no. RQP/UDP/354/2009/B hereby authorise the following Key Persons to prepare the Mining Plan and Progressive Mine Closure Plan under Rule 24 of M.C.R.1960 and rule 23 B of M.C.D.R.1988 of Aniali limestone mine, area 16.21 Ha, Survey no.207/P, near village Aniali, Taluka Ranavav, district Porbandar, Gujarat of M/S Tata Chemicals Limited, P.O. Mithapur, Taluka Okhamandal, district Devbhumi Dwarka (formerly Jamnagar) 361345. Gujarat.

Names and addresses of Key person & RQP are as follows:

1. Shailendra Singh Bist, Mining Geologist & RQP(IBM)
2. B L Mod, Mining Engineer & RQP (IBM)

Address : 206 "APEKSHA COMPLEX"
SECTOR NO. - 11, HIRAN MAGRI,
UDAIPUR – 313001(RAJ.),
PHONE – 91-294-2489672
E mail- ssbist@udrmintech.com

For Udaipur Min-Tech Pvt. Ltd.
(No. RQP/UDP/354/2009/B,valid up to 20.8.2019)

Place : Udaipur
Date : 10-5-13

(Shailendra Singh Bist)
Authorized Signatory

UDAIPUR MIN-TECH PVT. LTD.
MINING & GEOLOGICAL ENGINEERS
RQP (IBM), EIA CONSULTANT (NABET)

CERTIFICATE

We, M/S Udaipur Min-Tech Private Limited, holding RQP Certificate no. RQP/UDP/354/2009/B herby certify that

A. The provisions of the Mineral Conservation and Development Rules 1988 have been observed in the Mining Plan with Progressive Mine Closure Plan for Aniali limestone mine, area 16.21 Ha. Survey no.207/P, near village Aniali, Taluka Ranvav, district Porbandar, Gujarat of M/S Tata Chemicals Limited, P.O. Mithapur, Taluka Okhamandal, district Devbhumi dwarka (formerly Jamnagar) 361345, Gujarat, and wherever specific permission is required the Lessee will approach the concerned authorities of Indian Bureau of Mines for granting the permission.

B. It is also certified that the provisions of the Mines Act, Rules and Regulations made there under have been observed in the aforesaid Mining Plan with Progressive Mine Closure Plan and wherever specific permissions are required, the Lessee will approach the Directorate General of Mines Safety.

C. It further certified that the aforesaid Mining Plan including PMCP is prepared as per the copies of the records and documents provided by the Lessee and information given as per discussions held with the representative of Lessee.

D. It is also certified that the information furnished in the aforesaid Mining plan including PMCP are true and correct to the best of our knowledge and belief, and in case of default the approval would be withdrawn.

For Udaipur Min-Tech Pvt. Limited
No. RQP/UDP/354/2009/B,
Vaiid up to 20.8.2019

Place Udaipur
Date 5-11-13

Bheru Lal Mod
Mining Engineer & RQP
Key Person

Shailendra Singh Bist,
Geologist & RQP
Key Person

ISO 9001:2008 CERTIFIED CO
206 "APEKSHA COMPLEX" Sector 11, Hiran Magri, Udaipur - 313 002
Telefax +91-294-2489672 (O), Cell : +91 94141 67672 Email : ssbist@udrmintech.com
visit us at : www.udrmintech.com

CERTIFICATE

1. It is certified that the provisions of the Mines Act, Rules and Regulations made thereunder have been observed in the Mining Plan with Progressive Mine Closure Plan for Anialli Limestone mine, S. No. 207/P over an area of 16.21 Hect for mineral Limestone in village -Anialli, Taluka – Ranavav, Distt. Porbandar (Gujarat.) belonging to M/s Tata Chemicals Ltd. At & Post- Mithapur, Taluka - Okhamandar, Distt. Devbhumi Dwarka (Gujarat) and wherever specific permissions are required, the Lessee will approach the Director General of Mines Safety. Further, standards as prescribed by DGMS in respect of Miner's health will be strictly implemented.

2. The Progressive Mine Closure Plan for Anialli Limestone mine S. No. 207/P over an area of 16.21 Hect for mineral Limestone in village Anialli, Taluka – Ranavav, Distt. Porbandar (Gujarat) belongs to M/s Tata Chemicals Ltd. At & Post - Mithapur, Taluka – Okhamandar, Distt. Devbhumi Dwarka(Gujarat) complies all statutory Rules, Regulations, Orders made by the Central or State Government, Statutory Organization, Court etc. have been taken into consideration and wherever any specific permission is required, Lessee will approach the concerned authorities

For M/S Tata Chemicals Ltd.,

R.Mukundan.
Managing Director
Nominated owner
IBM registration No. IBM/437/2011

Place : Mumbai
Date : 8-11-13

TATA

DECLARATION

1 The Mining Plan including Progressive Mine Closure Plan for Anialli Limestone mine, S. No. 207/P over an area of 16.21 Hect for mineral Limestone in village Anialli, Taluka –Ranavav, Distt. Porbandar (Gujarat) belonging to M/s Tata Chemicals Ltd. At & Post - Mithapur, Taluka - Okhamandar Distt. Devbhumi Dwaraka (Gujarat) has been prepared in full consultation with me and I understand its contents and agree to implement the same in accordance with law and in case of default the approval would be withdrawn.

2 It is further declared that during the pendency period of the approval of above said document or thereafter if any change occurs in the name and address of lessee / partners / Board of directors etc., it will be informed promptly.

3 It is also further declared that I am not working in any other Firm / Organization / Company.

For M/S Tata Chemicals Ltd.,

R.Mukundan.
Managing Director
Nominated owner
IBM registration No. IBM/437/2011.

Place : Mumbai
Date : 8-11-13

TATA

UNDERTAKING

1. I, R. Mukundan, on behalf of Lessee Anialli Limestone mine, S. No. 207/P over an area of 16.21 Hect for mineral Limestone in village Anialli, Taluka –Ranavav, Distt. Porbandar (Gujarat), belongs to M/s Tata Chemicals Ltd. At & Post – Mithapur, Taluka – Okhamandar, Dist – Devbhumi Dwarka hereby undertake that all the commitments so made in the aforesaid Mining Plan with Progressive Mine Closure Plan by the RQP M/s Udaipur Min-Tech Pvt. Ltd., RQP/UDP/354/2009/B to be deemed to have been made with my knowledge and consent and as such shall be acceptable to me and binding on me in all respects.
2. I, R. Mukundan , on behalf of Lessee Anialli Limestone mine, S. No. 207/P over an area of 16.21 Hect for mineral Limestone in village Anialli, Taluka –Ranavav, Distt. Porbandar (Gujarat), belongs to Tata Chemicals Ltd. At & Post – Mithapur, Taluka – Okhamandar, Dist – Devbhumi Dwarka (Gujarat), hereby also undertake that all the measures proposed in this Progressive Mine Closure Plan will be implemented within a time bound manner from the date of approval of this PMCP as proposed
3. I, R. Mukundan, further undertake that information and requisite plates as required under CCOM's Circular No. 2/2010 regarding provisions of fixing of boundary pillars, Geo-referenced Cadastral Map/Mining Lease Map etc. shall be submitted within 180 days from the date of approval of this document comprising Scheme of Mining with Progressive Mine closure Plan for the aforesaid mine.

For M/S Tata Chemicals Ltd.,

R.Mukundan,
Managing Director
Nominated owner
IBM registration No. IBM/437/2011

Place : Mumbai
Date : 8-11-13

AUTHORISATION LETTER BY THE LESSEE

I, R. Mukundan, hereby authorize M/s Udaipur Min-Tech Pvt. Ltd. RQP No RQP/UDP/354/2009/B to prepare the Mining Plan including PMCP under rule 24 (A) MCR, 1960 & 23 (B) 2 of MCDR, 1988 in respect Anialli Limestone mine, S. No. 207/P over an area of 16.21 Hect for mineral Limestone in village Anialli, Taluka –Ranavav Distt. Porbandar (Guarat.) belonging to M/s Tata Chemicals Ltd. At & Post - Mithapur, Taluka - Okhamandar Distt. Devbhumi Dwarka (Gujarat.)

I request to the Regional Controller of Mines, Indian Bureau of Mines, Udaipur to make further correspondence regarding modification /withdrawal /re-submission and to collect the approved copies of the aforesaid Mining Plan with PMCP with the said recognized person on his following address:

M/s UDAIPUR MIN-TECH PVT LTD.
(RQP/UDP/354/2009/B, Valid up to 20.08.2019)
Address:- 206 Apeksha Complex,
Sector no.11, Hiran Magri,
Udaipur. 313002. Phone no. 0294-2489672.
E mail :- ssbist@udrmintech.com

For M/S Tata Chemicals Ltd.,

Place : Mumbai
Date : 1-5-13

R.Mukundan.
Managing Director
Nominated owner
IBM registration No. IBM/437/2011.

CONTENTS

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4	Mining Lease Renewal deed form K
5	Application for second renewal of M.L.for 20 years
6	S.O.M. approval letter dt. 29-1-2004
7	S.O.M. approval letter dt. 21-10-2008
8	TOR letter dt.19-3-2013
9	Board resolution for Nominated owner
10	Photo ID and address proof of nominated owner
11	Analysis report of Limestone from NABL Lab.
12	Letter to DILR, Porbandar
12 A	Land jamabandi map for survey no.207
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14	RQP certificate.
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अनुमोदित
पत्र सं. CC2 (23) MP/437/2008
खा.नि.ख.स. (उ) उदय.
दिनांक 01/06/2015 के द्वारा

INTRODUCTION

Tata Chemicals Ltd. is world's second largest producer of Soda ash and most geographically diversified Soda Ash Company. It has manufacturing facilities in India, U.K., U.S.A. and Kenya. The company has a global capacity of around 5.5 million tones of soda ash per annum. The company has 5 star rating from British Safety Council.

Tata Chemicals limited is a public limited company registered under Company's Act, Refer Annexure no.1, the certificate of company's incorporation is enclosed as Annexure no.2.

Tata Chemicals limited had put their first Soda Ash plant at Mithapur in 1939 with 50 tpd capacity & have gradually expanded their capacity & widened their product line over the years to become one of the most important national center for integrated production of basic chemicals in the country.

Tata Chemicals Ltd. have in due course expanded the capacity of their chemical plant to 8,75,000 t.p.a., which is about 34% of the country's capacity. Company has also established a cement plant at Mithapur with an annual rated capacity of 4,40,000 t.p.a. with a view to utilizing the fines (-50 mm) left behind after screening the ROM to obtain sized material for Soda Ash Plant along with other sub grade limestone obtained as overburden or interburden during mining of chemical grade limestone. TCL now propose to expand the capacity of the Soda Ash Plant to 10,00,000 t.p.a and of the Cement Plant to 8,80,000 t.p.a. in future.

Soda ash product line consists of four categories i.e. Soda ash light, dense, medium dense and granular. Soda ash is used in glass, soap & detergent, chemicals, pulp & paper industry.

अनुमोदित
Approved
1/6/15
क्षेत्रीय खान नियन्त्रक
Regional Controller of Mines
भारतीय खान ब्यूरो, उदयपुर
Indian Bureau of Mines, UDAIPUR

The chemical grade limestone is one of the basic raw materials used in soda ash manufacturing process in the form of CaO and CO2. To manufacture one tonne soda ash 1.55 tonne of limestone is required. Sized limestone of (+50mm to -100mm) is fired in lime kiln. The lime is used for disengaging fixed ammonia from mother liquor and carbon dioxide also known as kiln gas is required for carbonating ammonia brine.

Company is operating number of mines and details of the leases held by the company are given below:

Sr. no.	Survey No.	Village	Taluka	District	Area in Hect.
1	60/1 & 71/2	Godhana	Porbandar	Porbandar	86.65
2	A1, F & D Plots, 5/6 & 602/P	Adityana	Ranavav	Porbandar	42.90
3	602/P	Adityana	Ranavav	Porbandar	16.8755
4	602/P	Adityana	Ranavav	Porbandar	2.14
5	22/P	Boricha (Zinzerka)	Porbandar	Porbandar	14.27
6	5/6/P	Adityana naviline	Ranavav	Porbandar	12.62
7	5/6/P	Adityana naviline	Ranavav	Porbandar	9.21
8	QP-209	Adityana	Ranavav	Porbandar	1.0995
9	78/P	Ranavav Govalani	Ranavav	Porbandar	25.45
10	207/P	Anjali	Ranavav	Porbandar	21.04
11	207/p	Anjali	Ranavav	Porbandar	16.21
12	21/P	Anjali	Ranavav	Porbandar	15.9953
13	207/P	Anjali	Ranavav	Porbandar	12.27
14	94/P	Anjali	Ranavav	Porbandar	6.07
15	180/P	Ishwariya	Kutiyana	Porbandar	26.10
16	448/P	Ishwariya	Kutiyana	Porbandar	21.04
17	180/P	Ishwariya	Kutiyana	Porbandar	14.37
18	221	Ishwariya / Devda	Kutiyana	Porbandar	13.44
19	437/P	Ishwariya	Kutiyana	Porbandar	13.15
20	399/P	Ishwariya	Kutiyana	Porbandar	8.7
21	437/P	Ishwariya	Kutiyana	Porbandar	3.4
22	211/216	Ranpur	Bhanwad	Jamnagar	232.10
23	160/P	Pachhtar	Bhanwad	Jamnagar	116.05544
24	51/P	Mokhana	Bhanwad	Jamnagar	107.69
25	77/P	Pachhtardi	Bhanwad	Jamnagar	76.19
26	209/P	Ranpur	Bhanwad	Jamnagar	28.85
27	209/P	Ranpur	Bhanwad	Jamnagar	14.16

Presently out of 27 leases, 11 leases are active others are dormant in the absence of enviornment clearance for which the process is on. Only the chemical-grade limestone is being produced from these leases and after sizing, the sized material (+50 to 100 mm) is fed to the company's Soda Ash plant at Mithapur. The under size

is fed to company's cement plant, situated near the Soda Ash plant for cement manufacture. From the production figure of previous years that over-all production of plant feed is about 50% of the plant from captive mines and rest is being procured from open market and import. Now company has made strategy to increase production from captive mines and reduce the procurement from open market.

