जहाँ है हरियाली ।
वहाँ है खुशहाली ॥

Ministry of Environment & Forests
GOVERNMENT OF INDIA, NEW DELHI

Environmental Impact Assessment Guidance Manual for MINING OF MINERALS

Prepared by

Administrative Staff College of India
Bellavista, Khairatabad, Hyderabad

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Environmental
Impact Assessment Guidance Manual
for

Mining of Minerals

Foreword

The EIA Notification 2006 not only reengineered the entire EC process specified under the EIA Notification 1994 but also highlighted the need to introduce specific sectors/categories under the sectors such as Industry and Infrastructure and also introduced new sectors such as Construction to be brought in the ambit of the EC process based on their extent of impacts on environment. The EIA Notification 2006 has notified 39 developmental sectors, which require prior environmental clearance. Based on the capacity, the Projects have been categorised into Category A or B which has been further categorised as B1 or B2. The Ministry of Environment and Forests (MOEF) has so far constituted 25 State level Environmental Impact Assessment Authorities (SEIAs) and State Expert Appraisal Committees (SEACs) to appraise B category projects.

The need for Sector specific manuals and guidelines for appraisal of projects under the EIA Notification 2006 has been felt for some time with a view to bringing clarity in the EC process consists of Screening, Scoping, Public Consultation and Appraisal for the purpose of granting and expediting environmental clearance. This need was further reinforced after the constitution of various SEIAs and SEACs in the various States, who were assigned this task for the first time. It was also felt that Manuals on each Sector would help in standardisation of the quality of appraisal and in reducing inconsistencies between SEACs/SEIAAs in granting ECs for similar projects in different States.

The MOEF at the first instance decided to bring out EIA Sector Specific Manuals for 37 developmental projects and the preparation of EIA Manuals of ten of these Sectors was assigned to Administrative Staff College of India (ASCI), Hyderabad.

1. Mining
2. Mineral Beneficiation
3. Ports & Harbours
4. Airports
5. (A) Building Construction
5. (B) Townships
6. Asbestors
7. Highways
8. Coal Washery
9. Aerial Ropeways
10. Nuclear Power Plants, Nuclear Fuel Processing Plants and Nuclear Waste Management Plants

The Manual for the sectors contain Model TOR of that Sector, technological options and processes for a cleaner production and waste minimisation, wherever applicable, monitoring of environmental quality, related regulations, and procedure of obtaining EC if linked to other clearances for eg., CRZ, etc.

The draft Manuals were uploaded on the MOEF website and comments/responses received were considered and finalised. Since the environmental clearance process itself is a dynamic one dependent on developmental needs, technologies available and standards for cleaner environment for a sustainable development, these manuals would require regular updation in the future. I hope the Manuals in their present form are of use and we would appreciate receiving responses from various stakeholders for further improvements that could be taken up in the future.

I congratulate the entire team in the Administrative Staff College of India, Hyderabd, experts of the sectors who were involved in the preparation of the Manuals, members of the Core and Peer Committees of various sectors and various Resource persons whose inputs were indeed valuable in the preparation and finalisation of the Manuals.

(JAIRAM RAMESH)
MINISTER OF STATE FOR ENVIROMENT & FORESTS

5th May 2010

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DIRECTOR GENERAL

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Leadership through Learning

Acknowledgements

Environmental Impact Assessment (EIA) is a planning tool generally accepted as an integral component of sound decision-making. EIA is to give the environment its due place in the decision-making process by clearly evaluating the environmental consequences of the proposed activity before action is taken. Early identification and characterization of critical environmental impacts allow the public and the government to form a view about the environmental acceptability of a proposed developmental project and what conditions should apply to mitigate or reduce those risks and impacts.

Environmental Clearance (EC) for certain developmental projects has been made mandatory by the Ministry of Environment & Forests through its Notification issued on 27.01.1994 under the provisions of Environment (Protection) Act, 1986. Keeping in view a decade of experience in the Environmental Clearance process and the demands from various stakeholders, the Ministry of Environment and Forests (MoEF) issued revised Notification on EC process in September 2006 and amended it in December 2009.It was considered necessary by MoEF to make available EIA guidance manuals for each of the development sector.

Accordingly, at the instance of the MoEF, the Administrative Staff College of India, with the assistance of experts, undertook the preparation of sector specific Terms of Reference (TOR) and specific guidance manual for **Mining of Minerals**. I wish to thank **Mr. J. M. Mauskar,** IAS, Additional Secretary, Govt. of India MoEF for his continuing support during the preparation of the manuals. I wish to place on record also my sincere thanks to **Dr. B. Sengupta**, former Member Secretary, Central Pollution Control Board and Chairman of the Core Committee for his help in the preparation of the manuals. His suggestions helped us a great deal in improving the technical quality of the manuals. **Mr M. Parabrahmam**, Former advisor MoEF and Chairman of the Peer Committee II for this project, has given constant guidance to the ASCI project team. His vast experience has been immensely helpful in preparing these manuals. I would like to thank the officials of the Ministry, **Dr. Nalini Bhat** and **Dr. T. Chandini,** for coordinating the project from the Ministry side and for providing guidance whenever needed My thanks are also due to **Dr. S. K. Aggarwal** of MoEF for the valuable inputs they had given during our interactions with the officials at Delhi and Hyderabad.

I thank **Dr. D. K. Behera,** Senior scientist, Orissa Pollution Control Board, resource person, who, drawing on his vast experience in the sector, prepared the EIA guidance manual on **Mining of Minerals** along with **Dr. Valli Manickam**, Member of Faculty of ASCI. The efforts put in by both of them are commendable.

I would like to thank all the Peer and Core Committee members for having given a valuable feed back in the preparation of the manual. I hope the manuals would prove to be useful to the community at large and to the experts working in this area in particular.

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S.K. Rao

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ABBREVIATIONS

ASCI	–	Administrative Staff College of India
CPCB	–	Central Pollution Control Board
CRZ	–	Coastal Regulation Zone
CSR	–	Corporate Social Responsibility
CGWB	–	Central Ground Water Board
EAC	-	Expert Appraisal Committee
EIA	–	Environmental Impact Assessment
EC	–	Environmental Clearance
ETP	–	Effluent Treatment Plant
EMP	–	Environmental Management Plan
DMP	–	Disaster Management Plan
IA	–	Impact Assessment
MoEF	–	Ministry of Environment and Forests
R O	–	Regional offices
R&R	–	Rehabilitation and Resettlement
SPCBs	–	State Pollution Control Boards
STP	–	Sewage Treatment Plant
TOR	–	Terms of Reference

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ABOUT THE MANUAL

Environmental Impact Notification S.O.1533 (E), dt.14th September 2006,as amended 2009, issued under Environment (Protection) Act 1986, has made it mandatory to obtain environmental clearance for scheduled development projects. The notification has classified projects under two categories 'A' & 'B'. Category A projects (including expansion and modernization of existing projects) require clearance from Ministry of Environment and Forest (MoEF), Govt. of India (GoI) and for category B from State Environmental Impact Assessment Authority (SEIAA), constituted by Government of India.

The existing manual on Environmental Impact Assessment (EIA) of MoEF, is common for all the sectors requiring prior environmental clearance. Considering the diversity in all sectors related to infrastructure and industrial development projects, MoEF launched a program for development of sector specific technical EIA guidance manuals. The EIA guidance manual will help the project proponent/consultant in the preparation of the EIA report. It also helps the regulatory authority to review the report as well as the public to become aware of the related environmental issues. This EIA guidance manual accordingly addresses the related environmental concerns for the specific sector – "**Mining of Minerals**". This manual consists of terms of reference (TOR), manual and questionnaire.

The sector specific manual consists of twelve chapters, which correspond to the generic structure given as per EIA notification 2006, as amended Dec 2009.

Chapter 1: Introduction

This chapter contains the general information on the mining of minerals, major sources of environmental impacts in respect of mining projects and details of environmental clearance process.

Chapter 2: Project Description

In this chapter the proponent should also furnish detailed description of the proposed project, such as the type of the project, need for the project, project location, layout, project activities during construction and operational phases, capacity of the project, project operation i.e., land availability, utilities (power and water supply) and infrastructure facilities such as roads, railways, housing and other requirements. If the project site is near a sensitive area it is to be mentioned clearly why an alternative site could not be considered. The project implementation schedule, estimated cost of development as well as operation etc should be also included.

Chapter 3: Analysis of Alternatives (Technology and Site)

This chapter gives details of various alternatives both in respect of location of site and technologies to be deployed, in case the initial scoping exercise considers such a need.

Chapter 4: Description of Environment

This chapter should cover baseline data in the project area and study area.

Chapter 5: Impact Analysis and mitigation measures

This chapter describes the anticipated impacts on the environment and mitigation measures. The method of assessment of impacts including studies carried out, modelling techniques adopted to

assess the impacts where pertinent should be elaborated in this chapter. It should give the details of the impacts on the baseline parameters, both during the construction and operational phases and suggests the mitigation measures to be implemented by the proponent.

Chapter 6: Environmental Monitoring Program

This chapter should cover the planned environmental monitoring program. It should also include the technical aspects of monitoring the effectiveness of mitigation measures.

Chapter 7: Additional Studies

This chapter should cover the details of the additional studies required in addition to those specified in the ToR and which are necessary to cater to more specific issues applicable to the particular project.

Chapter 8: Project Benefits

This chapter should cover the benefits accruing to the locality, neighbourhood, region and nation as a whole. It should bring out details of benefits by way of improvements in the physical infrastructure, social infrastructure, employment potential and other tangible benefits.

Chapter 9: Environmental Cost Benefit Analysis

This chapter should cover on Environmental Cost Benefit Analysis of the project.

Chapter 10: Environmental Management Plan

This chapter should comprehensively present the Environmental Management Plan (EMP), which includes the administrative and technical setup, summary matrix of EMP, the cost involved to implement the EMP, both during the construction and operational phase and provisions made towards the same in the cost estimates of project construction and operation. This chapter should also describe the proposed post-monitoring scheme as well as inter-organizational arrangements for effective implementation of the mitigation measures.

Chapter 11: Summary and Conclusions

This chapter gives the summary of the full EIA report condensed to ten A-4 size pages at the maximum. It should provide the overall justification for implementation of the project and should explain how the adverse effects have been mitigated.

Chapter 12: Disclosure of Consultants

This chapter should include the names of the consultants engaged with their brief resume and nature of consultancy rendered.