The term Inferior grade is used and meant for cement grade limestone in the text of this mining plan.

The Mining lease for Survey no. 207/P, over an area of 16.21 hectares near village Aniali, Taluka Ranavav, District Porbandar, Gujarat was executed for a period of 20 years with effect from 29-10-1964 to 28-10-1984.

The first renewal was executed on 21-7-1987 vide letter no.MCR-1583(T-4)GOI-184-CHH dt.9-9-1986 for 20 years and expired on 29-10-2004. Refer Annexure no. 3.

The first renewal mining lease deed in form K is attached as Annexure no.4.

The second renewal was applied on 21-10-2003 in Form J for 20 years from 29-10-2004 to 28-10-2024 and it is still under consideration of the state government. Refer Annexure no.5.

The lease is being worked as deemed extended period pending the agreement for renewal.

This mine has been worked during the years 1985-1994, when total Limestone excavated was 284043 tons, whereas the maximum production during the year 1987-88 was 55065 tonnes.

The Scheme of Mining was approved under MCDR 1988 by Regional Controller of Mines, Indian Bureau of Mines, Udaipur vide letter No. 682(23)(MS-228)-MCCM(N)-Udp. dt.29-1-2004, for period of 2003-04 to 2007-08. This SOM expired on 31-3-2008 . Refer Annexure no. 6.

The Company has further submitted their next SOM which was approved under MCDR 1988 by Regional Controller of Mines, Indian Bureau of Mines, Udaipur vide letter No. 682(23)(MS-437)/2008-MCCM(N)-Udp. dt. 21-10-2008, for period ending 31-3-2013. Refer Annexure no. 7.

The Mining Plan was to be submitted at the time of renewal of mining lease when it was due in 2004, but not so done earlier, so the present document is submitted now.

Environment clearance for Aniali Limestone Mining Project- 16.21 Ha has been applied and it is under process. TOR letter no.J-11015/308/2012-IA.II(M) dt.19-3-2013 is received from MoEF , GOI, New Delhi, Refer Annexure no.8.

The company has applied for Geo referenced Cadastral map to the District Inspector of Land Records , for area of this mining lease superimposed on scale of 1:3960 for submission to IBM. The copy of the request letter dt.30-6-2012 is enclosed in this report for record. Refer Annexure no.12.

The Land Jambandi map with mining lease area's dimensions in Survey no.207, issued from the District Inspector Land Records , Junagadh ,Village report no.7 and 12 are enclosed as Annexure no.12A.

During the pendency of approval, in case there is any change in the name and address of the Board of Directors, the I.B.M. will be informed forthwith.

This Mining Plan along with Progressive Mine Closure Plan is submitted under the Rules 24(A) of M.C.R. 1960 & 23(B) of M.C.D.R.1988 for approval.

=====*******======

1.0 GENERAL

a) Name & address of the Lessee

Registered office:
M/S Tata Chemicals Limited,
Bombay House,
24, Homi Mody Street, Fort, Mumbai – 400001.
Phone +91 22 6665 8282, 6665 8143/44

b) STATUS OF THE LESSEE

The lessee M/S Tata Chemicals Limited, is a Public Limited Company, operations of the company are controlled by Board of Directors. List of Directors along with their addresses is given below:

S.no.	Name Of Directors	Address
1.	Cyrus P.Mistry (Chairman)	Bombay House, 24, Homi Mody Street, Fort, Mumbai – 40001. www.tatachemicals.com
2.	R Gopalakrishnan (Vice-chairman)	Do
3.	Prasad R Menon	Do
4.	Nusli N Wadia	Do
5.	Nasser Munjee	Do
6.	Dr Yoginder K Alagh	Do
7.	E A Kshirsagar	Do
8.	Dr Y S P Thorat	Do
9.	R Mukundan , M.D.	Do
10.	P K Ghose	Do
11	Dr Vijay Kelkar	Do

Nominated Owner:

Shri R. Mukundan, Managing Director is nominated owner of the company. Copy of Board resolution in favour of Nominated owner is attached as Annexure No.9.

The Photo ID and address proof of Nominated Owner Shri R.Mukundan passport photocopy is attached as Annexure No.10.

c) MINERAL INTENDED TO BE MINED:

Limestone is occuring in the area and intended to be mined.

d) PERIOD FOR WHICH THE MINING LEASE IS GRANTED/RENEWED:

The renewal application is pending consideration of the Government , mine is being worked as deemed extended period from 29-10-2004 to 28-10-2024.

e) Name &Address, registration number of RQP together with validity date.

M/s Udaipur Min-Tech Private Limited.

RQP/UDP/354/2009/B valid up to 20.08.2019

Following two Key persons are authorized to prepare the mining plan.

i) Shailendra Singh Bist & ii) Bheru lal Mod

Address : 206 "APEKSHA COMPLEX"
SECTOR NO. - 11, HIRAN MAGRI,
UDAIPUR – 313002(RAJ.),
PHONE & FAX no. 91-294-2489672. Mobile no. 9414167672.
E mail : ssbist@udrmintech.com, info@udrmintech.com

f) Name of the Prospecting Agency:

M/S Tata Chemicals Limited has carried out prospecting of the area.

g) Reference no. and date of Consent letter from the State Government :

No. MCR-1583-(T-4) COI-104, Chh1 Dt.9th September 1986. See Annexure no.3 and Annexure no.4.

Mineral(s) to be mined

Lessee intends to mine Limestone. The group composite sample of Limestone showed the following percentage values on analysis as given in Table below, Refer Annexure no.11.

Radicals	Chemical Analysis %
SiO_2	1.73
Al_2O_3	0.17
Fe_2O_3	0.32
CaO	54.51
MgO	0.50
LOI	42.37
$CaCO_3$	97.30
$MgCO_3$	1.05
Bulk density	2.016

Area and date of expiry of lease

The Mining lease for Survey no. 207/P, over an area of 16.21 hectares near village Aniali, Taluka Ranvav, District Porbandar , Gujarat was executed for a period of 20 years with effect from 29-10-1964.

The lease is being worked as deemed extended period , the date of expiry of lease will be 28-10-2024.

During pendency of approval of Mining Plan, if there is change in the name, address of the applicant the Regional Controller of Mines, Indian Bureau of Mines, Udaipur will be informed forthwith.

Applicant will comply with the provisions of CCOM's circular 02/2010 within six months of approval of Mining Plan, and updated plans will be submitted to IBM.

.....**********.....

2.0 LOCATION AND ACCESSIBILITY

a) Detail of Area (Refer plate 1):-

District and State	Porbandar , Gujarat
Taluka	Ranvav
Village	Aniali
Khasra No./Block Range / Felling Series etc.	Govt. Barren Land, s.no.207/P
M.L. Area (hectares)	16.21 hectares

b) Whether the area is recorded to be in forest:-

There is neither reserve nor protected forest within the M.L. area. No archeological site is within core & buffer zone.

c) Ownership / Occupancy:

The lease area is Govt. Barren Land.

d) Existence of Public road / Railway line, if any nearby and approximate distance:

The lease area can approached by a motorable tracks from the road connecting Aniali village to Vadwala on NH-8B, between Ranavav and Kutiyana. The road distance from Vadwala to the lease area is 15 km. From the village center of Aniali, this lease area is 4.5 Km.

The taluka town of Ranavav, which is the nearest population center from the lease area, is connected with other important towns and cities through a good network of roads with regular public transport services. The distance by road from Aniali lease to Ranavav town via Vadwala is around 15 to 16 km. The centralized mining office complex of TCL at Adityana is at distance of about 25 km from the Aniali lease.

The district town of Porbandar is at a distance of about 33 km. from the lease area. The coastal highway NH-8E running along the Saurashtra coast from Okha to Bhavnagar intersects at Porbandar.

The Soda Ash and Cement plant complex at Mithapur is at a distance of [illegible] km. from Porbandar along the coastal highway.

The road distance from the plant complex at Mithapur to this lease is around 151 km. The state capital at Gandhi Nagar is at a distance of about 388 km from the lease via Vadwala, Kutiyana and Rajkot along NH-8B and 8A.

The railhead at Ranavav is at a distance of 20 km from Aniali along NH-8B and the port town & district town Porbandar at 33 km along the same highway. The railway link at Ranavav connect the place to Ahemdabad via Jamnagar, Rojkot and Viramgam, the distance by rail being as follows :

Ranavav to Jamnagar	:	118 Km.
Ranavav to Rajkot	:	263 Km.
Ranavav to Ahemdabad	:	499 Km.

The railway connection to the factory at Mithapur from Ranavav is through Kanalus Junction(Short of Jamnagar) and Dwarka over a distance of 223 Km.

The nearest civilian air port for regular commercial flights is at Porbandar, the road distance from the lease area Ranavav along NH-8B being around 30 km. Porbandar is also a sea port, the actual distance of the port from the lease area being around 40 km.

Other facility like postal , telegraph, telephone, FAX, STD,ISD etc. are available at Vadwala & Ranavav. TCI offices at Adityana quarry which is also equipped with telephone, STD, FAX & Internet facilities

e) Toposheet No. with Latitude and Longitude:

The applied area falls in Toposheet No. 41-G/14.

Latitude and Longitude of the 10 pillars of boundary are given in table below:

Pillar no.	Latitude	Longitude
1	21°42' 20.15"	69° 49' 38.56"
2	21°42' 17.62"	69° 49' 31.80"
3	21°42' 23.13"	69° 49' 29.44"

4	21°42' 21.73"	69° 49' 25.69"
5	21°42' 19.84"	69° 49' 26.50"
6	21°42' 18.43"	69° 49' 22.72"
7	21°42' 27.06"	69° 49' 19.01"
8	21°42' 35.11"	69° 49' 40.53"
9	21°42' 32.82"	69° 49' 41.52"
10	21°42' 30.11"	69° 49' 34.29"

f) Land use pattern

The total area (16.21 hectares) falls under Govt. Waste Land.

Present land use pattern is as follows:

	Activity	Land use in Ha.
Mining		
	Pits (including undersized Limestone stacks of 3.696 Ha)	9.544
	Dumps	0
	Road	0.49
	Plantation	0.02
	Infrastructure	0
	Mined out Plantation	0
Ag. Land		0
Remaining Virgin govt. Waste land		6.156
Total		16.21

g) General Location &Vicinity Map

General location and vicinity maps are attached as plate no.1 (Route map), Plate no.2 (Key plan). While general location of the area has been shown on plate no.1, showing access route and other available features, area boundaries, has been marked on plate no. 2 Key Plan.

.....*********.....

PART – A

3.0 GEOLOGY AND EXPLORATION

a) Topography, Drainage pattern, General Geology &Local geology

(i) Topography & drainage:-

The lease area falls within the latitude 21° 42' 17.62" to 21° 42' 35.11" & longitude 69° 49' 31.80" to 69° 49' 40.53". Lease area is a limestone outcropping ridge with moderate height. The lease area under reference is a waste land of Aniali village revenue area which is rocky covered and part of the area is covered with soil. There is no prominent water course available within and near lease area but during rainy season rain water flows SE to NW direction and meets nearby small nallas. One Pond is in north east corner of the lease area near pillar no.8. This is in dry position at present and shallow water is accumulated in rainy season only.

The low elevation coastal plains are covered by the rocks of the Miliolite Formation, which overlap the underlying basaltic rocks of the Deccan Trap basalts and the granophyres exposed in the foothills and higher elevations of the Barda range. Thin layers of Miliolite rock are also seen to occupy the hill slopes or interior depressions within the Barda hills as a result of either marine deposition during transgression of the sea or deposition of Aeolian sand blown from the coastal plain where the Miliolite Formation is thicker and purer in so far as the carbonate contents are concerned, one occasionally comes across the typical features of a Karst topography, in the form of cavities and caves, mounds and depressions, all resulting from solution effect of the carbonate rocks.

Regional Rock Type:

(ii) General Geology & Local Geology

a) General Geology:-

The rock formation belonging to Late Pleistocene to Early Holocene age and designated as Miliolite Formation occupies the Saurashtra coastal plain extending from northwest of Porbandar to near Gopnath Point in Bhavnagar district. This formation overlaps the Pliocene and Miocene rocks and occurs directly over the Deccan Trap Formation of Upper Cretaceous to Paleocene age towards the north and east. The regional stratigraphic sequence is given in Table 3.1.

Table 3.1 REGIONAL STRATIGRAPHIC SEQUENCE

AGE	FORMATION	ROCK TYPE
Recent(Holocene)	Alluvium/Recent Limestone	Alluvial Soil, Black-brown soil, coastal limestone
Early Holocene to Late Pleistocene	Miliolite Formation	Arenaceous limestone and calcareous sandstone
Pliocene	Dwarka Beds	Gypsiferous clay and sandy foraminifer limestone
Miocene	Gaj Beds Unconformity	Clay and calcareous clay .....
Paleocene to Upper Cretaceous	Deccan Trap	Basalt and its derivatives including the intermediate and acidic rock types like, dacites, granophyre etc.

The rocks of the Miliolite Formation along the coast have the appearance of dirty white, friable, oolitic calcarinite. Further inland but still along the coastal plains, these are somewhat purer, well consolidated, white oolitic limestone. The rocks occur in beds which show a gentle seaward dip of 5° to 14°. The rocks are extensively cross-laminated showing dune type current bedding.

Alternating coarse and fine grained laminations are common. They occur at various levels, in the coastal plains, along the foothills and high up in their glens. The name "miliolite" has been derived from the Miliolidae, belonging to

the common foraminifer present in profusion in the rock. Composition wise the rocks are extremely variable ranging from near pure limestone deve[illegible] to calcareous sandstone and clays limestone.

The rock formations originated as beach sediments formed in agitated, warm and very shallow waters. They were subsequently cemented by calcspar precipitated from sea water saturated with $CaCO_3$. The warm, shallow, circulating waters were favorable living areas for marine organisms which have left their in shells and fecal pellets.

The occurrence of the Pleistocene beach limestone all over Tertiary coastal plains fringing the Deccan Trap plateau and deep in the interior of the Deccan Trap country at high elevations, tends to lead to the conclusion that during Pleistocene at high elevations, tends to lead to the conclusion that during Pleistocene period the sea level stood much higher that at present. This may be true in respect of the areas of the coastal plain and the foothill regions. But the occurrence of the Miliolite rocks at higher elevation in the interior areas also point to an Aeolian origin indicating that the wind blown particles from the fragmented beach sediments might have been deposited in the valleys of the high hills which acted as natural wind barrier and the sea need not have transgressed to such great heights in order to form the thinner layers of the Miliolite rocks at such higher altitudes.

Geology of the lease Area:

Almost 70% of the lease area has been subjected to mining activity removing the upper part of the limestone formation by shallow pitting. The depth of pits is limited to the extent of chemical grade after which the downward progress has been ceased. The prime area now available for mining of chemical grade is in the Mining Block – 2, which has been demarcated in the Geological plan. The mined out area is now entirely covered by the lower layers of the limestone formation followed downwards by a thin layer of clay resting unconformably over the basement

granophyre. The local stratigraphic sequence as could be deciphered from drilling data is presented in Table 3.2.(Refer Plate No. 4)

GOVT OF INDIA-INDIAN BUREAU OF MINES

Table 3.2 LOCAL STRATIGRAPHIC SEQUENCE

AGE	FORMATION	ROCK TYPE
Recent	Soil (0.05 m·Max.)	Dark grey to brownish, thin impersistent layer of top soil.
Pleistocene	Miliolite Formation –11m(Max.)	Coarse to Medium to fine grained, light gray to grayish white limestone with occasional bands of impure limestone and calcareous clay.
Miocene	Gaj Beds(Impersistent)	Clay & Calcareous clay
.....	Unconformity	.....
Pliocene to Upper Cretaceous	Deccan Trap	Granophyre

3.3 Rock Types:

Description of the rocks units within the area:

Alluvium: A thin layer of soil of thickness about 0.05 m exists in the area, overlying the limestone.

Limestone : The limestone being the main subject of the study, its chemical and quality aspects will be discussed in a separate later chapter. The greater part of the limestone has already been mined. The maximum thickness of the remaining limestone horizon is about 11 meters along parts of the peripheral area outside the worked out pits. In the worked out area the thickness varies from two to nearly ten meters at places. Based on the quality variation, three separate bands have been identified–

1	Chemical grade	Chemical grade Limestone with $CaCO_3$ + $MgCO_3$ % - > 92%, SiO_2% below 4%.
2	Marginal grade	Cement grade Limestone with $CaCO_3$ + $MgCO_3$ % - 90 to 92%, SiO_2% above 4%
3	Inferior /Cement grade	Cement grade Limestone with CaCO3 + $MgCO_3$ % - Less than 92%, SiO_2% above 5%.

However, their distribution does not follow any regularity and thin lenses of inferior grade occur within the chemical grade band and vice versa. The upper band is comparatively thin with lensoidal occurrence having a thickness varying from 3 meters to 8 meters in some sections.

Gaj Beds : These are represented by thin layer of brownish clay underlying the limestone and resting over the basement granophyres. This consists of predominantly brown colored clay and calcareous clay.

Granophyre : Unconformably lying below the limestone/clay is the basement Granophyre, which is a late stage differentiate derived from the basaltic magma of the Deccan Trap Effusive. This is not exposed anywhere within the lease area but has been encountered in drilling in bore holes drilled.

3.4 EXPLORATION

Observing the nature & extent of the deposit, 17 boreholes have been dug and samples have been tested for quality assurance covering the entire lease area. The quantum and intensity of exploration already carried out in the area is considered adequate since the reserves & the quality have been proved with adequate degree of reliability. No additional exploration, therefore, is considered necessary in the area. (Refer Annexure no.15 to 18)

TOPOGRAPHIC SURVEY

The area is in irregular rectangle in shape bouded by 10 nos. boundary pillars marked over plate no.3. The eastern and western side are adjoined with the lease boundary of the same owner. The position of all 17 boreholes are marked and plotted on the plan. position of pits, benches, approach roads, heaps of undersized limestone in the area are surveyed and plotted on plate no.3. The highest point in the area is 73 mRL and lowest being 61 mRL.

A number of spot levels have been marked on the quarry floor and along the bench tops. Only in the small unbroken area within the lease and the adjacent undisturbed areas within the lease contouring has been done at 1 m interval. All other available surface features have been plotted on the map so prepared on scale of 1:1000. The topographic map so prepared is presented as plate no.3 (Surface Plan).

(c) Geological Plan

Geological mapping was undertaken on a scale of 1:1000 using the topographic map as described above. Within the limited area of the mining lease and its immediate surroundings, the rock type exposed are the limestone belonging to the Miliolite Formation.

As some part of the limestone has already been mined, the remaining reserves of Chemical grade are left out in patches which are shown in the Geological plan as Mineable Block – 2. There is no downward progress in the already worked out pits and the pits have reached the Inferior cement grade.

As the different quality types are not recognized at the surface and do not occur a regular pattern, these could not be differentiated in the surface geological map.

DRILLING

Core bore holes were drilled by Diamond bit NX size and core recovered was preserved for analysis. 17 bore holes were drilled at regular grid pattern as shown on the locations given in Surface plan plate no.3.

SAMPLING AND ANALYSIS

Core were split into equal halves and samples were powdered. After coning and quartering, half of the powder of all samples were sent to company central laboratory at Mithapur for complete analysis. Total 118 core samples were collected from 17 numbers of Bore–holes core and analyzed. Details of boreholes , analysis, lithology is given in Annexure no. 15.

Sampling was done at intervals ranging generally 1.0 meters depending upon litho·logical characteristics. The samples were prepared by manual crushing using iron mortar and pestle and by standard procedure of coning and quartering. The total number of samples generated from the 17 boreholes drilled stand at 118, refer Annexure no.15.

(d) Geological Sections

Geological sections have been prepared on horizontal scale of 1:1000 and vertical scale of 1:200. (Refer plate No. 4). Sections depict the reserve category as per UNFC code.

Exploration proposed to be carried out :

From the nature & extent of the deposit, the quantum and intensity of exploration already carried out in the area is considered adequate since the reserves and the quality have been proved with adequate degree of reliability. No additional exploration, therefore, is considered necessary in the area.

3.5 Category wise up dated Reserves with grade

Mineral Resources have estimated a fresh as per the UNFC guidelines.

A. Geological Assessment:

The existing excavations in the lease area in the form of pits and 17 core bore holes have formed the basis for estimation of mineral resources in the lease area.

B. Resource Quality and Quantity assessment:

i. Quality Assessment:

The chemical grade, marginal grade and inferior limestone from the area has been analyzed. Analysis details are given below:

Sr No	Grade	Characteristics
1.	Chemical grade	Total Carbonate > 92% & SiO_2 <4%
2.	Marginal grade	Total Carbonate > 92% & SiO_2 <4 to 5%
3.	Cement grade	Total Carbonate <92% or SiO_2 >5%

The management specified the Soda Ash and Cement grade limestone requirement as under :

$CaCO_3 + MgCO_3$	≥	92%
SiO2	<	4%
Size		+ 50 mm to ·100 mm

Limestone with the same total carbonate but with 4% or more of SiO2 but not exceeding 5% is considered to be marginal quality but still acceptable for the manufacture of Soda Ash. For the purpose of cement making the following broad chemical specification for limestone may be accepted :

$$CaO \geq 44\%, \quad MgO \leq 3.5\%$$

SiO_2, Al_2O_3 and Fe_2O_3 to satisfy the LSF & the silica & alumina module of the raw mix.

However, in view of the availability of adequate quantity of fines from the chemical grade limestone, all the inferior grade limestone including the clayey limestone and calcareous clay associated with the Miliolite limestone within the TCL lease area can be used for cement making by judicious blending with the fines generated during crushing of the chemical grade limestone.

The group composite sample so prepared showed the following percentage values on analysis as given in Table below:

Radicals	Chemical Analysis %
SiO_2	1.75
Al_2O_3	0.39
Fe_2O_3	0.64
CaO	54.33
MgO	0.47
LOI	42.2
$CaCO_3$	96.98
$MgCO_3$	0.99

ii Quantity Assessment

The geological section of cross – section method has been used for the purpose of estimation of reserves. As has been mentioned earlier, N-S geological sections have been drawn at 100 m interval along section lines and the sectional quality of the chemical grade, marginal and the inferior grade limestone have been computed along these sections. Refer Annexure no.16. Reserves have also been estimated along these section lines by the cross section method.

From the geological cross sections drawn at 100 meter interval, the sectional areas on individual sections for the chemical grade, marginal and the inferior grade limestone were separately calculated. The sectional areas were multiplied by the length of influence of each section calculated as the sum of half the distance to the next section lines on either side in order to arrive at the intersectional volumes of limestone bands. Though the sections are drawn at intervals of 100 m, the lengths of influence of all the sections are not equal. In the case of the terminal sections, this is affected by the lease boundaries. In the case of the intermediate sections also the lease boundary does not always run approximately normal to the section lines. The length of influence of each of the section line has, therefore, been averaged over the entire length of the section line.

The volume of the limestone of both the grades separately multiplied by the tonnage factor gave their respective reserves. The limestone of the Mi... Formation are very soft and porous with lots of very minute interstitial voids. As such their insitu density never approaches the density of a normal compact limestone rock. Apparent specific gravity of a large number of random samples from limestone of this region has been determined during the earlier phases of investigation. From the data so obtained and based on TCL's experience of mining this limestone over the years, a tonnage factor of two tones per cubic meter in situ has been taken for the purpose of converting the volume to reserves tonnage. Refer Annexure no.17.

The effect of the porous nature of the deposit on the estimation of reserves has been taken care of in the tonnage factor as explained above. There are other factors, which bear significant effect on the reserves particularly in case of limestone deposits. The effect of such factors can be judged from a study of the occurrence of cavities and the percentage of core recovery. The core recovery statistics show that the undisturbed limestone representing about 68% of the total thickness of limestone(including cavity) drilled through recorded a recovery factor of about 90%, indicating loss on account of core grinding to the extent of about 10%. The remaining 32% of the limestone thickness (including cavity) drilled through, cavity accounts for about 4% and the balance 28% represents fractured and weathered limestone in which core recovery was to the extent of only 46%. Assuming around 10% grinding loss, the loss on account of the inherent nature of the deposit can be taken as around 44% in this part of the limestone, Thus for the entire deposit, the loss on account of the cavities and the inherent nature and quality of the rock can be taken as around 16-17%. In order to arrive at the net assured geological reserves, a deduction of 20% has been made from the calculated gross reserves, so as to take care of these factors and also any possible human error in computation.

C. Feasibility Assessment:

Geological: Geological details have been discussed above. Core bore holes have been drilled at in interval of 100 m grid spacing. In addition there are 4 pits in the area and details have been discussed above.

Mining: Deposit is right on surface with no overburden. Present mining is being carried out by opencast method of mining and same method will continue in future also.

Beneficiation: No beneficiation is proposed at the mining site. The company is considering installation of central crushing site at Aniali 21.04 Ha site for crushing of the RoM produced at entire Aniali group of mines. The proposed crusher will be similar to the MMD sizer with vibrating screen already installed at Ishwaria mine.

Environmental Concern: Approved progressive mine closure plan is being followed by the company. Conditions of EC will be followed.

Economic Aspects: Mining cost inclusive of all expenditure relating to environment works out to Rs.104 per tonnes of sized limestone.

Legal & Administrative aspects: The whole lease area is in Govt. waste land. Some unauthorized encroachment of land has taken place in the form of houses and agriculture fields near boundary. However No mining will take place in such areas.

Bulk Density : 2.016 ton per cubic meter of limestone in situ. Refer Annexure no.11.

Estimation of Reserves out of Measured Mineral Resources:

Geological: Mineable reserves considered up to the bottom limit of Chemical & Marginal grade.