The contents of the manual are to be considered as version 1.0 (2010). The ministry as per the requirements will take up an updating /revision of the manual. In case of interpretation of any question related to law, the provisions of the original laws and the Rules made thereunder with various Government directions /resolutions will have to be read and followed. In case of amendment to the original Act /Rules /Notifications made thereunder, the provisions as amended from time to time shall be applicable. Any obligations of international conventions, where GoI is a signatory and accepted for implementation are also to be followed.

1 INTRODUCTION

1.0 Preamble

Environment Impact Assessment (EIA) 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 proposed projects. It aims predicting environmental impacts at an early stage of project planning and design, find ways and means to reduce adverse impacts, shape projects to suit the local environment and present the predictions and options to decision makers. By using EIA, both environmental and economic benefits can be achieved. EIA systematically examines both beneficial and adverse consequences of the proposed project and ensures that these impacts are taken into account during the project design. By considering environmental effects and mitigation early in the project planning cycle, there are many benefits, such as protection of the environment, optimum utilization of resources and saving overall time and cost of the project. Properly conducted EIA also lessens conflicts by promoting community participation, informs decision-makers, and helps lay the base for environmentally sound projects.

The Ministry of Environment & Forests, Govt. of India, made environmental clearance (EC) for certain development projects mandatory through its notification of 27/01/1994 under the Environment Protection Act, 1986. Keeping in view of the experience gained in environmental clearance process over a period of one decade, the MoEF came out with Environment Impact Notification, SO 1533(E), and dt.14/09/2006. It has been made mandatory to obtain environmental clearance for different kinds of developmental projects (Schedule-1 of notification).

The notification has classified projects under two categories-A and B. Category-A Projects (including expansion and modernization of existing projects) require clearance from Central Government (Ministry of Environment and Forest, Govt. of India) while category-B projects should be considered by State Level Environmental Impact Assessment Authority (SEIAA), constituted with the approval of MoEF.

1.1 General Information on Mining of Minerals

Indian mining industry is characterized by a large number of small operational mines. The number of mines that reported mineral production (excluding minor minerals, petroleum (crude), natural gas and atomic minerals) in India was 2954 in 2008-09 as against 2854 in the previous year (Table 1.1).

Table 1.1 Number of reporting mines in the country 2007 / 2008

Mining	Number
All minerals	2854
Fuel minerals	569
Metallic minerals	676
Non-metallic Minerals	1609

Source: Ministry of Mines GOI, www.mines.nic.in.

Out of 2954 reporting mines, 433 were located in Gujarat followed by Andhra Pradesh (406), Madhya Pradesh (298), Jharkhand (298), Rajasthan (252), Orissa (236), Karnataka (230), Tamil Nadu (159), Maharashtra (154), Chhattisgarh (150) and West Bengal (113). These 11 states together accounted for 92.38 % of total number of mines in the country in 2008-09. During 2008-09, mineral production was reported from 23 States and Union Territories of which the bulk of value of mineral production of about 78.99% was confined to 8 States (Including offshore areas) only. Offshore areas continued to be in leading position, in terms of value of mineral production in the country and had the share of 19.36% in the national output. Next in order was Orissa with a share of 14.70% followed by Chhattisgarh (11.61%), Jharkhand (8.94%), Madhya Pradesh (7.83%), Andhra Pradesh (6.46%), Gujarat (5.09%), Karnataka (5.00%), Maharashtra (4.39%), Goa (3.35%), Assam (3.14%) and West Bengal (3.11%) in the total value of mineral production. Remaining 11 States/Union Territories having individual share of less than 3% together accounted for 7.02% of total value during the year under review (www.mines.nic.in).

India's ranking in 2007-08 in world production was 2nd in barytes, chromite and talc/steatite/pyrophillite, 3rd in coal & lignite and bauxite, 4th in iron ore and kyanite/sillimanite, 5th in manganese ore and steel (crude), 7th in zinc and 8th in aluminium. The statistics on indigenous and world production of principal minerals and metals are given in Table 1.2.

Table 1.2 Contribution and rank of India in World Production of Principal Minerals & Metals, 2007

Commodity	Unit of Quantity	Production		Contri-butio%	India's rank in Order of Quantum of production
		World	India		
Mineral Fuels					
Coal & Lignite	Million tones	6357	491	7.7	3rd
Petroleum (crude)	Million tonnes	3885	34	0.9	24th
Metallic Minerals					
Bauxite	'000 tones	213000	23084	10.8	3rd
Chromite	'000 tones	24000	4798	20.0	2nd
Iron ore	Million tonnes	2043	206	10.0	4th
Manganese ore	'000 tones	33800	2550	7.5	5th
Industrial Minerals					
Barytes	'000 tones	8100	1072	13.2	2nd
Kyanite, andalusite & sillimanite	'000 tones	400(e)**	47	11.7	4th
Magnesite	'000 tones	23500	248	1.0	11th
Apatite & Rock phosphate	'000 tones	159000	1866	1.2	13th
Talc/Steatite/Pyrophllite	'000 tones	8600	1031	12.0	2nd
Mica	'tonnes	310000	4583	1.5	11th
Metals					
Aluminium	'000 tones	38200	1240	3.2	8th
Copper (refined)	'000 tones	20900	501	2.4	11th
Steel (crude/liquido)	Million tones	1344	54@	4.0	5th
Lead (refined)	'000 tones	8100	58	0.7	25th
Zinc (slab)	'000 tones	11300	457	4.0	7th

Source: World mineral production data compiled from World Mineral Production, 2003-2007, British Geological Survey.
* Figures relate to 2007-08.
** Mineral Commodity Summaries, 2009, US Geological Survey.
@ JPC data (March 2009)

Mineral-wise analysis revealed that building stone had the largest share of 24.5% to the value of minor minerals followed by brick-earth 20.9%, road metals 17.1%, marble 12.1%, ordinary sand 6.4%, quartzite & sandstone 5.2%, limestone 3.6%, gravel 3.3%, murrum 1.8%, kankar 1.5%, ordinary earth 1.4% and ordinary clay 1.1%. The remaining minerals together contributed 1.1% of value of minor minerals. The proven geological resources of coal in India are given in Table 1.3. The coal production in India during 2008-2009 is presented in Table 1.4

Table 1.3 Inventory of Geological Resources of Coal in India

Type of Coal	As on	Reserve (Mill. Tonne)			
		Proved	Indicated	Inferred	Total
Prime Coking	01/04/2008	4,614	699	-	5,313
	01/04/2009	4,614	699	-	5,313
Medium Coking	01/04/2008	12,308	12,136	1,880	26,324
	01/04/2009	12,448	12,064	1,880	26,393
Blendable / Semi Coking	01/04/2008	482	1,003	222	1,707
	01/04/2009	482	1,003	222	1,707
Non Coking (including High Sulphur)	01/04/2008	84,425	110,378	38,388	231,191
	01/04/2009	88,275	109,704	35,819	233,798
Total	**01/04/2008**	**101,829**	**124,216**	**38,490**	**264,535**
	01/04/2009	**105,820**	**123,470**	**37,921**	**267,211**

Table 1.4 Coal Production (in Million Tonnes) in India during 2008-09

Sl. No.	Company	Production		Achievement %
		Target	Achievement	
1.	Coal India Ltd. (CIL)	405.00	403.73	99.7
2.	Singareni Collieries Co Ltd. (SCCL)	41.50	44.54	107.3
3.	Others	50.79	44.68	88.0
	Total	**479.29**	**492.95**	**99.1**

Source : Provision Coal Statistics (2008-09), Coal Controller Organisation, Ministry of Coal, Govt. of India

Primary step of mining of minerals is the removal of the deposits from the ground. Once the minerals / ore is removed, additional preparation process is required to isolate the valuable minerals from their waste gangue minerals. There are two basic method of mining of minerals opencast and underground mining. The choice of method depends on the geologic, hydrological, geo-technical, geographic, economic, technological, environmental, safety, socio -political and financial considerations. Table 1.5 gives a classification of the prevalent mining methods.

The major purpose of mine development is to provide auxiliary and support facilities for physically opening a surface or underground, or mine and bringing it to full production is to be planned. The facilities will not contribute directly to the production operation. It is a period of intensive and diversified activity on the project site with environmental impacts, which are usually different in nature from operational impacts, which are crucial for successful environmental management.

Table-1.5 – Classification of Mining Methods

Method	Deposit
Surface Mining	
▸ Quarrying	Nonmetallic
▸ Opencast Mining (incl. Strip mining)	Coal, Metal, Non-metallic
Auger/High wall mining	
▸ Placer mining (mineral and mining)	Coal
Hydraulicking	Metal, Non-metallic
Dredging	Metal, Non-metallic
▸ Solution Mining	
Borhole mining	Non-metallic
In-Site leaching	Metal
Underground Mining	
▸ Unsupported / minimum supported	
- Room and pillar / Bord and pillar mining	Coal, Non metallic
- Stope and pillar mining	
- Shrinkage stopping	Metal, Non metallic
- Sub level stopping	Metal, Non metallic
- Hydraulic mining	Metal, Non metallic
▸ Supported (with fill)	Coal
- Cut and fill stoping	Metal
- Longwall mining	Coal
- Room-and-pillar mining	Coal, Metal
- Sub-level mining	Coal
▸ Caving	
- Longwall mining	Coal, Metal
- Sub-level / caving	Coal, Metal
- Block caving	Metal

The surface facilities unique to underground mining are mine main entries (shafts, declines and adits) head frame(s), heap; stead, storage bins, hoist houses, etc. the additional underground facilities may consist of secondary and tertiary openings for providing access haulage and ventilation and various other facilities such as transportation, crusher stations, power distribution equipment and numerous other installations.

In surface mines if the deposit does not outcrop, advanced stripping is required before mineral production can begin. Development is carried out according to a carefully designed plan which is to be outlined in the feasibility report. Scheduling of the entire mine development work is to be clearly indicated by bar charts.

Selection of Mining Method

Factors in the choice of an actual mining method for a given deposit are deposit characteristics, percentage recovery, requirement of health and safety and environmental concerns, production, scheduling scope of mechanization and automation, workforce requirements wage rates, land reclamation, operating and capital cost estimates. The selection of the mining method (development and extraction) is a key decision to be made in the opening up of a mine.