Mining: Out of the estimated resources, mineral resources blocked in statutory barriers along the lease boundary cannot be mined at present so these resources classified under UNFC code 211. Remaining reserves which can be mined are classified under UNFC code 111. It is proposed that the lessee should obtain permission from DGMS for mining in 7.5 m statutory barrier.

Environmental Concern: Approved Mining Plan , PMCP, EC, and consent to operate will be followed.

Economic Aspects: Mining can be economically continued with open cast method of mining.

Legal and Administrative Aspects: MMR 1961, MCDR 1988, MCR 1960 are being followed. The lease area is in Govt. waste land and no forest land is involved. Lessee is in process to obtain the consent to operate from state government.

Mineable Reserves (In tonnes) : as per previous approved mining plan

Block	CG	MG Blendable	IG Blendable	Total CG	Reserves Blocked in Barriers	Losses @ 5%	Total Deduction	Net Mineable
UNFC Code	Proved (111)	Proved (111)	Proved (111)					
	A	B	C	D=A+B+C	E	F	G=E+F	H=D-G
Block I	113400	-	400	113800	20200	4700	24900	88900
Block II	322200	4000	63700	389900	16200	18700	34900	355000
	435600	4000	64100	503700	36400	23400	59800	443900

4000MT of Marginal Grade and 64100 of Cement grade (IG) limestone which occur within the chemical grade limestone bands have been considered blendeble as the average quality (taking weighted average) worked out to be chemical grade limestone.

Updated Reserves :

Reserves estimated as per earlier approved Scheme of Mining	Depletion	Additional Rreserves during Period under Review	Updated Reserves as on 01.03.2014
A	B	C	D=A-B+C
443900	Nil No mining was carried out during the period under review.	Nil No exploration was carried out.	443900

SUMMARY OF MINERAL RESOURCES UNDER UNFC

Total resources =Reserves+ remaining resources			Limestone	Detailed breakup constraint wise
Reserves	Proved	(111)	443900	
	Probable	(121)		
		(122)		
Remaining Mineral Resources	Feasibility Mineral resources	(211)		Ultimate pit limit
			36400	Lease barrier/ safety barrier
			23400	Others (*to specify*)
	Pre-Feasibility Mineral resources	(221)		Ultimate pit limit
				Lease barrier/ safety barrier
				Others (*to specify*)
		(222)		Ultimate pit limit
				Lease barrier/ safety barrier
				Others (*to specify*)
	Measured Mineral Resources	(331)	513900	Inferior /cement grade limestone , Not suitable for Soda Ash plant
	Indicated Mineral Resources	(332)		
	Inferred Mineral Resources	(333)		
	Reconnaissance Mineral Resources	(334)		
SUB TOTAL	RESERVES (a)		503700	
	Remaining Resources (b)		513900	
All Total Resources (a+b)			1017600	

PRESENTATION OF MINERAL RESOURCES AS PER UNFC

Classification	Code	Quantity (In Million Tonnes)	Grade CaO%
TOTAL MINERAL RESOURCES (A+B)		1017600	
A. MINERAL RESERVE:-			
1. Proved Mineral Reserves	111	443900	
2. Probable Mineral Reserves	121 & 122		
B. REMAINING RESOURCE			
1. Feasibility Mineral Resource	211	59800	
2. Pre-feasibility Mineral Resource	221 & 222		
3. Measured Mineral Resource	331	513900	
4. Indicated Mineral Resource	332		
5. Inferred Mineral Resource	333		
6. Reconnaissance Mineral Resource	334		

3.5 Mineable Reserves and Anticipated Life of the Mine :

Mineable reserves have been calculated by taking into account the reserves in all measured categories only. Future rate of production will be maintained at 77000 tonnes per annum.

1.	Net Mineable Reserves (as on 1-4-2014)	443900
2.	Mineral to be mined during the Mining plan Period	361121
3.	Remaining reserves at end of the Plan period	82779
4.	Rate of production per year	77000
5.	Life of mine at end of the Plan period	1.0
6.	Total Mine life	6.0

Note: If other grade of limestone is mined than life of mine will increase.

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4.0 MINING

(a) Proposed method of Development / working with design parameters:

The mining method is mechanized opencast method of mining. Salient features are described below:

- No overburden removal.
- Chemical grade limestone mined for manufacturing Soda Ash at company's own plant.
- Benches of 4 m height will be maintained.
- Blast holes of 110 mm dia by wagon drill .
- ANFO with cap sensitive explosive.
- Excavator / loader for loading of blasted material.
- 10 tonnes tippers for transportation of limestone to crusher.
- Haulage roads maintained at the gradient not exceeding 1:16.
- Blasted ROM is loaded into tippers and shifted to a nearby sizing yard pit inside the lease hold area where sizing of limestone is done manually using contract labourers , and final sized material is sent to soda ash plant.
- Alternatively in the event of Labour shortage, a MMD mobile sizer & screening equipment will be deployed at Aniali 16.21 Ha. mining lease for sizing of limestone.
- In future also it is proposed to continue with same method of mining.
- Effective pollution control measures will continue to be practiced.
- Some part of inferior (cement) grade limestone is to be mined with chemical grade limestone for systematic mining. Overall chemical grade will be maintained from mineral conservation point of view.
- Scattered fine limestone stacked at pit bottom in some pits will be removed and stacked at one place for dispatch to cement plant.

Provisions of MMR 1961 will be strictly be adhered. Lessee will obtain necessary permission from DGMS for deep hole drilling and blasting and use of HEMM.

b) The Quantum Of Development & Tonnage Of Production:

Year wise pit development is shown on the plate no. 5. Deposit is devoid of overburden; therefore no development work is required. As mining operations are continuous, repair and maintenance work of haul roads and mining machinery is taken up. During mining operations efforts shall be made to recover any thin layer of top soil, it shall be scrapped in separate slice and shall be preserved for plantation work.

About 2% of ROM is accounted for Mining Losses.

No mining will be carried out in 7.5 statutory barrier along lease boundary In the past mining in the area has been carried out haphazard manner and in this Mining Plan, an effort is being made to systematize the pit and the mining.

YEAR-WISE DEVELOPMENT FOR THE NEXT FIVE YEARS (Refer Plate No. 5A to 5E) :

There is a main pit proposed to be worked during 5 year proposal of mining plan . Year wise production of Chemical grade limestone during the plan period will be as given below. It is estimated that about 2 % of R.O.M. is lost during the course of mining. The proposed excavated tonnage is tabulated.

Year	ROM Limestone MT	Inferior Grade Limestone MT	Chemical Grade limestone MT
2014-15	86845	13818	73027
2015-16	86928	7380	79548
2016-17	87628	16206	71422
2017-18	87394	27598	59796
2018-19	83932	6604	77328
Total	432727	71606	361121

Bulk density of limestone is taken as 2.016 for all calculation work. Refer Annexure no.11.

Year wise / bench wise production schedule is given below:

First year Production Plan (2014-15) (Plate No. 5A):

During the year the actual limestone production from this mine is 0.86 lakh tones. During the year entire production of limestone from this mine will be from the bench 64.00 mRL towards section line J-J'(lengthwise) & M-M' (widthwise) in Mining Block No. II.

The likely position of the benches with height (4.5 m max.), roads & Plantation etc. in this mine area at the end of first year are shown in the plate no. 5A.

At the end of first year total 1.088 hect of area is likely to be degraded. Bench - wise calculations as given below :

BENCH RL	SURFACE AREA(IN Sqm.)	AVERAGE THICKNESS (IN Mtr.)	VOLUME (IN Cum.)	TONNAGE	REMARKS
CHEMICAL GRADE & INFERIOR GRADE LIMESTONE					Tonnage factor -2.016
64.00	10136.0	4.25	43078.0	86845.24	
Sub Total			43078.0	86845.24	
INFERIOR GRADE LIMESTONE					
64.00	5712.0	1.20	6854.4	13818.47	
Sub Total			6854.4	13818.47	
AVAILABLE CHEMICAL GRADE LIMESTONE			36223.6	73026.77	

Second year Production Plan (2015-16) (Plate 5B):

During the year the actual limestone production from this mine is 0.86 lakh tones. During the year entire production of limestone from this mine will be from the bench 64.00 mRL towards section line L-L' & M-M' (widthwise) in Mining Block No. II .

The likely position of the benches, roads & Plantation etc. in the mine area at the end of second year are shown in the plate no. 5B.

At the end of second year total 2.577 hect of area is likely degraded. Bench wise calculations as given below :

BENCH RL	SURFACE AREA(IN Sqm.)	AVERAGE THICKNESS (IN Mtr.)	VOLUME (IN Cum.)	TONNAGE	REMARKS
CHEMICAL GRADE & INFERIOR GRADE LIMESTONE					Tonnage factor -2.016
64.00	9582.0	4.50	43119.0	86927.9	
Sub Total			43119.0	86927.9	
INFERIOR GRADE LIMESTONE					
64.00	3328.0	1.10	3660.8	7380.17	
Sub Total			3660.8	7380.17	
AVAILABLE CHEMICAL GRADE LIMETSTONE			39458.2	79547.73	

Third year Production Plan (2016-17) (Plate No. 5C):

During the year the actual limestone production from this mine is 0.87 lakh tones. During the year entire production of limestone from this mine will be from the bench 62.50 mRL towards section line I-I' (lengthwise) & M-M' (widthwise) in Mining Block No. II.

During the third year of operation 16206 tones of inferior grade will be generated. The likely position of the benches, roads & Plantation etc. in this mine area at the end of third year are shown in the plate no. 5C.

At the end of third year total 4.166 hect of area is likely to be degraded. Bench wise calculations as given below :

BENCH RL	SURFACE AREA(IN Sqm.)	AVERAGE THICKNESS (IN Mtr.)	VOLUME (IN Cum.)	TONNAGE	REMARKS
(A) CHEMICAL GRADE & INFERIOR GRADE LIMESTONE					Tonnage factor -2.016
62.50	12074.0	3.60	43466.40	87628.26	
Sub Total			43466.40	87628.26	
(B) INFERIOR GRADE LIMESTONE					
62.50	7308.0	1.1	8038.80	16206.22	
Sub Total			8038.80	16206.22	
AVAILABLE CHEMICAL GRADE LIMESTONE			35427.60	71422.04	

Fourth year Production Plan (2017-18) (Plate No. 5D) :

During the year the actual limestone production from this mine is 0.87 lakh tones. During the year entire production of limestone from this mine will be from the bench 62.00 mRL towards section line I-I' (lengthwise) & L-L' (widthwise) in Mining Block No. II.

During the fourth year of operation 28565 tones of inferior grade will be generated. The likely position of the benches, roads & Plantation etc. in this mine area at the end of fourth year are shown in the plate no. 5 D.

At the end of fourth year total 5.825 hect. of area is likely to be degraded. Bench - wise calculations as given below :

BENCH RL	SURFACE AREA(IN Sqm.)	AVERAGE THICKNESS (IN Mtr.)	VOLUME (IN Cum.)	TONNAGE	REMARKS
(A) CHEMICAL GRADE & INFERIOR GRADE LIMESTONE					Tonnage factor -2.016
62.00	11408.0	3.80	43350.40	87394.40	
Sub Total			43350.40	87394.40	

(B) INFERIOR GRADE LIMESTONE					
62.00	11408.0	1.2	13689.60	27598.23	
Sub Total			13689.60	27598.23	
AVAILABLE CHEMICAL GRADE LIMESTONE			29660.80	59796.17	

Fifth year Production Plan (2018-19) (Plate No.5E):

During the year the actual limestone production from this mine is 0.87 lakh tones. During the year entire production of limestone from this mine will be from the bench 62.00 mRL towards section line L-L' (widthwise) in Mining Block No. II.

During the fifth year of operation 6604 tones of inferior grade will be generated. The likely position of the benches, roads & Plantation etc. in this mine area at the end of fifth year are shown in the plate no. 5 E.

At the end of fifth year total 5.825 hect. of area is likely to be degraded. Bench - wise calculations as given below :

BENCH RL	SURFACE AREA(IN Sqm.)	AVERAGE THICKNESS (IN Mtr.)	VOLUME (IN Cum.)	TONNAGE	REMARKS
(A) CHEMICAL GRADE & INFERIOR GRADE LIMESTONE					Tonnage factor -2.016
62.00	10956.0	3.80	41632.80	83931.72	
Sub Total			41632.80	83931.72	
(B) INFERIOR GRADE LIMESTONE					
62.00	2730.0	1.2	3276.0	6604.41	
Sub Total			3276.0	6604.41	
AVAILABLE CHEMICAL GRADE LIMESTONE			38356.80	77327.31	

Year wise Opening Reserves, production and Closing Balance in tonnes for the Mining Plan period is given below: (for overall limestone of all grades)

Year	Opening reserves	Production	Closing Reserves
	Limestone MT	Limestone MT	Limestone MT
2014-15	1017600	86845	930755
2015-16	930755	86928	843827
2016-17	843827	87628	756199
2017-18	756199	87394	668805
2018-19	668805	83932	584873
Total		432727	

For chemical grade Limestone:

Year	Opening reserves	Production	Closing Reserves
	Limestone MT	Limestone MT	Limestone MT
2014-15	443900	73027	370873
2015-16	370873	79548	291325
2016-17	291325	71422	219903
2017-18	219903	59796	160107
2018-19	160107	77328	82779
Total		361121	

c) Layout Plan

The layout of the working at the end of the fifth year work have been given plate no 6 . An office cum rest shelter proposed as shown in plan.

All limestone mined will be stored on plot site and sizing will be done manually. Undersized limestone chemical grade will be temporarily stored on that sizing area. If the Sizing crusher is installed in future, then storage will be shifted to new crusher site. Planning of sizing will be changed in future.

d) Pit Layout, Dumps, Sub Grade Stacks Etc.

The layout of the working on plan & section have been given plate no.5 & 6.

e) Proposed Rate Of Production When The Mine is Fully Developed And Expected Life Of The Mine:

The mine planning has been devised for a annual ROM production of 77000 tonnes of chemical grade limestone.

a.	Total Mineable Reserves of Limestone(C.G.)	443900 tonnes
b.	Total production (ROM) during next five years period	361121 tonnes
c.	Mineable Reserves of Limestone at the end of fifth year period	82779 tonnes
d.	Proposed rate of production (ROM) from Sixth year onwards	77000 tonnes
e.	Life of the mine after fifth year period	1 year
f.	Total Expected Life of the Mine	= (5 + 1) years = 6 years

NOTE: If production of mine is increased or decreased, then life of mine will change accordingly. It will be reviewed at the time of next mining scheme submission.

f) **Conceptual Mining Plan :**

Mineable reserves of Limestone are just sufficient for ensuing 6 years at the proposed rate of production. However, there is need for undertaking further exploratory work for assessing the additional mineable reserves of Limestone in the area as well as to enhance the resources.

1) **Geological consideration:**

Geological investigation reveals that the deposit is exposed on the surface and stratified.

2) Exploration:

Reserves for mining are assessed under UNFC codes. Further exploration in the area is required to enhance the estimated resources and to further assess the mineral potentiality in the area. To achieve this exploration is proposed by way of bore holes at 100 m spacing and it is further proposed to complete this exploration within first two years of mining. Boreholes shall be drilled at the bottom of pit where Granophyre is exposed. Depth of borehole to drill shall be 20 m to ascertain presence of Limestone bed.

It is anticipated that outcome of proposed exploratory work shall be positive for mineral potentiality of the whole area.

3) Ultimate pit limit

It is anticipated that the true potentiality of the area in depth can be assessed at the end of first five years.

In absence of true potentiality of area, determination of ultimate pit limit shall be apparent and it likely to be revised at the end of the fifth year on the basis of out-come of exploratory work as proposed above.

On the above techno-economic as well as environmental consideration, the conceptual mining plan has been drawn keeping 45° ultimate pit slope angle.

The anticipated size of excavation for the 5 years period shall be as follows (as marked over Conceptual Plan (Plate No.8)).

4) Mining

As per the present scenario the mining will be done by mechanised open cast method of mining by forming benches of 4.0 m height. Width of the benches will be maintained between 15-20 m. Blast holes will be 110 mm and blasted using ANFO and slurry explosive. Loading of mineral and overburden will be with the use of excavator. Transportation will be with the tippers of 10 t capacity.

On the above techno-economic as well as environmental consideration, the conceptual mining plan has been drawn keeping 45° ultimate pit slope angle.

5) Disposal of waste and backfilling

there is no waste generated during plan period . There is no proposal for backfilling.

6) Post mining land use pattern:

Post mining land use will be in the form of plantation over the benches .

Dump slope shall be stabilised with grass. Closing benches of the pit will also be levelled and plantation done over them. The abandoned pit will be fenced & plantation will be done all around the ultimate pit.

(g) Opencast Mines :

i) Salient features of mode of working:

It is proposed to work the mine by mechanised open cast method of mining.

Height of bench will be maintained at 4.0 m.

Slope of bench will be 80° from horizontal.

Bench width will be 15-20 m.

Approach road to have gradient of 1:16.

Drilling of holes will be with compressed air operated Wagon drill.

Hole diameter will be 110 mm and 10% sub grade drilling.

ii) Layout of Mine workings, faces and disposal of OB/waste:

(Refer Plate no. 5A toE, Five Year dev. Plan & sections).

Faces will be opened in central part of area and will advance in East direction, as shown on the plan.

Year wise description is given above. Upper bench will be kept sufficiently advanced for safe working of lower bench.

h) Underground Mines : Not applicable

i) Extent of Mechanization

Requirement of Machinery

Operating Parameters

No. of working Days	300
No. of Shifts per day	2
Limestone Production per Year (Max)	87000
Waste Generation in tonnes per year	Nil
ROM Limestone	290 tpd
Waste / OB (Max)	Nil
Total ROM + Waste	290 tpd
ROM per shift	145 t

Drill Machine Requirement:

Calculation for drill machine requirement is given in table below:

Drill machine in use	Wagon drill
Hole dia	110 mm
Bench Height	4.0 m
Hole Depth	4.0 m
Hole burden	1.5 m
Hole spacing	2.0 m
Tonnes per hole	1.5x2.0x4.0x2.016 = 25.2 t
Tonnes to be blasted per day	290 t
No. of holes to be blasted per day	290 / 25 = 12 say
Inclined length of hole (Inclination of hole 85^0)	4.1 m
Length of hole including Sub grade drilling @ 10%	4.1 x 1.1 = 4.51 m
Total drilling meters per day	4.51 x 25 = 112 m
Drilling rate per hour	12 m
Meters per shift = 12 x 6 hrs.	72 m
Meters per day	144 m
No. of machines required	1

One wagon drill is required to meet the targeted production.

Excavator requirement:

Particulars		Excavator	Tipper
Bucket capacity (struck) in cum		1.54	–
Bucket fill factor		0.9	–
Bulk Density of Limestone in situ		2.016	–
Bulk Density broken rock		1.54	
Broken rock per load of bucket in cu.m.		1.386	
Tonnes per pass of bucket		2.14	
Cycle time for one bucket in sec		28	–
Efficiency of machine considering 10 m loading distance		75%	–
No of cycle per hour		96	–
Limestone loaded per hour		205 t	–
Say, tph		205 t	–
Operating hours per shift		6	
Tonnes handled per shift		1230	
Tonnes per day		290	
Excavators required		290/2460= 0.11 (say 1)	1
Tipper capacity			5.7 cu.m.
Fill factor			0.9
Tipper Capacity in tones			10
No. of passes required to fill the tipper			5
Spotting (in minute)			1
Loading time (minute) @ 28sec/load			2.5
Average speed in kmph			25.00
Distance in km for both way			24.00
Hauling time in minute			58.00
Unloading time in minute			1.00
Cycle time in minute			63
Nos. of trips per hour (N)			0.95
Handling per / hr. = NxT.			6.15

Daily working hours available	6.5 hrs	6.5 hrs	
Handling per shift			61.5
Average handling per tipper per shift			62
Handling per tipper per day			124 t
Tippers Required			300/124 =2.41
Availibility			75%
Tippers Required			3
Standby			0
Total required			3

One excavator of 1.54 cu.m. bucket capacity and 3 tipper of 10 t (5.7 cu.m.) capacity will be required to meet the production target of 290 t per day.

Compressor & Wagon drill

Name	Make	Capacity	No. of Units
Compressor	Atlas Copco	450 cfm	1
Wagon Drill	Atlas Copco	110 mm dia.	1

Summary:

Equipment	Capacity	Nos.	Make	Motive power HP
Excavator	1.54 cu.m.	01	HM-2021	Diesel 110 HP
Tipper	10 t	03	Tata	Diesel 110 HP
Air Compressor	450 cfm	01	Atlas Copco	Diesel 125 HP
Wagon Drill	110mm dia	01	Atlas Copco BVB 25	Compressed Air
Explosive van	1 ton	01	Tata 407	Diesel 60 HP
Water Sprinker	5000 litre	01	Mahindra Tractor	Diesel 45 HP
Jeep		01	Mahindra	Diesel 40 HP
Tractor		01	Mahindra	Diesel 45 HP
Diesel pump		01	Local	Diesel 7.5 HP

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5.0 BLASTING

a) Broad Blasting Parameters:

Mineral / OB (Max)	290 t
Depth	4.0 m
Depth of hole including sub grade drilling	4.1 m
Burden	1.5m
Spacing	2.0 m
Volume blasted per hole	12.0 cu.m.
Tonnes blasted per hole	25.2 t
Powder Factor t / kg of explosive	6
Explosive per hole	4.2 kg
Explosive per day (300 /6 = 50 kg)	50 kg
Booster Charge 25%	12.5 kg / day
ANFO @ 75 %	37.5 kg/ day

Holes will be drilled parallel to free face and staggered in the subsequent rows.

b) Powder Factor

Powder factor is 6.0 tonnes / kg.

c) Secondary Blasting

Secondary blasting is ruled out. Hired rock breaker will be used to break big boulders.

e) Storage of Explosives :

Company has a licensed magazine of 800 kg capacity at its Govalani Ranavav mine and explosive from that magazine will be used at this mine also. This magazine is 11 km west of the Aniali mine.

f) Precautionary Measures:

As the mining area is in close proximity to human settlements, adequate precautionary measures will be taken as given below:

- Adequate siren system will be in operation.
- Legible warning sign in the language understood by the local people.
- Enough security guards, especially posted on roads etc.
- Before blasting the upper surface of the bench shall be cleaned off, of any stones lying on top, as it is a major source of flying stones.
- The trunk line of the detonating cord shall be covered with sand to reduce air over pressure, as it is major source of air blast noise.
- Controlled blasting shall be practiced and only during day time.
- All safety measures as prescribed under M.M.R.1961 and circulars issued by DGMS.
- The danger zone shall be distinctly demarcated (by means of red flags properly arranged and supported) at least 30 minutes before firing of holes is to commence.
- Ten minutes before firing, a siren installed for the purpose shall be blown three times for one minute each at interval of one minute.
- An effective record of instruction to guards given for working and clearance shall be maintained.
- No shots shall be fired when there is traffic on any road within danger zone.

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6.0 MINE DRAINAGE

The lease area is bounded by 10 intermediate and corner pillars of the boundary. The latitude and longitude of each pillar is recorded and marked on the plan. The length of the area measured east to west is about 670 m Maximum and width of the area measured north to south is about 410 m Maximum. The allotted lease area is 16.21 Ha.

At present, general elevation within the lease area varies from around 73 mRL to around 59 mRL showing a relief of about 14 mt.

A number of small hillocks about 2 nos. comprises in the area. There is no prominent stream or nalla within the area. There is occasional flow of water during the rainy season, in the hill slopes.

One Pond is in north east corner of the lease area near pillar no.8. This is in dry position at present and shallow water is accumulated in rainy season only.

a) Depth of water table :

The ground water is encountered at the depth of 60 m to 100 m below the ground level in the plain area and there is no indication of ground water up to the depth of 55 m during the course of drilling.

(b) Depth of expected working :

The proposed working will not touch the water table. The maximum depth of working will be at 58 mRL. Hence, water table will not be touched during proposed working.

(c) Quantity and quality of water likely to be encountered :

There is no permanent water body or any perennial stream located in the area/proposed working site. The surface accumulated water body in the area is out of question, as the sub-surface formation is porous, which allows water to percolate fast into sub-surface making area dry very soon.

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7.0 STACKING OF MINERAL REJECTS AND DISPOSAL OF WASTE

a) The nature and Quantity of Top Soil, Overburden/ Waste and Mineral Rejects:

(i) Top Soil:

The mineable area is devoid of top soil. Hence, no proposals are made for top soil management. But efforts shall be made to recover even thin layer of soil (incidental soil), it shall be scrapped in separate slice and kept preserved for utilization in plantation work.

(ii) Overburden/waste limestone:

The mineral Limestone is exposed on the surface and stratified. There is no overburden to handle.

(iii) Sub Grade Mineral:

There is no sub grade mineral to be seperated .

b) Land Chosen for Disposal of waste:

There is no proposal for disposal of waste in this mining plan.

c) The Manner of Disposal and Configuration:

There is no disposal of waste proposed in this mining plan.

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8.0 USE OF MINERAL

(a) Use of mineral:

M/s Tata Chemicals Limited, is manufacturing Soda ash & Cement at its plant at Mithapur in Jamnagar district. The entire limestone production from this mine is used by the company, the ROM is dispatched to plant at Mithapur.

No changes are proposed in the use of mineral. Limestone produced at this mine is sent to company's soda ash plant after sizing and in future also the same will continue.

Company management has specified the following for Soda ash plant & Cement Plant:

Soda Ash Plant

Chemical Specification		Physical Specification
		Size: +50mm -100mm (For Chemical grade L.st.) Hardness: Medium to Low
$CaCO_3 + MgCO_3$	> 92%	
SiO_2	< 4.0%	
Limestone with same total carbonate and silica between 4 & 5 % is marginal grade but still acceptable in the plant		

Cement Plant:

Chemical composition	Acceptable range for OPC %	Limiting value for other type opf cement , scope of beneficiation and blending %
CaO	44 – 52 %	40
MgO	Max 3.5 %	Max 3.5
SiO_2	To satisfy LSF, Silica & Alumina Moduli of raw mix	
Al_2O_3		
Fe_2O_3		
Mn_2O_3	<0.5	<3.0
R_2O	<0.6	<1.0
Total S as SO_3	<0.6	<0.8
P_2O_5	<0.6	<1.0
Cl	<0.05	<0.1

LSF	0.90 -0.95
SM	1.8 – 2.8
AM	1.8-2.8

(b)Physical & Chemical specifications stipulated by the buyers:

The limestone is not proposed to be sold outside, but it is proposed to be used in company's own chemical plant and cement plant.