Surface or open pit mining is used for large, near-surface deposits. Rock is drilled, blasted, loaded into trucks, and hauled to a facility where it is crushed and ground to a uniform size for further processing. Surface mining requires the removal and disposal of layers of top soil and underlying rock commonly called the overburden. The ore is broken into pieces that can be easily transported and moved to a crushing plant for further processing. Mining must be planned so that the combine of mining processing and reclaiming the land is taken up concurrently.

Open cast Mining

General geology and hydrogeology of the study area, and geologic sections of the deposit (transverse and longitudinal) in the project area are to be prepared. Natural and geologic factors, terrain topography, depth, geological disturbances climate, mineral / ore grade, mineable reserves within the property boundary, production rate, estimated life of mine are to studied before selection of the mine area. Depth of the deposit at the final it limit thickness and dip be given. Overburden thickness (maximum and minimum) is to be estimated.

Maximum allowable stripping ratio, overall stripping ratio, mining plan (development and exploitation) are to be critically examined. Year wise development plan and year wise production plan for the next five years are to be worked out. Methods for handling of overburden waste for the next five years are to be outlined. Similar plans of five year duration subsequently should be prepared and the approval of the concerned regulatory authority is to been taken.

Underground Mining

Underground mining methods are used where a deposit occurs beneath the Earth's surface. To reach to the deposit for its removal, miners must excavate either vertical shaft, a horizontal adit, or an inclined short. Within the ore deposit, horizontal passages called drifts and crosscuts are developed on several levels to access mining areas to form stopes. Blasted rock is hauled away from the stopes by loaders, or trucks that may bring it directly to the surface or transport it to a shaft where it is hoisted to the surface and sent to a crushing facility.

In both underground and surface operations, extraction on mining ore and waste requires the use of heavy machinery and explosives. A variety of mineral earth moving equipment such as backhoes, front end loaders, tractors etc are used to remove surface soil and soft waste rock. Explosives such as mixtures of ammonium nitrate and fuel oil are used to blast away harder rocks. Small transportation equipments are used to transport the mineral / ore to the surface from underground mines, large loaders and trucks are used to carry the mineral away from the mine site for further processing.

Underground Coal Mining

Mine geology, geological section, and hydrology, number and thickness of coal seams occurring in the project area are to be critically examined. Minerable reserves, production rate and mine

life needs to be mentioned. Further a general description of mode of mine main entry (shaft, declines adits) general mine development with multiple headings (main, secondary and tertiary) in coal to layout the seam in room and pillar or longwall panels and to provide for haulage and ventilations are to be given.

There are several variants of room-and-pillar or long-wall mining methods. Factors in selection of a suitable room-and-pillar or long-wall mining methods are number and thickness of seams, dip their contiguity, strength of roof and floor, depth, gassiness of seam, liability to spontaneous heating, presence of dirt bands, method of roof control, percentage recovery, effect on mine surface due to subsidence, water influx, efficiency, productivity, safety and environment, availability of matching equipment, Capital and operating costs are to be estimated.

In the conventional room-and-pillar mining, the production cycle consists of fundamental unit operations rate, cut, drill, blast, haul which are closely associated with equipment. With continuous mining, production cycle consists of the operations mining (break and load) and haul. The method of roof control is by caving or non-caving methods.

Underground metal mining

In this method of mining, the amount of underground development required to achieve desired production rate depends on the shape and size of the ore body (length, width and thickness, dip, grade and reserves of the deposit, strength and structure of the stoping method selected. The mine development effort in steeply inclined deposits generally consists of several horizontal levels at specified vertical intervals, sub levels between main levels, drifts, crosscuts, connecting ramps ore passes etc for ore handling.

Factors that must be considered for the selection of a suitable stoping method are shape and size of the deposit in the mineralized zone (s), deposit characteristics, productivity dilution with waste rock and ore losses, variation of metal content in the ore body, regularity, irregularity of discontinuity ore body, blasting techniques, use of selective mining, applicability of mechanization effective ventilation and safety.

There are many approaches to the management of mining-related environmental problems. There are also many agencies involved in enforcement of various legislations, dealing with environmental protection. Environmentally sound mining technologies and practices should be adopted in all phases of mining and the related activities. Best management practices should be adopted to minimize environmental degradation. Environmental considerations are an integral component of mining operations, from the planning stage to mine closure. The general recommended approach is integration of environmental concerns into every mining activity.

Subsidence due to underground mining

Excavation operations of underground mines either for minerals or coal may result in disturbing the surface land and the natural features and valuable surface assets. Subsidence in mine is a movement of ground surface due to failure of the underground workings or result of collapse. Certain times the subsidence can occur concurrently with the mining operations. Such occurrences can be seen in activities adopting longwall mining or high extraction pillar recovery methods. Sinkhole subsidence during mining operations can occur in the areas above where the working

is relatively close the ground surface. This is a fairly localised phenomena and its magnitude is usually observed by abrupt depression at the ground surface. This is one of the most common type of subsidence.

Surface subsidence can cause extensive damage/degradation affects. In the unmined areas of abandoned mines coal pillar of various shapes and sizes are left out. In such a case no one can predict when subsidence in that area will can occur. Natural surface drainage pattern, groundwater regime and utilizable land are affected. This can also cause minor / major / extensive damage to highways, buildings, water supply lines oil/gas pipelines, cable lines depending on the affected surface area its land use type and magnitude of ground movement and location of the surface facilities with reference to the center of subsidence trough when the remaining pillars support downward sag of the over burden or by punching of the pillars into a soft mine floor or roof. Such a trough subsidence is generally at the center and horizontal ground movements will usually occur at that time. Structures at the center will bear the brunt of the subsidence effect whole at the edges they experience the effect caused by the tension or stretching of the surface. Ground movement will result in a variety of damage to the buildings, roads, railways, bridges water and oil lines, flow of streams and other utilities. Usually surface cracks occur at the edges of the trough. Different mining operations in the production of minerals produce / release a variety of pollutants into environment. Table 1.6 lists typical emissions, effluents and solid wastes from selected mining activities. A flow diagram showing the sequence of operation of mining for coal through surface/underground mining is shown in Fig 1.1.

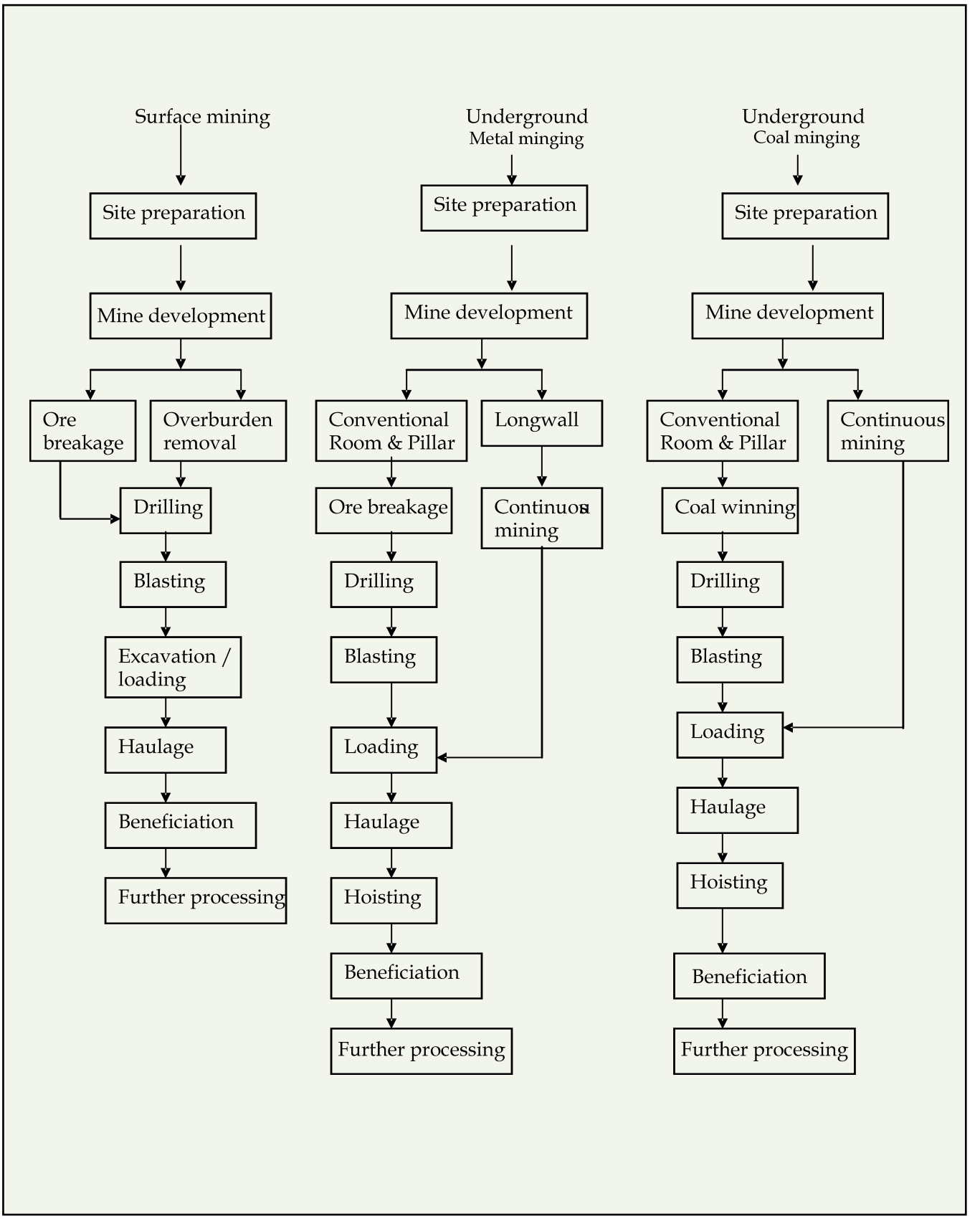


Fig.1.1 Sequence of main mining operations in surface mining, underground metal mining and coal mining methods.

Table-1.6 Typical Emissions, Effluents, Byproducts, and Solid Wastes

Coal	Borate	Iron	Copper
Methane Carbon dioxide Carbon monoxide Sulphur dioxides Coal dust Radon gas Acid Waste alkaline Sulfuric acid Trace metals Waste Rock Inert silica Lubricating Oils Nitrates / Ammonium salts Washery Rejects	Airborne particulates Calcination Particulates Residual particulates Calciner offgases Particulate emissions from dryers Crushing ore particulates Ore insolubles Filter aid and carbon absorbent Scrubber water Spent carbon and Filter wastes Suspended particulate mater Spentbrine	Carbon dioxide Sulfur compounds Chlorides Fluorides Waste rock Tailings/silicate rock	APC dust/sludge Waste contact cooling water WWTP liquid effluent Process wastewaters Surface impoundment Waste liquids Slime/muds Crud/gunk Tankhouse/anode slimes Acid plant blowdown Waste rock Tailings Raffinate or barren leachate Spent bleed electrolyte Discarded furnace and converer brick Chamber solids and scrubber sludge WWTP sludge
Lead & Zinc	**Gold & Silver**	**Phosphate**	**Crushed Rock**
Sulfur dioxide Particulates Lead oxides Iron pyrites Iron-limestone sicicate slag Arsenic Acid plant blowdown WWTP effluents Slag granulation water Spent furnace brick Slurried APC dust Baghouse incineraor ash Ferrosilicon Tower blowdown Geothite Spent cloths, bags, filters Synthetic gypsum Surface impoundment solids Trace / heavy metals Zinc-rich slag Zinc-keab slag	Sulfur dioxide Mine water Spent leaching solution Sulfuric acid Waste rock Spent ore Filter cake Gangue Slag WWTP sludge Spent furnace dust cyanide wastes	Rock dust Phosphorus pentoxide Carbon monoxide Precipitator slurry Phossy water Furnace scrubber blowdown Furnace building washdown WWTP liquid Anderson filter media Slag Furnace offgas solids Wet process waste Streams Fluorides Taulings / Phosphogypsum Solid waste	Carbon dioxide (Lime) Rock dust

Acid Mine Drainage

Acid Mine Drainage (AMD) also called as acid rock drainage (ARD) / acid rock water (ARW) refers to outflow of acidic water, from a mine of any type in permeable formation interacts with water table, aquifer, perched water body or where surface water find its way into a mine in terrains where sulfides are present in the ore or rock. An array of complex physical and chemical processes, involving a number of factors result in the formation of such highly acidic drainage. Such drainage is primarily associated with mining because many coal, precious metals, base mineral deposits occur in sulphide bearing rocks. It is also to be noted that all sulphide-bearing rocks exposed due to mining do not produce acid drainage. The group of micro-organisms which activate the biological process resulting in acceleration of acid formation and their growth conditions are given in Table 1.7

Table-1.7 Sulfide Ore Bacteria and Their Growth Conditions

Microorganism	pH	Temp., ^{o} C	Aerobic	Nutrition
Thiobacillus thioparus	4.5 - 10	10-37	+	autotrophic
T. ferrooxidans	0.5 - 6.0	15-25	+	”
T. th”iooxidans	0.5 - 6.0	10-37	+	”
T. neapolitanus	3.0 - 8.5	8-37	+	”
T. denitrificans	4.0 - 9.5	10-37	+/_	”
T. novellas	5.0 - 9.2	25-35	+	”
T. intermedius	1.9 - 7.0	25-35	+	”
T. perometabolis	2.8 - 6.8	25-35	+	”
Sulfolobus acidocalderius	2.0 - 5.0	55-85	+	”
Desulfovibrio desulfuricans	5.0 - 9.0	10-45	-	heterotrophic

1.2 Environmental Clearance

As per the EIA notification of 14th September 2006 and its amendment dated 1st December 2009, mining projects are divided into two categories as mentioned below:

Project Activity	A Category	B Category	General Condition
Mining of Minerals	= 50 ha of mining lease area in respect of non-coal mine lease >150 ha of mining lease area in respect of coal mine lease Asbestos mining irrespective of mining area	<50 ha = 5 ha of mining lease area in respect of non-coal mine lease = 150 ha = 5 ha of mining lease area in respect of coal mine lease	Any project or activity specified in category B will be treated as category A, if located in whole or in part within 10 km from the boundary of: (i) Protected areas notified under the Wildlife (Protection) Act, 1972; (ii) Critically polluted areas as identified by the Central Pollution Control Board from time to time; (iii) Eco-sensitive areas as notified under section 3 of the Environment (Protection) Act, 1986, such as,

Project Activity	A Category	B Category	General Condition
			Mahabaleswar Panchangi, Matheran, Pachmarhi, Dahanu, Doon Valley and (iv) inter-state boundaries and international boundaries Provided that the requirement regarding distance of 10km of the inter-state boundaries can be reduced or completely done away with by an agreement between the respective states or U.Ts sharing the common boundary in the case the activity does not fall within 10 kilometers of the areas mentioned at item (i), (ii) and (iii) above The environmental clearance process for all projects will comprise a maximum of four stages. These four stages in sequential order are:

Stage (1) - Screening

In case of category 'B' projects or activities, this stage will entail the scrutiny of an application seeking prior environmental clearance made in Form 1* by the concerned SEAC for determining whether or not the project or activity requires further environmental studies for preparation of an Environmental Impact Assessment (EIA) for its appraisal prior to the grant of environmental clearance depending upon the nature and location specificity of the project. The projects requiring an Environmental Impact Assessment report shall be termed Category 'B1' and remaining projects shall be termed category 'B2' and will not require an Environmental Impact Assessment report.

Stage (2)- Scoping

'Scoping' refers to the process by which the EAC in the case of Category 'A' projects or activities, and SEAC in the case of Category 'B1' projects or activities, including applications for expansion and/or modernization and/or change in product mix of existing projects or activities, determine detailed and comprehensive TOR addressing all relevant environmental concerns for the preparation of an EIA report in respect of the project or activity for which prior environmental clearance is sought. The EAC or SEAC concerned shall determine the TOR on the basis of information furnished in the prescribed application Form 1 including TOR proposed by the applicant, a site visit by a sub-group of EAC or SEAC concerned only if considered necessary by the EAC or SEAC concerned and other information that may be available with the EAC or SEAC concerned.

Stage (3)- Public consultation

"Public consultation" refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impact of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate. All Category 'A' and Category 'B1' projects or activities shall undertake Public consultation, except the following:

After completion of the public consultation, the applicant shall address all the material environmental concerns expressed during this process, and make appropriate changes in the draft EIA and EMP. The final EIA report, so prepared, shall be submitted by the applicant to the concerned regulatory authority for appraisal. The applicant may alternatively submit a supplementary report to draft EIA and EMP addressing all the concerns expressed during the public consultation

Stage (4)- Appraisal

Detailed scrutiny by the EAC or SEAC of the application and other document like the Final EIA report, outcome of the public consultations including public hearing proceedings, submitted by the applicant to the regulatory authority concerned for grant of EC

Flow-charts depicting these stages to obtain the prior environmental clearance for mining projects are presented in **Figure 1.1 & Figure 1.2**