Efforts made for utilization of the sub-grade mineral including fines

Fine sized limestone (Undersized (-50 mm)) shall be used in the cement plant as sweetener. This undersized limestone is temporarily stacked at the pit floor.

(c) Blending if any :

There is no proposal of blending at present.

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9.0 OTHER

(a) Site Service :

At present there is no site service available in the area therefore office cum rest shelter is proposed as shown in the lay out plan. First Aid station, Toilets as per the provisions of Mines Rules shall be constructed and maintained. Regular medical check up of the mine employees will be carried out as per the provisions of Mines Rules 1955.

(b) Employment Potential:

Semi Mechanised Opencast mining has been proposed accordingly following persons are to be employed at the mine.

S.No.	PARTICULARS	NUMBER
1.	Managerial and Supervisory personel	
	(i) Mines Manager (As per MMR,1961)	1
	(ii) Mining Engineer (As per MCDR, 1988)	1
	(iii) Mining Geologist(As per MCDR, 1988)	1
	(iv) Mining Mate/Supervisor	1
	(v) Driller cum Blaster	1
	Total	5
2.	Skilled:	
	(i) Excavator operator	2
	(ii) Tipper operator	6
	(ii) Drill m/c operator	2
	(iv) Driver Explosive Van	1
	(v) Driver Water Tanker	1
	(vi) Driver Jeep	1
3.	Semi- skilled:	
	(i) Helpers	8
	(ii) Clerk-cum-store keeper	1
		27
4.	Un-Skilled:	2
	Total	29

Total Manpower at the mine will be 29.

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10.0 MINERAL PROCESSING

(a) Mineral Processing:

As discussed earlier, a crusher similar to MMD sizer installed at Ishwariya 13.15 Ha mine is proposed to be set up when Aniali group of mines will come under operation. The plant details and crushing studies have been conducted earlier and shall be done for the current lease also before setting up the plant. The proposed site is at Aniali 21.04 site.

The proposed methodology for this is similar to the one at Ishwariya 13.15 Ha mine, where the RoM from individual mines is manually sized to 700 mm size. This material will be transported by trucks to the plant. When this material is subjected to the crushing, the end product is around 50-100 mm size. Oversized particles are re-fed to the hopper.

(b) Tailings Disposal:

Results of any beneficiation investigations conducted and changes made in the existing mineral beneficiation plant and tailings disposals, if any, with benefits expected.

No beneficiation studies have been conducted for RoM from this area.

Beneficiation test done, if any, on sub grade mineral including fines and proposals for installation of new or additional beneficiation facility, if any.

The sub grade limestone recovered from the interbands will also be directly dispatched to the cement plant & necessary blending with high grade crusher fines will be done at the cement plant during crushing and grinding without any future beneficiation process at any stage.

Hence, no beneficiation tests were carried out during the plan period.

(c) Flow Chart for ROM:

No processing at the mine site.

(d) Quantity and type of chemical to be used:

Not applicable.

(e) Quantity and type of chemicals to be stored:

Not applicable.

(f) Quantity (Cu.mtr. per day) of water required:

Quantity of water required for mining and allied activities is about 10-15 Cu.mtr. per day. There is no requirement for processing. Required quantity of water will be available from the bore-hole located near lease area.

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11.0 ENVIRONMENT MANAGEMENT PLAN

(a) Base Line Information

The lease area is bounded by 10 intermediate and corner pillars of the boundary. The latitude and longitude of each pillar is recorded and marked on the surface plan plate no.3. The length of the area measured east to west is about 670 m Maximum and width of the area measured north to south is about 410 m Maximum. The allotted lease area is 16.21 Ha.

At present, general elevation within the lease area varies from around 73 mRL to around 59 mRL showing a relief of about 14 mt.

A number of small hillocks about 2 nos. comprises in the area. There is no prominent stream or nalla within the area. There is occasional flow of water during the rainy season, in the hill slopes.

One Pond is in north east corner of the lease area near pillar no.8. This is in dry position at present and shallow water is accumulated in rainy season only.

There are two old pits and one working pit of limestone in the central area near to the boundary line and one working pit of limestone in the western side of the lease area near the boundary. Pit approach roads are existing outside the lease area for plying of trucks and mining machinery.

The limestone bearing area is fully covered by 17 nos. core bore holes marked on the surface plan plate no.3, at a regular grid pattern of 100 m.

The low elevation coastal plains are covered by the rocks of the Miliolite Formation, which overlap the underlying basaltic rocks of the Deccan Trap basalts and the granophyres exposed in the foothills and higher elevations of the Barda range. Thin layers of Miliolite rock are also seen to occupy the hill slopes or interior depressions within the Barda hills as a result of either marine deposition during transgression of the sea or deposition of Aeolian

sand blown from the coastal plain where the Miliolite Formation is thick and purer in so far as the carbonate contents are concerned, one occasionally comes across the typical features of a Karst topography, in the form of cavities and caves, mounds and depressions, all resulting from solution effect of the carbonate rocks.

(i) Existing land use pattern:

The area is a Non Govt. Barren land.

There is no reserves forest or protected forest land within the area. There is no village or hutments within the area. Existing land use pattern is given as below:

TABLE – 11.1

PARTICLUARS	Present Land Use pattern in Ha.
Pits (including undersized Limestone stacks of 3.696 Ha)	9.544
Dumps	0
Road	0.49
Plantation	0.02
Mined out plantation area	0.0
Top soil storage	0
Ag. Land encroached	0
Remaining Virgin Govt. Waste Land	6.156
Total	16.21

(ii) Water Regime

The proposed mining activity in the next five year period will not intersect ground water table. Hence, mining will not have any impact on ground water in the area. All the rain water gravitates to lower side in the lease area. There it is allowed to pass through settlers to arrest any silt in the water. Clean water is allowed in the natural drainage system. Limestone is non-toxic and hence no chemical treatment of mine water is required. Periodical quality monitoring will be carried out and

reports submitted to concerned authorities. An irrigation canal has been constructed in the eastern part of the area, which divides the lease area in two parts.

(iii) Flora & Fauna:

The area is located in a landform. This area is relatively calm and there is no source of high noise level. Common flora that found in the region are as follows:

TABLE – 11.2 : FAUNA OF THE REGION

Zoological Name	Common Name
Pyenonotus cafer	Red vented bulbul
Corvus splendens	House crow
Corvus maerorhynchos	Jungle Crow
Cuculus micropterus	Indian cuckoo
Columba livia	Common pigeon
Asio flammeus	Owl
Psittacula krameri	Parrot
Ceentropus sinensis	Crow Pheasant
Gyps bengalensis	Vulture
Herpestes edwardii	Mongoose
Rattus rattus	Rat

Core zone - No wild animal.

The structure of this ecosystem comprises very common plant species of tropical area. Following plant species are present in the area.

TABLE – 11.3: FLORA OF THE STUDY REGION

S. No.	Local Name	Botanical Name
1.	Teak	Tectona grandis
2.	Ashoka	Polyalthia longifolia
3.	Mango	Mangifera indica
4.	Neem	Azadirachta indica
5.	Amaltas	Cassia fistula
6.	Silver oak	Gravalia robusta
7.	Banana	Musa pudica
8.	Guava	Psidium guava
9.	Lemon	Citrus lemon
10.	Thuja	Thuja spp.
11.	Peepal	Ficus religiosa

(iv) Quality Of Water, Air And Ambient Noise Level:

Air Environment

Ambient air qualities of the immediate surroundings of the mining area are well within the permissible limit.

Noise Environment

There are several sources in the 5 Km. radius buffer zone, which contributes to the local noise level of the area. Traffic, cement factory as well as activities in mines and near by villages add to the ambient noise level of the area

(v) Climatic Conditions

The climate of the district is fairly diverse climate with an average annual precipitation of around 500 mm to 700 mm with 40 to 90% relative humidity. The rainfall is mostly distributed between the months of July and September. About 90 percent of the annual rainfall is received during the period June to September, July and August being the rainiest months. The variation in annual rainfall from year to year is very large. During the monsoon season, the relative humidity is generally over 90 percent. The coldest month is January and the hottest month is May.

The micro meteorological conditions at the mine site determine the transport diffusion pattern of air pollutants released into atmosphere. The principle variables include horizontal connective transport (average wind speed and direction) vertical convective transport (atmospheric stability) and topography of the area.

Based on the Meteorological data such as wind speed, wind direction, temperature, and relative humidity from IMD station summarized as below:-

TABLE 11.4 : MICRO-METEOROLOGY

SUMMER SEASON							
Temperature °C		Relative humidity %		Wind Speed(km/hr) & Direction			
				8.30 Hrs.		17.30 Hrs.	
Max.	Min.	8.30 Hrs.	17.30 Hrs.	Direction	Speed	Direction	Speed
32.2	18.5	70	34	NE	04	SW	04

(vi) Human Settlements

There is no habitat within core zone. In buffer zone of the study area main workers are 40.43% and marginal workers are 4.72% resulting into 54.85% non-workers indicating at chronic unemployment problem. Total literates are 45.98%.

The occupational pattern of the people in town is approximately as under Mining - 10% Trade - 12% Agriculture - 1% Industry - 77%.

Demography

Total population in the study area as per 2001 census records is 6806. It is evident that the concentration of SC is found to be 1.8% and concentration of ST is 6.6%. The overall literacy rate in the village of buffer zone area is approximately 24% while that in town is about 50%.

The total population of the study area has been furnished in the following as under.

Name of the village	Total Population	Distance from the Mine lease area km
Aniali	2291	4.0
Ramgarh	1494	4.0
Sakhpur	686	4.5
Khiosara	2335	4.0

Sex - Ratio

The population of females in the population of the district as a whole has always been on the lower side as compared to males. A sex ratio is 1:1.

(vii) Public Building Place Of Worship And Monuments

There is no public building or place of worship or monument nearby, which could be affected by mining activities. Also the area does not fall under Natural Park or any wild life sanctuary.

(viii) Notification Of Area Under Water Act 1974

The status of applicability of water (Control of Pollution) Act , 1974 is not available.

(b) Environmental Impact Assessment

i) Land Environment

At the end of first five years, damage to the landscape in the form of pit & road, about 13 hectares will be degraded. The area influence of mining at the end of 5th year, is given below:

TABLE – 11.5

PARTICLUARS	Present	By the end of Fifth year
Pits(including subgrade stacks)	9.544	13.08
Dumps	0	0
Road	0.49	0.32
Plantation	0.02	0.52
Mined out plantation area	0.0	0
Top soil storage	0	0
Ag. Land encroached	0	0
Remaining Virgin Govt. Waste Land	6.156	2.29
Total	16.21	16.21

ii) Air Quality:

Air Pollution due to Mining operation will be as follows:-

(i) Gaseous Pollution

The gaseous pollutants (SO_2, NO_x and CO) are quite low as the area is plain terrain covered with no vegitation. Although these pollutants will be generated during blasting and operation of diesel equipments i.e. tippers, compressors, pump & other transport vehicles.

(ii) Suspended Particulate Matter

The generation of dust is anticipated from various mining activities i.e. drilling, blasting, loading, haulage and other transport activities related to mining.

Effort will be made to achieve following National Ambient Air quality standards:

Parameters	Ug/m³
PM_{10}	100
$PM_{2.5}$	60
SOx	80
NOx	80

iii) Water Quality:

I) Surface Water : The proposed mining activity in the next five year period will not intersect ground water table. Hence, mining will not have any impact on ground water in the area. All the rain water gravitates to lower side in the lease area. There it is allowed to pass through settlers to arrest any silt in the water. Clean water is allowed in the natural drainage system. Limestone is non-toxic and hence no chemical treatment of mine water is required. Periodical quality monitoring will be carried out and reports submitted to concerned authorities.

II) Ground Water : Though the area is in a high rainfall region, most of the precipitation constitute "run off' with very meager scope of infiltration. Therefore ground water is not available in the hilly terrain of lease area.

The ground water is encountered at the depth of 60 m to 100 m below the ground level in the plain area and there is no indication of ground water up to the depth of 55 m during the course of drilling. Hence, there is no adverse impact of mining on the ground water quality. Besides this the sources of ground water i.e. wells etc. are very less in number and there are few wells at a distance of more than 2 Km. from site.

iv) Noise Levels :

Several mining and mineral processing activities in the buffer zone generates obnoxious levels of noise and vibration. In opencast mines, drills, tippers, compressors etc. will be prominent sources of noise pollution in neighboring

communities. Following Ambient Air Quality Standards in respect of noise will be maintained.

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

Day time is 6.00 to 10.00 hrs and night time 10.00 hrs to 06.00 hrs.

v) Vibration Levels(Due to blasting)

Ground vibration and air blast takes place due to blasting. This may be harmful to nearby buildings or structures, if they are not kept within safe limits. Blasting also generate air vibration wave (air blast). Vibration may cause structural damages, which depends upon the periodical acceleration due to vibration. Air blast can damage structurally unsound building and cause window glass failure. Blasting may generate fly rock, which may cause damage to both life and wealth. But appropriate steps towards this; eliminate probability of any such damage. Noise and vibration are primarily occupational health problem for people working within active mining zone. However, public at large are not exposed to noise level due to mining activity. Blasting will be in controlled manner, hence no negative impact expected due to blasting.

vi) Water regime:

No negative impact anticipated on the water regime of the area. Mineral limestone is non toxic and no mineral processing is to be carried out in the area. No chemical will be used in the mining. Mine water accumulated in the worked out pit will be used for plantation.

vii) Socio-economics:

The mining activity will have positive impact on the socio economic condition of the area by generation of new employment to the local in habitants; resulting in increase in per capita income. The density of population in the nearby area will be increased due to improved economic conditions such as frequent transportation and medical facilities.

viii) Historical monuments:

Historical monuments are neither present in the area nor in the buffer zone.