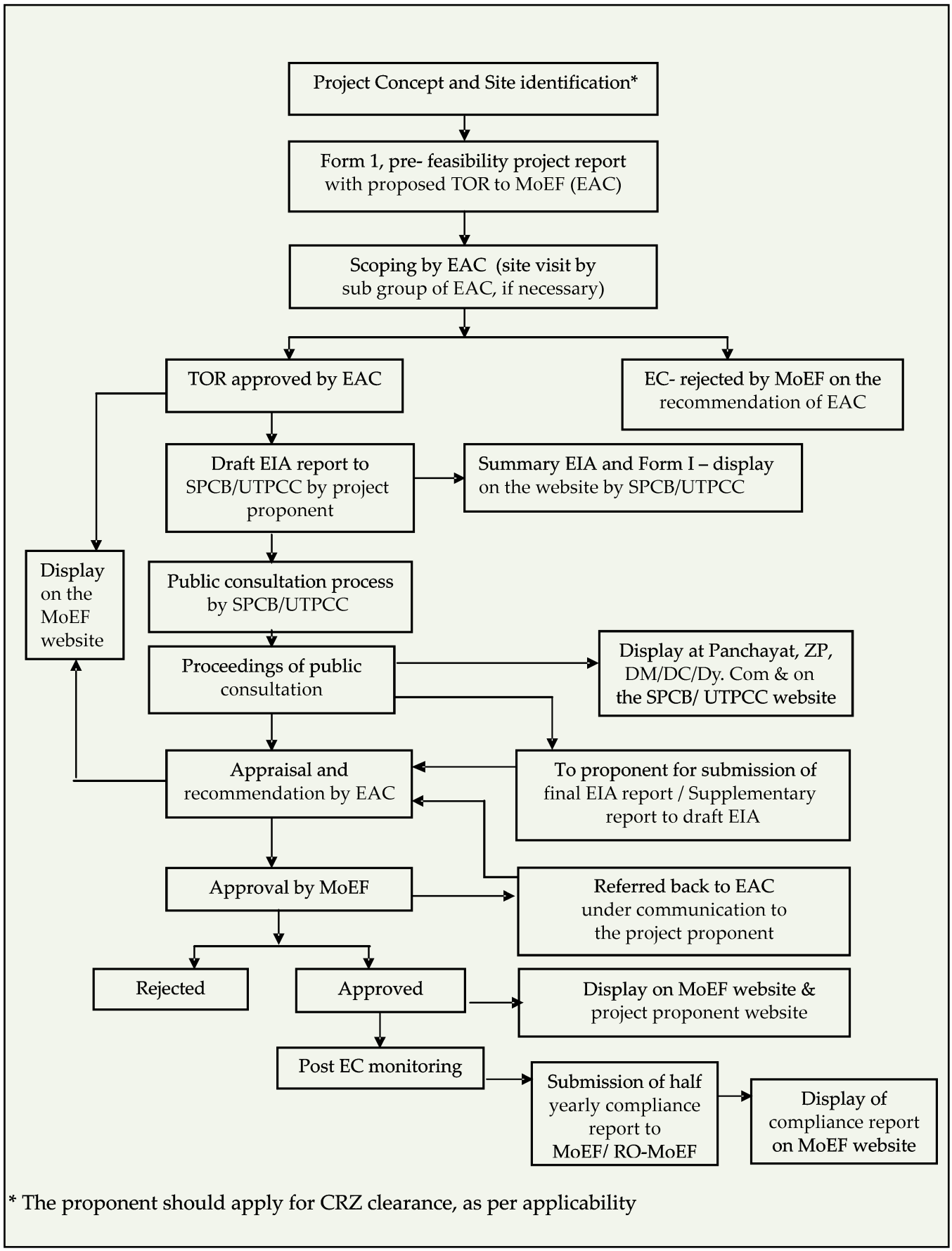


Fig.1.2 Prior Environmental clearance process for category A projects

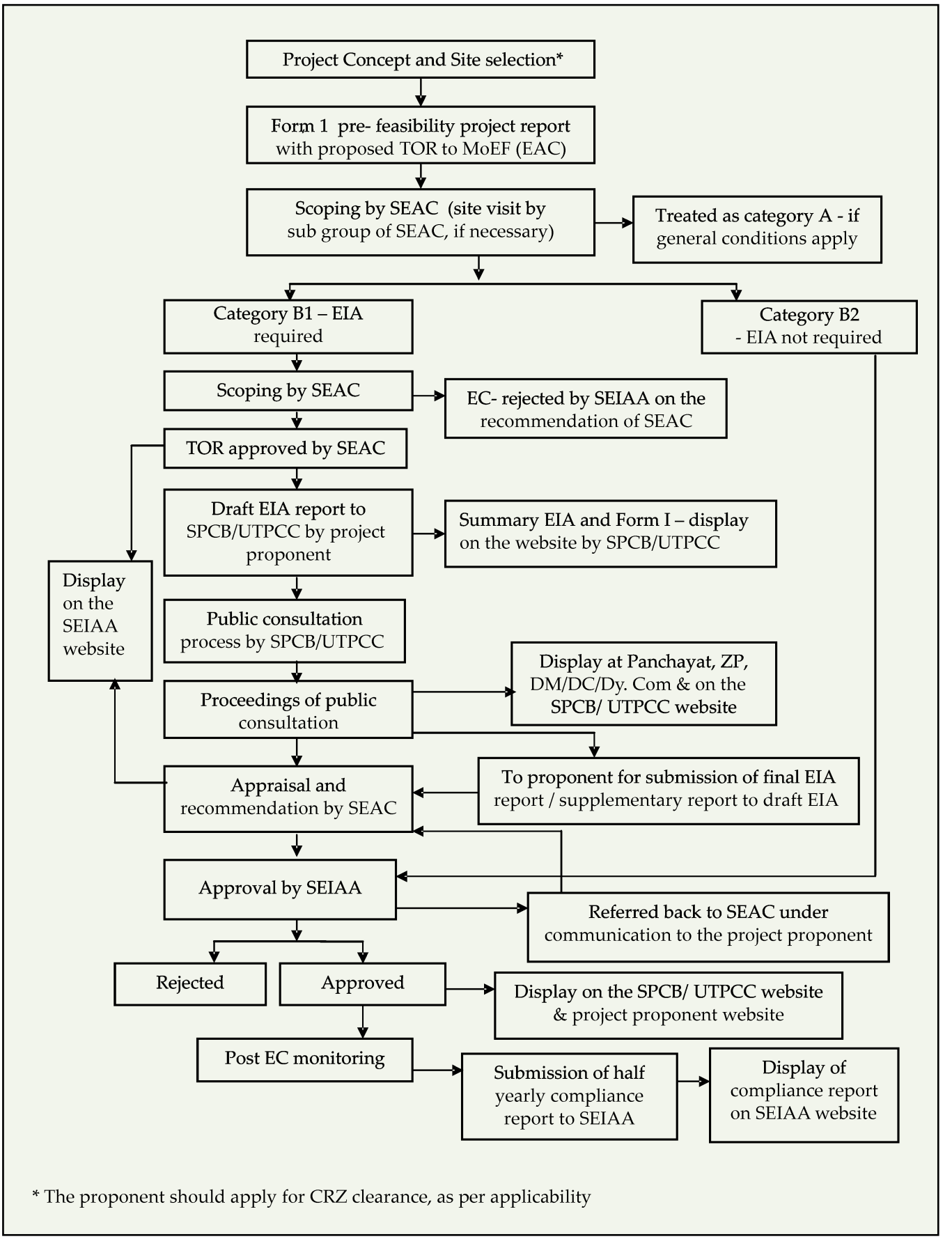


Fig.1.3 Prior Environmental clearance process for category B projects

- The projects involving clearance under Coastal Regulation Zone Notification, 1991 shall submit with the application a CRZ map duly demarcated by one of the authorized agencies, showing the project activities, w.r.t. C.R.Z (at the stage of TOR) and the recommendations of the State Coastal Zone Management Authority (at the stage of EC). Simultaneous action shall also be take to obtain the requisite clearance under the provisions of the CRZ notification, 1991 for the activities to be located in the CRZ[#]
- The projects to be located within 10km of the National Parks, Sanctuaries, Biosphere Reserves, Migratory corridors of wild animals, the project proponent shall submit the map duly authenticated by Chief Wildlife Warden showing these features vis-à-vis the project location and the recommendations or comments of the Chief Wildlife Warden thereon (at the stage of EC) [#]
- For the projects located in critically polluted areas as notified by CPCB, the project proponent shall make available a copy of their application for the TOR to the concerned SPCB. The SPCB should either send its representative at the time of consideration of the proposal by the EAC, at the stage of appraisal of the project for prescribing TOR or consideration of EC or provide their written comments with respect to pollution load in terms of ambient air quality, water quality or solid/hazardous waste management [##]

[#] S.O No. 3067 (E) dated 1st December 2009 of MoEF
[##] Circular dated 25th August 2009 of MoEF

1.3 Terms of Reference (TOR)

Duly catering to the commonly expected environmental concerns, Terms of Reference (ToR) for the sector is prepared and given in Annexure-1. In addition, the proponent is required to identify specific issues if any, pertinent to the project and include those issues also in the ToR for preparation of EIA and EMP report upon approval of the ToR by the Expert Appraisal Committee.

1.4 Post-Environmental Clearance Monitoring

For category A projects, it shall be mandatory for the project proponent to make public the environmental clearance granted for their project along with the environmental conditions and safeguards at their cost by prominently advertising it at least in two local newspapers of the district or state where the project is located and in addition, this shall also be displayed in the project proponent's website permanently.

For category B projects, irrespective of its clearance by MoEF/SEIAA, the project proponent shall prominently advertise in the newspapers indicating that the project has been accorded environmental clearance and the details of MoEF website where it is displayed.

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

1.5 Transferability of Environmental Clearance

A prior environmental clearance granted for a specific project or activity to an applicant may be transferred during its validity to another legal person entitled to undertake the project or activity

on application by the transferor or the transferee with a written "no objection" by the transferor, to, and by the regulatory authority concerned, on the same terms and conditions under which the prior environmental clearance was initially granted, and for the same validity period.

1.6 Generic Structure of Environmental Impact Assessment Document

In terms of the EIA notification of the MoEF dated 14th September 2006 as amended Dec 2009, the generic structure of the EIA document should be as under:

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

1.7 Identification of Project Proponent

Profile of the project proponent, contact address with e-mail, fax, phone number etc should be furnished. All correspondence with MoEF shall be made by the authorized signatory only. The authorized signatory should also submit a document in support of his claim of being an authorized signatory for the specific project

1.8 Brief Description of Project

In this section details of the project nature, size, location and its importance to the country and the region are to be included. Project site description; survey/khasra nos, village, tehsil, district, state & extent of the land, latitude & longitude of the boundaries are to be furnished.

Description of existing national and international environmental laws/regulations on the proposed activity is to be brought out clearly. If there are any notified restrictions/limitations from environmental angle, issued by the district administration, State or Central government, the same should be furnished. Details of litigation(s) pending against the project/ proposed site and or any direction passed by the court of law against the project, if any, should be stated.

In case of expansion/ modernization of the project, the environmental compliance status for the existing project should be furnished for the following:

- Status of Environmental Clearance and compliance for the terms & conditions for the existing project

- Validity of the Air & Water Consent orders, and Hazardous Waste Authorization (HWA) from SPCB/ PCC for existing project and their compliance status
- Notices/directions issued by the regulatory agencies under section 33(A) of the Water Act, 1974 as amended, under section 31(A) of the Air Act 1981 as amended and any directions issued under the provisions of the E (P) Act, 1986 during the last one year.

Legislation Applicable to Mining of Mineral Sector

The mining sector has separate set of legislations covering management, conservation, grant and operation of mining leases etc. There are also separate legislations for coal mines, non-ferrous mines etc. In addition, there are environmental / forest regulations, applicable to all types of mining activities have been prescribed by ministry of environment and forests and CPCB.

A few important legislations are given below:

- The Mines Act, 1952
- The Mines and Mineral (Development and Regulation) Act, 1957
- Mines Rules, 1955
- Mineral Concession Rules, 1960
- Mineral Conservation and Development Rules, 1988
- State Minor Mineral Concession Rules, 1960
- Granite Conservation and Development Rule, 1999
- The Water (Prevention and Control of Pollution) Act, 1974
- The Air (Prevention and Control of Pollution) Act, 1981
- The Environment (Protection) Act, 1986
- The Forest (Conservation) Act, 1988
- The Wildlife (Protection) Act, 1972

2

PROJECT DESCRIPTION

2

2.0 General

The background of the project gives broad description of the project, project proponent their detailed address, type of ore deposit(s), locations etc. The downstream use of mineral for value addition and its importance should also be described. The purpose for which mining is proposed should be clearly stated (captive use, export, selling etc.). The mineral(s) occurring in the area, which the proponent intends to mine and the period for which the mine lease is granted, present or proposed to be applied. Description of linkages, market status (demand, supply) export potential of finished product, domestic demand of the finished products is to be given. A description on national and state scenarios and prospect of the mineral should be given.

The background should cover the following:

- Location of the project (longitude, latitude, MSL, revenue village, Tehsil, District, State, nearest railway station, and airport)
- Objective of the project (captive mine, standalone etc) whether it is new or expansion (increase in ML area or Increase in annual production) or modernization. Proposed use of minerals (sale, use as intermediates or raw materials). Any change in technology proposed should be specified.
- Significance and relevance of the project highlighting the benefit to surrounding area and economic development of the area local/state/ country.
- Deposit conditions such as ore strength, host rock strength, shape, grade, size, uniformity and depth associated hazards, recoverable resources and recoverable reserves

2.1 Description of the Project

The project description should clearly mention whether the mine is a new one or expansion / modernization of existing mine for which environmental clearance is sought. The details of mining lease with area and approval of Mine Plan is given. The history of mining done by the same project proponent in the same location for expansion is to be covered. Details of lease of the mine with historical information, if any, should be provided.

Location Details

The exact location of the proposed mine with longitude, latitude, revenue village / forest area, tehsil, district and state be given. The mine lease boundary with the individual activity boundary demarcation is to be superimposed on the toposheet & map (2 Km radius 1:5000 scale). The distance from nearest major urban agglomeration in the area connecting the mine should be given. Approach of mine through road and rail linkage should also find a place to define the location. A locational digitized map based on the remote sensing showing the major road, railway, settlements, water bodies with mining lease area in the scale of 1: 25,000 should be presented. Map should be prepared for buffer area of 10 km, 5 km, 1 km from the outer boundary of the core zone. If the mining is in coastal area, CRZ is to be discussed.

2.2 Leasehold Area

In addition to mine lease area, certain ancillary features to be developed in the vicinity are to be presented in tabular form (Table2.1). Existing surface features, such as quarry, contour, natural nallah, lease boundary, road, exhausted quarry (if any) or any other significant site-specific features may be shown in map. The mining leasehold area with forest type and name (if in forest area) should be presented.

2.3 Geology

Regional Geology

Regional geology with type of ore formation in the basin should be described. The classification of lithiology with the extent and type of geological formations in the region should be discussed. If there are any major faults / seismic zones should be specifically marked.

Local Geology

The local stratigraphic sequence of the mining lease area should be interpreted from geological mapping, exploration and / or any opened up quarry / mine. The lithiological sequence of the leasehold area may be interpreted either from existing quarry or trial pits and should be given for different geological strata. Mineral deposits should be shown in the map. Geological plan and cross sections layers should be shown in a separate drawing. (1: 50m scale). This is a part of Mine Plan and brief summary may be given.

2.4 Quality of Reserves

The distribution of different types of deposits in mine lease area should be discussed. The deposit should be broadly classified on the basis of mineralogical composition and strength. Average chemical characteristics in percentage should be presented in tabular form (Table 2.2). This has to be as per approved mine plan. The grade – tonnage distribution will provide an estimate of what can be reasonably recovered and processed.

2.5 Types of Mining

It is to be mentioned whether the proposed mine will be open cast, underground or combination of both. The method of mining may be manual, mechanized and semi- mechanized. Annual ore production and overburden generation for five yearly programme should be presented in tabular form (Table-2.3). Disposal of overburden, as given in Mining Plan, to be included in summarized form.

Open Cast Mining

The stripping ratio (overburden in cum to tonnes of mineral) is to be calculated. The average thickness of topsoil and overburden (minimum, maximum and average) should be presented. The working depth below ground level and above Mean Sea Level (MSL) with the height and width of the bench in overburden and the deposit should be clearly mentioned. Proposed inclination / slopes of the side for each mine should be given for a period of five years and also for the whole mine life period of mine development.

The description of mine should include the following.

- Deposit conditions (min., max. average thickness in meters). If there are multiple deposits to be worked similar details should be given for each of them.

- Maximum allowable stripping ratio (ratio of overburden in cum to mineral in tonnes), thickness of top soil and overburden rock (minimum, maximum and average),
- Working depth (below ground level & mean sea level)
- Mining Plan (height and width of the benches in overburden, ore body, proposed inclination/ side slopes),
- Surface plan showing mine working with dumps and other features for 5^{th} year, 10th year, 15th year, 20th year, 25th year, 30th year as per the approved mine plan.
- Type of blasting safeguards, explosives and their quantities
- Detail of machineries (excavators, material handling and processing equipment, in-pit crusher and conveyor system if used)
- Plan for backfilling of mine pit as it is excavated.

Underground Mining

The mode of mine main entry such as shaft, adit, incline or any other method should be mentioned. The method of stoping or extraction of ore with machineries to be used should be described. The effect of subsidence due to ground control on the surface features such as natural drainage pattern, usable land, houses, water bodies, and infrastructure facilities should be explained.

- Deposit conditions
- Ore body (min., max. average thickness in meters)
- Mode of mine main entry (shaft, adit, incline)
- Details of major machineries planned to be used in underground and on surface giving their size and quantity, availability and utilization
- Method of mine development and extraction/sloping
- Blasting practise and explosives
- Subsidence (maximum predicted subsidence, max. slope change, impact on surface features like natural drainage pattern, water bodies, surface structures water table, nature of magnitude of ground movement etc.)
- Mine drainage management details
- Ventilation system for adequate control of quality and quantity of air underground

Drilling & Blasting

Breakage of rock by drilling and blasting prior to excavation and loading is an important activity in a mine. This is decided on the basis of geological conditions. The quantity of materials likely to be blasted is also assumed. The types of explosive and blasting methods should be explained. The explosive storage magazine with inventory should be presented in format (Table-2.4).

The mines also store High Speed Diesel (HSD) to be used as fuel in vehicles other equipments and blasting (emulation explosives). The inventory should be presented in format (Table-2.5).

Excavation

Dumps and other surface features at the end of 5^{th} year, 10^{th} year, 15^{th} year, 20^{th} year, 25^{th} year and 30^{th} year should be shown in digitized map in the scale of 1: 50 m scale for mine lease area. The excavation of mineral ore and overburden on yearly basis should be compiled in tabular form (Table-2.6).

2.6 General Features

Surface Drainage Pattern

The natural surface drainage pattern of proposed mine site may require to be changed and modified. The mode of change should be discussed.

Vehicular Traffic Density

Vehicular traffic density outside in mine lease area, existing and after beginning of the mining activities should be given. The mode of transport of mineral and waste including loading, unloading in mining area should also be discussed. Vehicular load must be calculated. Further, the mineral transportation outside the mining lease area (road, rail, conveyor, rope way, water way, pipeline etc.) may be specified.

Beneficiation / Processing

The details of mineral beneficiation, if done in mine lease area should be described and may include the following:

- beneficiation flowchart with equipment
- Capacity
- Tailings management

Separate EIA guidance manual for mineral beneficiation may be referred and the environmental issues may be taken up combinely, if the beneficiation is carried out in the pithead.

Coastal Zone: If the project is located in coastal area, details of coastal zone classification, Low Tide Line (LTL), High Tide Line (HTL), characterization of beaches should be described.

Township

The area earmarked for developing / expansion of the township is very important. The number of houses, sources of water with quantities may be mentioned. The distance from mine and nearest water bodies should be indicated. A layout map of township with the proposed landuse, showing built up ores, water supply and sewage disposal points should be presented.

Power, Water Supply and other Infrastructure requirement

The details of total power requirement during development and operational changes with source should be provided. The source of water supply, type of treatment and break-up for different use should be given. Other infrastructure such as grid, DG set, workshop etc. should also be mentioned.

Water demand for the project should be presented as in (Table-2.7). Water balance covering water abstraction, consumption and discharge should also be shown in figure with flowchart.

2.7 Manpower Requirements

Manpower requirement (supervisors and labour) during mine development (construction) and operation phases should be given in (Table-2.8).

2.8 Project Implementation Schedule / Stages

The two phases of mining (mine development and exploitation) with time schedule to be implemented should be supported by bar chart, PERT chart etc.

ANALYSIS OF ALTERNATIVES (Technology & Site)

3

3.0 General

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.

The consideration of alternatives is most useful when the EIA is undertaken early in the projects cycle. The type and range of alternatives open for consideration include:

- Demand alternatives (e.g. using energy more efficiently rather than building more alternative generating capacity)
- Input or supply alternatives (e.g. use of mine drainage water)
- Activity alternatives (e.g. providing public transport rather than increasing road capacity)
- Location alternatives (e.g. location of field crusher /beneficiation plant/ tailings dam)
- Process alternatives (e.g. use of waste minimizing and energy efficient and efficient process technologies, use of less toxic chemicals)

Mineral deposits are site specific, and therefore, selection of a mine site has limited alternatives. However, the activities relating to mine development and exploitation have many alternatives in terms of choice of mining method, drilling and blasting methodologies, location of waste dumps etc. Alternatives available in mining activities should be analysed on the basis of:

- Impact of each alternative
- Mitigation measures for each alternative

After analysis of the various factors the most environmentally compatible alternative must be selected. Reference may be made to available technologies, policy objectives, social attitudes, environmental and site constraints, projects economic etc. Analysis of alternatives should be similar to the content of approved mine plan.

DESCRIPTION OF ENVIRONMENT

4.0 General

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. Mining activities invariably affect the existing environmental status of the site. It has both adverse and beneficial effects. 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.

Study Area:

The study area for the mining projects should be defined as follows:

- Mine lease area should be the "core zone"
- 10 km. radius from the boundary limits of the mine lease area of more than 50 hectares should be the "buffer zone".
- 5km radius from the boundary limits of mine lease area of 5-50 hectares would be "buffer zone".
- Maps (appropriate scale) of the study area (core and buffer zones), clearly delineating the locations of various monitoring stations (air/water/noise/soil), superimposed on locations of habitats are to be shown.
- Indicate 2 km, 5 km distance from the boundary limits of mine lease by appropriate line.
- Monitoring and testing should be done as per guidelines of CPCB / MoEF.

Baseline information is required to be collected by field surveys, monitoring etc. Secondary data with source should be clearly mentioned. Normally, one season monitoring data (excluding monsoon) are to be collected. However, Expert Appraisal Committee (EAC) may specify collection of baseline data for a longer period considering the nature, size and location of the project.

Environmental data to be collected in relation to proposed mining would be: (a) land (b) water (c) air (d) biological (e) noise (f) socio-economic (g) health etc.

4.1 Land Environment

Since mining is essentially an excavation of mineral ore the land environment is greatly affected by it, especially in the case of opencast mines. In contrast, underground mines cause limited effect on the surface land.

Land Use / Land cover

The existing landuse / land cover pattern in the study area is to be studied through satellite imagery data (Annexure 2). The source, date and resolution should be given. Existing landuse in the study area is to be clearly indicated.

Topography of the study area shown in the topographical map should be analyzed to describe the terrain viz. hill slopes, coastal and inland topography. The physiographical features of the study area should be explained by using latest satellite imagery. The source and date of the imagery should be shown in the map. The toposheet should also be used for interpretation of physiographical features. If the mine is located on hill range, the same may be mentioned. The slope and local features should be described.

The drainage pattern in the study area can be explained on the basis of topographic features shown in maps and satellite imagery. Major nallahs, rivulets, rivers in the study area with their features should to be discussed. The water reservoirs, water flow pattern of water bodies should also be covered. Perennial streams, if any should be identified and specially mentioned. Drainage pattern with elevation range should be shown in satellite imagery map. In all the maps the mining lease area should be distinctly marked. The maps should be prepared in 1:5,000 scale, and clearly show the sub-water sheds of the proposed mining area of 2 km. radius.