(c) Environment Management Plan:

i) Storage And Preservation Of Top Soil:

The proposed site for mining during the first five year has rocky exposure and has no soil cover, therefore storage of soil is not required. However if some soil is encountered in small patches during mining, then it will be recovered curefully and used for plantation purpose.

ii) Proposal For Reclamation Of Land Affected By Mining Activities: During And At The End Of Mining.

The mining area is in hilly terrain hence land reclamation by way of backfilling is not proposed. However the closing benches will be suitably graded and plantation done over them , to match with the surrounding greenery. The top of benches shall be properly fenced to prevent fall of cattle / person.

iii) Programme of Afforestation:

It is proposed to plant a total no. 500 trees during five year plan period. An effort will be made in the first three years to cover the entire green belt area along the statutory lease barrier. By the end of lease period about 0.5 ha area will be covered under plantation. Year wise plantation is shown on the lay out plan (Refer plate no. 6). The total proposed area for afforestation is 0.5 hectares and expected survival rate is 90%.

A number of species will be planted suitable to this area of climate conditions like Neem, Sagwan, Banyan, Pilu, Baval etc. The afforested area will be encircled by a barbed wire fence to protect it from cattles and regular watering thrice a week (except monsoon) and maturing as required will be done.

YEAR	NO. OF PLANTS	AREA (IN Hect.)	SURVIVAL RATE
FIRST	100	0.1	90%
SECOND	100	0.1	
THIRD	100	0.1	
FOURTH	100	0.1	
FIFTH	100	0.1	

iv) Stabilization And Vegetation Of Dumps

There is no proposal for dump area in the Mining plan.

v) Measures To Control Erosion / Sedimentation Of Water Courses

Mine water pumped during rainy season will carry some silt with it. This will be discharged into nearby sump, to assist in settling down of silt, and remaining clean water will be coursed in the nearby drainage system.

The drains will be made along the base of all the benches and a gentle slope will be given inwards so that the rain water flows along the base of the benches in a natural way & joins the nearest natural valley section for drainage. In the other parts of mine area the rainwater will automatically get drained following the natural ground relief.

vi) Treatment and Disposal Of Water From Mine

There is no proposal of beneficiation plant for processing of limestone, so no affluent will be generated. The discharged mine water will not carry any toxic or poisonous matter dissolved in the water, so no treatment of water is required & proposed.

vii) Measures Of Minimizing Adverse Effects On Water Regime:

The ground water table in this region is much below from the surface and water table will not be touched anytime during mining. However, during monsoon proper care will be taken to avoid any type of contamination of surface run-off water by limestone/ waste.

viii) Measures To Minimize Vibrations Due To Blasting And Check Noise Pollution:

Electric blasting with delay detonators will be used in carefully designed blasts to minimize ground vibration and noise due to blasting. Noise pollution due to operation of machineries will be kept to the minimum by proper maintenance of the machineries and equipping then with noise abating devices. Also whenever necessary, personal protective equipment like an ear plug and ear muff will be provided to workers.

ix) Measures For Protection Of Historical Monuments And For Rehabilitation Of Human Settlement Likely To Be Disturbed Due To Mining Activity

As mentioned in previous Para, There is no historical monuments within the applied and also in surrounding area (5.0 km zone), So no step is required to protect the historical monuments. There is no village and human settlement within the applied area. Therefore, no rehabilitation scheme or provision of compensation land will be required.

x) Socio Economic Benefits Arising Out Of Mining

Limestone mining in this lease area will give following social benefits:

a) Limestone production and employment opportunities.
b) Reduction in the migration of jobless laborers from native places to other distant places.

Interaction of local people with outsiders, and improvement in communication , which will enhance their present status of knowledge and confidence.

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12.0 ANY OTHER RELEVANT INFORMATION

Nil

For Udaipur Min-Tech Pvt. Limited
(No. RQP/UDP/354/2009/B, Valid up to 20.8.2019)

Place : Udaipur	B. L. Mod	S.S. Bist
Date : 10-2-14	Key Person	Key Person

======******=====

अनुमोदित
Approved
10/4/14
क्षेत्रीय खान नियन्त्रक
Regional Controller of Mines
भारतीय खान ब्यूरो, उदयपुर
Indian Bureau of Mines, UDAIPUR

Category - A

UNDER RULE 24 (A) OF M.C.R.1960 & 23 (B) OF M.C.D.R.1988.

For

SMALL LIMESTONE MINE

NEAR VILLAGE – ANIALI, TALUKA – RANAVAV

DIST - PORBANDAR (GUJARAT)

LEASE AREA - 16.21 HECT. SURVEY NO. 207/(P) (NON FOREST)

First Mining Lease grant - from 29.10.1964 to 28.10.1984

First Renewal of M.L. - from 29.10.1984 to 28.10.2004

Second Renewal of M.L. applied - from 29.10.2004 to 28.04.2024

(MINING PLAN PERIOD : 2014-15 TO 2018-19)

LESSEE

M/s TATA CHEMICALS LIMITED

P.O. – Mithapur: 361345,

Taluka – Okhamandal, Dist- Jamnagar, Gujarat.

Phone: +91 2892 223792, 223793 Fax: +91 2892 223227

Email: sbhakta@tatachemicals.com

Reg. No. IBM/437/2011 Mine Code No. 38 GUJ08177

PREPARED BY

M/S UDAIPUR MIN - TECH PVT. LTD.

UDAIPUR - 313002 (RAJ.)

RQP NO.- RQP/UDP/354/2009/B, valid up to 20.8.2019

Phone No. & Fax No.(0294) 2489672 Email - ssbist@udrmintech.com

PROGRESSIVE MINE CLOSURE PLAN
1.0 INTRODUCTION

Name of the lessee

Registered Office:
Tata Chemicals limited,
Bombay House,
24, Homi Mody Street, Fort,
Mumbai 400001.
Phone +91 22 2049131, 2042947

Works:
P.O.Mithapur. 361345,
Taluka : Okhamandal
District : Jamnagar, Gujarat
Phone +91 2892 222207, 222225,
Fax +91 2892 223227

Mine Office:

Ranavav Quarries,
P.O.Ranavav,
Taluka Ranavav,
District Porbandar, Gujarat
Phone : +91 2801 36381, Fax +91 2801 236320

(B) Location & extent of the lease area

District & State	Porbandar, Gujarat
Taluka	Ranavav
Village	Aniali
Survey No.	207 / P Govt. waste land
Type of Land	Non - Forest

(C) Extent Of The Lease Area

The lease area falls within the latitude 21° 42' 17.62" to 21° 42' 35.11" & longitude 69° 49' 31.80" to 69° 49' 40.53".

The lease area can approached by a motorable tracks from the road connecting Aniali village to Volwada on NH-8B, between Ranavav and Kutiyana. The road distance from Volwada to the lease area is 15 km. From the village center of Aniali, this lease area is 4.5 Km.

The taluka town of Ranavav, which is the nearest population center from the lease area, is connected with other important towns and cities through a good network of roads with regular public transport services. The distance by road from Aniali lease to Ranavav town via Wolwala is around 15 to 16 km. The centralized mining office complex of TCL at Adityana is at distance of about 25 km from the Aniali lease.

The district town of Porbandar is at a distance of about 33 km. from the lease area. The coastal highway NH-8E running along the Saurashtra coast from Okha to Bhavnagar intersects at Porbandar.

The Soda -Ash and Cement plant complex at Mithapur is at distance of 118 km. from Porbandar along the coastal highway.

The road distance from the plant complex at Mithapur to this lease is around 151 km. The state capital at Gandhinagar is at a distance of about 388 km from the lease via Wolwala, Kutiyana and Rajkot along NH-8B and 8A.

The railhead at Ranavav is at a distance of 20 km from Aniali along NH-8B and the port town & district town Porbandar at 33 km along the same highway. The railway link at Ranavav connect the place to Ahemdabad via Jamnagar, Rojkot and Viramgam, the distance by rail being as follows :

Ranavav to Jamnagar	:	118 Km.
Ranavav to Rajkot	:	263 Km.
Ranavav to Ahemdabad	:	499 Km.

The railway connection to the factory at Mithapur from Ranavav is through Kanalus Junction(Short of Jamnagar) and Dwarka over a distance of 223 Km.

The nearest civilian air port for regular commercial flights is at Porbandar, the

road distance from the lease area Ranavav along NH-8B being around 30 km. Porbandar is also a sea port, the actual distance of the port from the lease area being around 40 km.

Other facility like postal , telegraph, telephone, FAX, STD,ISD etc. are available at Volwada & Ranavav. TCI offices at Adityana quarry is also equipped with telephone, STD, FAX & Internet facilities

(D) Present land use pattern:

The total area (16.21 hectares) falls under Govt. Waste Land.

PARTICLUARS	Present Land Use pattern in Ha.
Pits (including sub grade stacks)	9.544
Dumps	0
Road	0.49
Plantation	0.02
Mined out plantation area	0.0
Top soil storage	0
Ag. Land encroached	0
Remaining Virgin Govt. Waste Land	6.156
Total	16.21

(E) Method of Mining:

Deposit is on surface with no overburden. Mechanized opencast method of mining is being used at this mine. Individual benches are maintained at a height of 4.0 m. Bench width is kept at minimum three times height of bench. Drill holes by wagon drill 110 mm dia holes at an angle of 80 ° are drilled and blasted using ANFO & booster charge. Loading of blasted rock is done using excavator. Broken material is loaded into 10 tonne tipper and sent to company's crusher. Haul roads are maintained at a gradient of 1:16.

No other means/ operation for up gradation of mineral is to be carried out at this mine.

- Bench height of 4.0 m will be developed.
- Minimum bench width will be 15-20 m.
- Individual bench slope will be 80° from vertical.
- 110 mm dia blast holes using wagon drill .
- Excavator of bucket capacity 1.54 Cum. will be used.
- For ore 10 t capacity tippers are proposed to be used.
- Haul roads will be developed at minimum gradient of 1:16.
- ANFO with cap sensitive explosive will be used.
- Rock Breaker will be used as and when required to break boulders.

(E) Mineral Processing:

No mineral processing is done at the mine site. The ROM limestone is sized in crusher at Adityana to get +50 to –100 mm sized chemical grade limestone which is a prime requirement of Soda –Ash plant. No other mineral processing is applicable for our limestone as it is to be directly consumed in same form and composition.

1.1 REASONS FOR CLOSURE:

It is an existing mining lease. At present no specific reasons have been observed for closure of mining operations. The Progressive Mine Closure Plan has been made to meet out the statutory requirement made under rule 23 (B) of M.C.D.R. 1988. In future the mine will close either due to depletion of reserves or becoming uneconomical.

1.2 STATUTORY OBLIGATIONS

Lessee is bound to follow the terms and conditions as stipulated in the following approvals / documents:

- Terms & Conditions of lease deed.

- Conditions stipulated in the Mining Plan / Scheme of Mining and approval letters.
- Conditions as per the EC.
- Conditions of Consent to Operate from State Pollution Control Board.
- Provisions of MMR 1961, MCDR 1988, Mines Rules 1955 and other laws applicable to mine.
- All other rules pertaining to the mining existing at that time has to be followed during the course of mining.

1.3 CLOSURE PLAN PREPARATIONS:

Name, Address And Registration Number Of The Recognized Persons Who Prepared The Progressive Mine Closure Plan

Name of the RQP preparing the mining plan	Udaipur Min-Tech Pvt. Limited, RQP/UDP/354/2009/B
Address for communication	206, Apeksha Complex, Sector – 11, Udaipur – 313002, Rajasthan
Phone	0294-2489672, +919414167672, +919829857672
Fax	0294-2489672
e-mail	ssbist@udrmintech.com, blmod@udrmintech.com

Name & Address of the executing Agency:

Mr. R Mukundan, Managing Director, (Nominated Owner) of M/S Tata Chemicals Limited, is the executing agency for the closure plan. At present there is no proposal for closure of the mine.

2.0 MINE DESCRIPTION

2.1 Geology:

(i)Topography & drainage:-

The lease area falls within the latitude 21° 42' 17.62" to 21° 42' 35.11" & longitude 69° 49' 31.80" to 69° 49' 40.53". Lease area is a limestone outcropping ridge with moderate height. The lease area under reference is a waste land of Aniali village revenue area which is rocky covered and part of the area is covered with soil. There is no prominent water course available within and near lease area but during rainy season rain water flows SE to NW direction and meets nearby small nallas. One Pond is in north east corner of the lease area near pillar no.8. This is in dry position at present and shallow water is accumulated in rainy season only.

The low elevation coastal plains are covered by the rocks of the Miliolite Formation, which overlap the underlying basaltic rocks of the Deccan Trap basalts and the granophyres exposed in the foothills and higher elevations of the Barda range. Thin layers of Miliolite rock are also seen to occupy the hill slopes or interior depressions within the Barda hills as a result of either marine deposition during transgression of the sea or deposition of Aeolian sand blown from the coastal plain where the Miliolite Formation is thicker and purer in so far as the carbonate contents are concerned, one occasionally comes across the typical features of a Karst topography, in the form of cavities and caves, mounds and depressions, all resulting from solution effect of the carbonate rocks.