Geology of the area is very important to ascertain seismic sensitivity. The various strata of geological formation should be described. From this, the soil permeability, possible faults and fissures should be found out and explained. Soil quality of the study area is one of the important components of the environment. Soil samples from villages located in the study area should be collected as per methodology specified in BIS to make them representative and analyzed for physico- chemical analysis. Samples are collected by hand auger boring and soil pits. Some samples from agricultural fields (if any) should also be collected. The locations of sampling points may be presented as in (Table-4.1) and also to be shown in the map of study area. The physical properties of soil should be presented in (Table-4.2). The chemical properties of soil should be presented in (Table-4.3). The agricultural crops being grown in the study area should be discussed. Data may be collected for district statistical handbook for the study area or local agricultural department and also ground truthing by field survey.

4.2 Water Environment

Mining and its associated activities use huge quantity of water for various purposes and also affect the hydrological regime of the area. The water quality of the region is also likely to be effected through run-off. Extraction of different minerals also leads to water pollution due to heavy metals, acidic water, increased suspended solid etc. Therefore, baseline information on water regime is very important. Water availability and water quality are two major aspects considered for baseline status of water environment.

Water Consumption and Sources

The water consumption in mine is mostly used for afforestation, beneficiation, machine cooling, dust suppression, fire fighting, water sprinkling on road, vehicle washing, domestic use etc. The water consumption at a mine depends on size, method of mining and the equipments used. Underground mines have lower water consumption as compared to open cast mines, which consumes large quantity of water for dust suppression and the beneficiation plant. The specific water consumption for various purposes should be worked out.

Groundwater

The groundwater potential as identified by Central Ground Water Board (CGWB) for the study area should be presented considering the local geology, hydrogeology, topography etc. Average depth of water level in summer and post monsoon should be specified.

Groundwater recharge calculation of the study area is one of the most important inputs to baseline condition. The rainfall infiltration method is one of the best methods suggested in groundwater assessment methodology by CGWB. The details of method and calculation should be given in the report. The stages of ground water development are categorized as given in Annexure 4 (Ground Water Estimation Committee report (GC – 1997)). The sampling locations and the physic-chemical properties are to be presented as shown in Table 4.4 and 4.5.

Surface Water

Sources of surface water in the study area are required to be identified. The sub-water sheds, where mine lease once is located and comprised of contributing and receiving streams should be studied for hydrological regime. Physical characteristics of the sub-water shed should be analysed from the map and presented.

The river flow measurement should also be taken for the streams flowing adjacent to the mine lease area. Historical data on river flow can also be obtained from Water Resource Dept., Public Health Dept., Central Water Commission etc.

Water samples from available surface water and groundwater from both core as well as buffer zone should be collected, representing the study area. Water sampling points are to be selected from all directions of mine lease area. Grab samples from water survey should be collected. The description of surface water sampling locations may be given as shown in Table-4.6 and physic-chemical properties are to be presented as shown in Table 4.7.

The locations of water sampling stations should also be shown on the map of study area. Samples of surface water upstream and downstream of the mine lease area must be collected. The parameters, sampling, frequency and method of analysis is given in Annexure 3.

Interpretation of surface and groundwater quality results for both core and buffer zone should be done separately by comparing with drinking water specification IS: 10500 and Central Pollution Control Board Water Quality Criteria for surface water are given in Annexure-6**.**

4.3 Air Environment

The existing ambient air quality of the area is very important for evaluating the impact of mining. The sampling frequency, methods and standards are compiled and shown as Annexure 3**.** Baseline air quality data available with adjacent mine (if any), State Pollution Control Board, educational institutions etc. may also be collected and compiled in the report.

The sampling and analysis should be done through a planned field monitoring. Monitoring stations should be ideally located in nearby settlements / villages surrounding the mine lease. Moreover, many of the mines do not have any stack (point emission source), therefore ambient air quality is expected to be affected in and around mining areas upto a limited distance depending on wind speeds / direction. This should be considered while selecting monitoring stations in all the direction of lease area. Five km. buffer zone may be adequate for monitoring ambient air quality. At least two ambient air quality monitoring stations should be located in the core area. The predominant wind direction is also required to be considered for selection of monitoring station. Upwind and crosswind direction also should be considered to estimate the background concentration. Location of monitoring stations should be presented in tabular form (Table-4.8) and also should be shown in map.

The monitoring schedule of ambient air quality should be clearly described. The frequency and methodology followed should be as per the guidelines. Ambient air quality should not be monitored during rainy season. All the ambient air quality monitoring stations, selected on the basis of wind direction should be done simultaneously. The wind direction meteorological conditions are to be considered and correlated during the monitoring. The ambient air quality monitoring results for all the stations should be presented in (Table-4.9). It may be seen that the format contains monitoring stations, category (Industrial, Residential & Sensitive), standards (Annexure 7) and results. The table, therefore, should be useful for data interpretation.

4.4 Noise Environment

The noise level monitoring in the study area should be done at the ambient air environment monitoring locations. Monitoring should be done as per the guideline in Annexure 3. Hourly monitoring of noise level (leqs) should be recorded for 24 hours by using sound level meter for 15 minutes during each hour. The sound level monitoring data are to be presented in format (Table-4.10).

The noise monitoring results should be compared with the Ambient Noise Quality Standard notified under Environment (Protection) Act, 1986, given in the format Annexure 8.

4.5 Biological Environment

In order to maintain the natural ecosystem, a study on biological environment of the area is a basic requirement. Biodiversity can be defined as the sum of life and its processes including the variety of living plants, animals and others organisms. The biodiversity has social, economical and cultural implications. Since most of the mining is carried out in remote forest areas, it is likely that the biodiversity of the area is significantly altered. The general observations are that mining projects are threatening forest, livelihood of people dependent on forest based economy and creating conflicts between wild animals and local inhabitants due to loss of forest.

Based on the size and location of the mine, it should be decided during the scoping process of EIA whether a full-fledged biodiversity assessment study should be taken up. This may be decided by the Expert Appraisal Committee, considering the type and size of the mine and sensitivity of location.

The secondary data on list of flora and fauna in the study area is required to be collected from concerned Forest Division. Field survey and consultation with local people and Forest Department should be the basis of preparation of list of flora & fauna of the area.

The study on phyto-sociology of the vegetation, covering frequency, density, abundance & species diversity, in the area falling both in core as well as buffer zone is to be done by field survey in selected patches so that the whole area is represented. The phyto-sociological features of the shrubs/trees growing in core and buffer zone should be presented in format (Table-4.11) separately discussed. Phyto- sociological features of natural vegetation growing in core zone should be presented in format (Table-4.12) and summary be discussed. The plantations around settlements are different and should be listed in format (Table-4.13). The forest type and stretches in the study area may be different. The Forest area should be described and presented in format (Table-4.14).

Wildlife and avifauna

The baseline status of wildlife and avifauna in the mining area is one of the most important components, since most of the mines are located in remote areas, and forest patches are considered to be ideal wildlife habitations.

Following data on fauna should be collected.

- Distribution
- Abundance
- Rarity
- Species diversity and critical habitat requirements
- Migratory and travel routes
- Predator – prey balance
- Habitat residence

The list of wildlife and avifauna found in the study area should be presented in format (Table-4.15) and discussed.

4.6 Socio-Economic Environment

Mining activity in an area has long term irreversible impact on local, sociological, cultural and economical situation. In order to evaluate socio-economical impact of the project, an extensive study on the existing socio-economic status is required. The project may also bring benefits to local people. Most of the mineral deposits are found in areas with tribal population. Socio-economic feature, therefore, becomes very important. The displacement of people and loss of livelihood are the major impact of the mining projects.

Village wise demographical profile of the study area can be obtained from census record and presented in format (Table-4.16) (separately for core & buffer zone). The summary indicating the population and occupational pattern should be presented in format (Table-4.17) and analyzed to draw inference.

Representing cross-section of people in the study area, a survey should be carried out to evaluate the socio-economic status of local inhabitants. This can be done by a field survey and directly interacting with people through a questionnaire. The survey should cover the following aspects:-

- Composition and size of the families
- Educational status
- Homestead land
- Information on agricultural situation (land holding size, cropping pattern, productivity, net return etc.)
- Employment (source of employment)
- Annual income from various sources
- Information on family budget
- Savings
- Family assets
- Respondent's perception about the proposed mining project

Holding size distribution of households in the study area should be given in format (Table-4.18). From the table, necessary interpretation on agricultural status in the study area should be made.

Employment and Income

This is an analysis of occupational structure of the study area. The occupational pattern should be presented in format (Table-4.19). Data in the table should be analyzed and interpreted. Description on the findings from these interpretations should be given in the report.

4.7 Public Utilities

Vehicular traffic during mine development and operation may result in excessive use of existing public infrastructure like roads, railways, waterways etc. and may cause congestion and pollution. An existing road, passing through habitation, may cause air pollution problem due to increase in traffic volume. Similarly public utilities such as water supply, drainage, power grid may also be utilized. Baseline information / data on existing public utility infrastructure and service should be reported.

4.8 Site Specific Features

Any site-specific features such as nearness to large water body, nearness to forest etc. should also be mentioned. Specific study as given below also be suggested during scoping.

Specific Condition	Study Required
Nearness to water body/reservoir	Details of hydrogeology and hydrology
Nearness to forest	Details of conservation plan
Nearness to township	Blasting vibration study
Groundwater scarcity area	Details of ground water availability and recharge

ANTICIPATED ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

5.0 General

Identification of all potential environmental impacts due to project is an essential step of Environmental impact Assessment. These are critically examined and major impacts (both beneficial & adverse) are further studied. The construction, commissioning and expansion of any type of developmental projects have significant influence on the existing physical, biological and social components of environment. In case of mining projects, impacts on biodiversity, air pollution, water pollution, waste management and social issues are significant. The nature and characteristics of impacts are required to be taken into consideration while evaluating the magnitude of impacts. Various parameters considered for evaluation of impact are complied in Annexure 9.

In case of mining projects, the site has little relevance since it is mainly guided by mineral deposits. Mining activities underground and open cast have different types of impacts with respect to both magnitude and significance. During the working life of mine, air, water, noise and land use are likely to be affected due to mining of minerals and associated activities.