(ii)General Geology & Local Geology

a) General Geology:-

The rock formation belonging to Late Pleistocene to Early Holocene age and designated as Miliolite Formation occupies the Saurashtra coastal plain extending from northwest of Porbandar to near Gopnath Point in Bhavnagar

district. This formation overlaps the Pliocene and Miocene rocks and occurs directly over the Deccan Trap Formation of Upper Cretaceous to Paleocene age towards the north and east. The regional stratigraphic sequence is given in Table 3.1.

Table 3.1 REGIONAL STRATIGRAPHIC SEQUENCE

AGE	FORMATION	ROCK TYPE
Recent(Holocene)	Alluvium/Recent Limestone	Alluvial Soil, Black-brown soil, coastal limestone
Early Holocene to Late Pleistocene	Miliolite Formation	Arenaceous limestone and calcareous sandstone
Pliocene	Dwarka Beds	Gypsiferous clay and sandy foraminifer limestone
Miocene	Gaj Beds Unconformity	Clay and calcareous clay .....
Paleocene to Upper Cretaceous	Deccan Trap	Basalt and its derivatives including the intermediate and acidic rock types like, dacites, granophyre etc.

2.2 Reserves :

BLOCKWISE GEOLOGICAL RESERVES HAVE BEEN TABULATED BELOW:

BLOCK No.	LIMESTONE RESERVES		
	CHEMICAL GRADE	MARGINAL GRADE	CEMENT GRADE
BLOCK-I	1,13,400	1,100	45,900
BLOCK-II	3,22,200	4,000	5,31,000
TOTAL	4,35,600	5,100	5,76,900

2.3 Mining method:

It is proposed to work the deposit by mechanized open cast method of mining with the use of Loader for loading of blasted rock. Following broad design parameters have been considered.

- Bench height of 4.0 m will be developed.
- Minimum bench width will be 15-20 m.
- Individual bench slope will be 80° from vertical.
- 110 mm dia blast holes using wagon drill .
- Excavator of bucket capacity 1.54 Cum. will be used.
- For ore and waste 10 t tippers are proposed to be used.
- Haul roads will be developed at minimum gradient of 1:16.
- ANFO with cap sensitive explosive will be used.
- Rock breaker will be used to break boulders as and when required.
- Water sprinkler will be used for dust suppression in the mine.

Provisions of MMR 1961 will be strictly be adhered.

Mining Machinery deployed

Equipment	Capacity	Nos.	Make	Motive power HP
Excavator	1.54 cu.m.	01	HM-2021	Diesel 110 HP
Tipper	10 t	03	Tata	Diesel 110 HP
Air Compressor	450 cfm	01	Atlas Copco	Diesel 125 HP
Wagon Drill	110mm dia	01	Atlas Copco BVB 25	Compressed Air
Explosive van	1 ton	01	Tata 407	Diesel 60 HP
Water Sprinker	5000 litre	01	Mahindra Tractor	Diesel 45 HP
Jeep		01	Mahindra	Diesel 40 HP
Tractor		01	Mahindra	Diesel 45 HP
Diesel pump		01	Local	Diesel 7.5 HP

2.4 Mineral beneficiation:

No mineral beneficiation is proposed at this mine for mineral up-gradation by mechanical or chemical process as there is no need of beneficiation for Limestone.

2.5 Production levels

Year wise production of Chemical grade limestone during the plan period will be as given below. It is estimated that about 2 % of R.O.M. is lost during the course of mining. The proposed excavated tonnage is tabulated.

Year	ROM Limestone MT	Inferior Grade Limestone MT	Chemical Grade limestone MT
2014-15	86845	13818	73027
2015-16	86928	7380	79548
2016-17	87628	16206	71422
2017-18	87394	27598	59796
2018-19	83932	6604	77328
Total	432727	71606	361121

3.0 REVIEW OF IMPLEMENTATION OF MINING PLAN INCLUDING FIVE YEARS PROGRESSIVE CLOSURE PLAN UPTO THE FINAL CLOSURE PLAN.

3.1 Afforestation

Year	No. of Saplings		
	Proposed	Actual	Deviation
2008-09	100	Nil	Mining operation was closed due to EC not received.
2009-10	100	Nil	
2010-11	100	Nil	
2011-12	100	Nil	
2012-13	100	Nil	
Total	500	Nil	

3.2 Reclamation & Rehabilitation

There was no proposal for reclamation during plan period.

3.3 Control of Noise, dust & ground vibrations

No mining was carried during the period under review. No monitoring of air, water noise carried out.

4.0 CLOSURE PLAN

4.1 Mined out land

Land use pattern at present and at the end of plan period is given below:

Activity		Present Ha	At the end of Plan Ha
Mining			
	Pits	9.544	13.08
	Dumps	0	0
	Road	0.49	0.32
	Plantation Grazing land Rain water storage	0.02	0.52
	Old Mined out area covered by fine stack	0	0
	Top soil storage	0	0
Ag. Land encroached		0	0
Remaining Virgin Govt. Waste Land		6.156	2.29
Total		16.21	16.21

At no point of time reclamation of the workout area by backfilling will be possible as there is no O/B. Therefore the deepest part of pit at the end of mining will be use for rain water storage for the benefit of recharge of ground water.

The abandon pit will be fenced & plantation will be done all around the ultimate

pit boundary and rest of mined out area use for grazing by local people. This plantation shall be completed at the end of mining activity.

Barbed fencing/bund shall be constructed along the periphery of the quarry to render it safe and prevent accidental fall of men and animals into it. All necessary precaution shall be taken as per Reg. 115(1) of MMR, 1961. So that it can be gainful post mining use to the society.

4.2 Water Quality Management:

The proposed mining activity in the next five year period will not intersect ground water table. Hence, mining will not have any impact on ground water in the area. All the rain water gravitates to lower side in the lease area. There it is allowed to pass through settlers to arrest any silt in the water. Clean water is allowed in the natural drainage system. Limestone is non-toxic and hence no chemical treatment of mine water is required. Periodical quality monitoring will be carried out and reports submitted to concerned authorities.

Air Quality Management:

Air quality pollution takes place due to drilling, blasting, loading & transportation of mineral / waste. Following measures are proposed to be continued:

- Wet drilling or use of dust extractors
- Water sprinkling along haul roads, loading, unloading points.
- Use of dust masks.
- Plantation along the statutory barriers.
- Preventive maintenance of equipment
- Proper maintenance of haul roads.
- Water spraying of the muck after loading into tippers.
- Tarpaulin cover over the tippers.

4.3 Waste Management:

Deposit of the area is devoid of waste / overburden. Therefore, no external dump will be created and no measures are to be taken.

4.4 Top Soil Management:

The mineable area is devoid of top soil. Hence, no proposals are made for top soil management. But efforts shall be made to recover even thin layer of soil (incidental soil), it shall be scrapped in separate slice and kept preserved for utilization in plantation work.

4.5 Tailing Dam Management:

There is no tailing generation in the process of mining.

4.6 Infrastructure:

Office-cum-store is located outside the lease hold area.

Any other facility through underground like electric transmission line, water supply line, gas pipe line, sewer line, telephone cables etc, have not been observed in the lease area.

There is no proposal for closure of mine in the next five years, hence no decommissioning of infrastructure is proposed. Buildings will be dismantled and reusable material sold or used elsewhere. Transmission line will be de-energised and dismantled. No live electric supply line will be left.

4.7 Disposal of Mining Machinery:

There is no proposal for closure of mine in the next five years, hence no decommissioning of mining machinery is proposed. However at the end of life of mine the mining machinery in operation will be either used at the other mine of the company or sold. Redundant machinery, fittings etc. will be sold as scrap.

4.8 Safety & Security:

During the opencast working, and allied activities, all the precautionary measures shall be taken into account as per Reg. 106, 181, 182 & 183 of MMR 1961 and Rules 31, 35, 37, 38 & 39 of MCDR 1988 for safety and security.

Following Safety & security measures will be enforced:

- Moving front of the quarry shall have temporary fencing.
- Permanent fencing will be provided where quarry has reached the ultimate pit limit.
- Mine entrance will have a permanent check post and record shall be maintained of all persons / vehicles entering the mine area.
- Round the clock security arrangement shall be provided to prevent inadvertent entry of persons.

4.9 Disaster Management and Risk Assessment:

It is a hard rock area and as such no serious disaster is foreseen. However accidents cannot be ruled out in the mine. Following risks are anticipated:

- Failure of benches.
- Fall of machinery / person from benches.
- Failure of transport machinery.
- Heavy rainfall.

4.10 The Onsite Emergency Plan is already in place and will be followed strictly in case of any emergency. Lessee is running a soda ash plant and having facility to deal with any emergency. If required help will be sought from district authorities and DGMS. Care & maintenance during temporary Discontinuance:

In case of any temporary discontinuance due to court order or due to statutory requirement or any other unforeseen circumstance following measure: maintenance and monitoring of status shall be taken.

- Notice of temporary discontinuance of work in mine shall be given to the Controller General, Controller of Mine and the Regional Controller, IBM and DGMS Officials under Rule 24 of MCDR 1988 and Reg. 6 of MMR 1961 respectively.
- All the mining machinery shall be shifted to a safe place.

- Entrance to the mines or part of the mines to be discontinued shall be fenced off as per DGMS Circular and security Guards shall be posted for the safety and, to restrict any unauthorized entry to the area.
- Competent persons shall inspect the area regularly.
- Air, water and other environmental monitoring shall be carried out.
- Care and upkeep of plantation done shall be carried out on regular basis.
- Measures of care, maintenance and monitoring of status of unplanned, discontinued mining operations expected to re-open in future.
- All rules and regulations shall be followed in case of any temporary discontinuance of mine.

No temporary discontinuance is anticipated during the closure plan period.

5.0 ECONOMIC REPURCUSSIONS OF CLOSURE OF MINE AND MANPOWER RETRENCHMENTS

5.1 Number of local residents employed in the mine, status of the continuation of family occupation and scope of joining the occupation back

About 29 persons are likely to be employed and the main family occupation is cultivation, cattle breeding, working as seasonal labor

in the surrounding mines. In the event of closure of mines, lessee will make the efforts to provide them suitable employment at the other mine / works. Or alternatively they can go back to their occupation or get employment in other mines.

5.2 **Compensation given or to be given to the employees connecting with sustenance of himself and their family members**

The employees shall be given compensation as per the provisions of Industrial Disputes Act, 1976 and subsequent amendments.

5.3 **Satellite occupations connected to the mining industry – number of persons engaged therein– continuance of such business after mine closes.**

Indirect employment in ancillary business in the event of mine closure is likely to continue.

5.4 **Continued engagement of employees in the rehabilitated status of mining lease area and any other remnant activities.**

Once the lease is determined all the remnant activities will come to an end and area handed over to State Govt. The lessee will make the efforts to provide them suitable employment at the other mine / works. Some of the employees may be engaged in security duties afterwards.

5.5 **Envisaged repercussions on the expectation of the society around due to closure of mine.**

The closure of mine will have grave repercussions on the expectations of the unemployed persons and society at large since the obvious advantages received will cease and the closure will directly affect their livelihood. The capacity of the retrenched

employees to provide education to their children, access to modern gadgets like TV, Refrigerator, telephone, cars etc. will tremendously be effected. Assistance provided to Gram Panchayats will also cease. Maintenance of roads will also suffer. The local habitat in general will feel insecure as their education, health standards and life expectancy will be badly affected.

To alleviate the problem of unemployment at the time of closure of the mine, the company can start the training programme of the employees and their dependents in local handicraft, and help them in establishment of small scale industry. Company should also explore the possibility of their employment in other mines / plant.

6.0 TIME SCHEDULING FOR ABANDONMENT:

The lessee is not planning to abandon mine at the end of plan period, hence the provision of abandonment cost at the present stage is not envisaged. This will be reviewed in the subsequent plan/scheme and the projections will be made thereafter. The cost of the work to be carried out during the ensuing five years is given below;

Activity	Year					Rate	Amount in Rs.
	14-15	15-16	16-17	17-18	18-19		
Plantation nos.	100	100	100	100	100	Rs. 100 / plant	50000
Barbed Wire Fence in m	300	300	300	300	300	Rs. 120 / m	180000
Post plantation care	5000	10000	15000	20000	25000	Rs. 50/plant/yr.	75,000

As projected in the conceptual plan the mineral is likely to be exhausted in next 5 years. In view of this the exact scheduling for closer in next scheme period as given in below table:

Time scheduling for mine closure during scheme period

Land : Stage Wise use reclamation Area(Ha.)					
S.No	Year	Disturbed	Afforested	Reclaimed/Rehabilitated	
				Grazing land	Rain water storage
1.	Present	10.034	0.02	--	--
3.	End of Mine Life	13.47	0.86	8.17	1.45

Proposed Land Use (till end of life) (in Ha.)

POST MINING LAND USE OF CORE ZONE WITH ENV. MANAGEMNET					
S.No.	Description	Area in Hect.	% of Total	Reclaimed/ Rehabilitated	
				Grazing land	Rain water storage
1.	Afforestation	0.86	5.30	--	--
2.	Undisturbed	2.22	13.69	--	--
3.	Under structure/Built-up	--	--	--	--
4.	Remaining mined out area covered by fine stack	3.51	21.65	--	--
5.	Reclaimed/ Rehabilitated	9.62	59.34	8.17	1.45
	Total	16.21	100	8.17	1.45