Open cast mines, which are more, preferred now for rapid increase is mineral production and safety reasons, the significant impacts are on land use, drainage, air quality, ecology, noise etc. Allied operations such as transport of materials, operation of workshop, drilling, blasting etc. affect the air, water and noise environment. Clearance of natural vegetation adversely affects the flora and fauna of the areas due to changed environment.

Positive impacts on socio-economic environment are expected due to creation of employment opportunities and development of infrastructure such as roads, schools, hospitals etc.

Mining activities are normally carried out over a long period (about 30 yrs or more. This also encourages downstream industrial development in the area which adds to environmental degradation. The identified significant impacts require detailed analysis for decision- making and formulating adequate mitigation measures. The various anticipated impacts and mitigation measures are discussed in this chapter.

Land Degradation in Mining Area

5.1 Land Environment

Anticipated Impact

The biggest impact of mining sector is land. If land use pattern in the core area consists of forest and agricultural land, the magnitude of impact on biodiversity would be significant. Similarly, if land is occupied by human habitation, their displacement would be a significant issue. So the impacts of mining on land are predominantly governed by the area acquired and landuse characteristics.

The satellite imagery on land use, discussed in Chapter 4 of baseline information should form the basis of impact prediction on land. The land impact can be assessed by carrying out cost-benefit analysis of the mining area. The overall benefits, the project will bring and the economic benefits the land is providing to the area are to be estimated. The economic value of land degradation in core area and in the surrounding should also be taken into account. The potential impacts of mining on land and their significance are compiled and presented in Annexure 10. The land use plan of core area (Mining area) over the years of mining should be shown in maps of appropriate scale.

The topsoil in the active mining area gets adversely affected. The topsoil is separately kept. The soil quality of the surrounding area are also likely to get affected due to siltation and run off from waste dumps. The mine drainage, if it is acidic and containing toxic constituents, not adequately treated when discharged to nearby land would affect the soil quality adversely; when discharged untreated into streams effects the quality of water and make in unfit for agricultural use. Agriculture is also directly linked to soil. If soil quality deteriorates, the agricultural productivity of the land decreases. The proximity of agricultural land, type of irrigation and crop is very important.

There is also positive impact of mining on agriculture, as sufficient water is discharged from the mine, which can be utilized for irrigation, increasing the productivity. Mine drainage water, in many mines, are not contaminated except high suspended solids, which can be removed by simple settling.

Mitigation Measures

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

- Compensation and rehabilitation of affected / displaced people would reduce the distress caused by the loss of land and land-based livelihood.
- Implementing adequate protection and conservation plan should conserve topsoil.
- Segregation of wastes based on the environmental risk potential. High-risk potential wastes should be treated and disposed off in environmentally sound manner.
- During the planning stage identification of waste storage yard and topsoil should be done based on slope and runoff characteristics.
- In-pit dumping of mine waste should be promoted wherever possible rather than external dumping. In case of external dumping, it should be stabilized by suitable plantations.

- Runoff from the mine and waste dumps should be regulated by constructing check dams and garland drains.
- Non-mineral zones and open areas should be planted with trees.
- In-pit dumping should be compacted and stabilized by green cover.
- Mine drainage should be suitably treated to meet the prescribed standard and discharged in to water bodies and land.
- Overburden dumps should be stabilized by mechanical and biological reclamation.
- Natural drains or nallahs should not be disturbed as far as possible. In case of diversion; alignments with natural drainage should be made by constructing artificial drains.
- Planned compensatory afforestation should be taken up to improve the catchments in core and buffer zone.
- Run-off from mine overburden dump, ore stockpiles etc. should be prevented to avoid being discharged to surroundings, particularly to agricultural land.
- Productive land should not be utilized for waste / ore dumping/ for construction of structures.

Following mitigation measures to minimize the impact on soil are suggested.

- Topsoils should be kept in a designated area and should be given minimum storage time to prevent nutrient loss.
- Garland drains, ditches, catchpits in different combinations should be provided to prevent run off affecting the surrounding agricultural land. These are to be designed looking into the locational site features.
- Mine drainage is to be treated adequately before discharge to stream outside the boundary of the project area
- Siltation of agricultural land should be prevented.

5.2 Water Environment

Anticipated Impact

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

Pumping of Mine Water

surface water regime are site specific and depends upon the characteristics of the mineral, hydrogeology and requirement of groundwater for other uses.

The anticipated impact of mining on water resources and their significance is compiled in Annexure 11.

Following suitable method of estimation, an assessment of impact on ground and surface water resources should be made. The detail method and calculation should be given in the report.

The impact on hydrogeology of the area can be:

- Regional surface and groundwater movement
- Groundwater inflow into the mine, with subsequent contact with mining related pollutants
- Surface water inflow and precipitation related recharge
- Increase in surface and ground water interaction with the mine working because of subsidence
- Loss of surface features such as lakes, streams and ponds through subsidence
- Pathways for post closure flow resulting from adits, shafts and overall mine design
- Operational and post closure geochemistry and resulting toxics mobility

Specifically, mine water, groundwater withdrawal and land subsidence can potentially create environmental problems that cannot be easily corrected. The ground water recharge calculation including groundwater budgeting should be done following standard methods.

The wastewater quality discharged to water bodies should meet the standard prescribed under Environment (Protection) Act, 1986 by MoEF, which is given in Annexure 12. There is no separate standard for mining. Therefore, wastewater discharge standard is applicable. Any other mine specific standards as per notification of MoEF from time to time are applicable. Recently, the Central Pollution Control Board has come out with effluent standards for iron ore & coal mines. These include standards for wastewater discharged from iron ore mining, beneficiation and associated activities or any other discharges, leaving the mining lease boundary, to natural river, stream or water bodies. No mine/mineral specific standards for wastewater are presently available. The standard for Iron Ore Mine is given in Annexure 13.

Retention Wall

Mitigation Measures

The following mitigation measures are suggested for water management and water pollution control. However, priority relevance depends on the location and type of mining and minerals.

- The overall drainage planning should be done in such a manner that the existing pre-mining

drainage conditions should be maintained to the extent possible so that run off distribution is not affected.

- Garland drains should be constructed on all side of quarries and external dumps. All the garland drains should be routed through adequately sized catchpits or settling pits to remove suspended solids from flowing into storm water. The design of catchpits should be calculated on the basis of silt loading, slope, detention time required.
- Retaining walls with weep holes should be built all round the external dumps. The storm water should pass through weep holes to the garland drains.
- The surplus treated mine water should be discharged into local ponds and agricultural fields which should act like a constant source of recharge to improve the groundwater level in the area.

- Rainwater harvesting by constructing check dams on natural nallah and developing water bodies should be planned for recharging groundwater.
- Considering the composition, the mine drainage water, should be adequately treated before utilized in agricultural fields in the surrounding through a planned network of drains / pipeline.
- The toxicity of the mine water should be treated specifically to meet the prescribed standard before discharge.

Settling Tanks to Treat Mine Water

- Ore, overburden and top soil
- Settling Tanks to Treat Mine Water should be stored / dumped / stocked preferably on a flat area, to reduce the risk of erosion.
- Shallow and deeper piezometers should be constructed close to mine area for monitoring the water levels in the aquifer. The locations of piezometers should be selected in consultation with Central Ground Water Board (CGW).
- Stone barriers across the drain should be constructed to check the water current and arrest solids.
- Stone pitching should be made at suitable location to regulate water flow and prevent soil erosion.
- Settling pits and drains should be periodically desilted.
- The vehicles workshop wastewater should be suitably treated for suspended solids and oil and grease.
- Effluents from the canteen, rest areas, township etc. should be adequately treated before discharge to outside.
- A water audit with a water balance diagram should be provided to gtive information on water use for all aspects of plant operation.

Water management plan also should be shown in mining plan for 5^{th}, 10^{th}, 15^{th}, 20^{th}, 25^{th} and 30^{th} year till closure of the mine.

5.3 Air Environment

Anticipated Impact

Mining operation and associated activities are potentially air polluting and the major air pollutant is the suspended particulate matter. Most of the air pollution problems are due to fugitive dust emission, which is more prominent in open cast mines in comparison to underground mines. The intensity of dust generation in the mining is influenced by factors such as hardness of rock, mining technology and material handling etc. The potential sources of air pollution are given in Annexure 14. Suitable procedure for fugitive dust emission should be followed and detail of the calculation should be presented in the report. In order to assess the impact on air environment, the factors to be considered are compiled in Annexure 15.

Prediction of fugitive dust level in the surrounding should be carried out (for 24 hours average) with the help of suitable computerized Fugitive Dispersion Model (FDM), based on Gaussian Plume formulation (Fig 5.1). Isopleths of fugitive dusts concentration ($\mu g/m^3$) are to be shown in map, mining lease area at centre. Prediction of PM 10 to PM 2.5 concentration due to mining in nearby village should also be presented in tabular form (Table-5.1). Suitable computer model may also be used for assessing the impact due to increase of vehicular movement in the area. The input data for modeling and type of software should be given in the report.

Mitigation Measures

Mitigation measures at various dust generating activities are discussed below.

Paved surfaces:

Paved surfaces have less dust generation potential. Dust pick-up by wind depends on the wind speed and is usually significant at wind speeds above 5 meters per second. However slight speed of vehicle can cause higher dust generation. Dust emissions from paved surfaces can be minimized by adopting following measures:

- Prevent spillages of materials on the paved surfaces during materials transportation.
- Minimize mud and dust track-out from unpaved areas by the use of wheel wash facilities.
- Regular cleaning of paved surfaces, using mobile vacuum sweeper or a water flushing system.
- Speed controls on vehicle movements.
- Wind reduction control by plantation.

Unpaved Surfaces

Dust emissions from unpaved surfaces are caused than from paved surfaces are usually much greater. Dust emissions can be controlled by using the following methods:-

- Water sprinkling on unpaved areas during dry wind periods, using a water tanker/or fixed sprinklers.
- Chemical stabilisation can also be used in association with wet suppression.

- This involves the use of chemical additives to the water, which help to form a crust on the surface and bind the dust particles together.
- Revegetation of exposed surfaces. This should be done wherever practicable at mines.
- Surface improvements may be done with concrete or asphalt, or the addition of gravel or chemical dust suppression to the surface for stabilization.

Plantation on Sides of Mining Road

- Speed controls on vehicle movements to limit speeds.
- Wind reduction control by plantation.
- Wet suppression of unpaved areas can achieve dust emission reductions of about 70 per cent or more, and this can sometimes be increased by up to 95% through the use of chemical stabilisation.

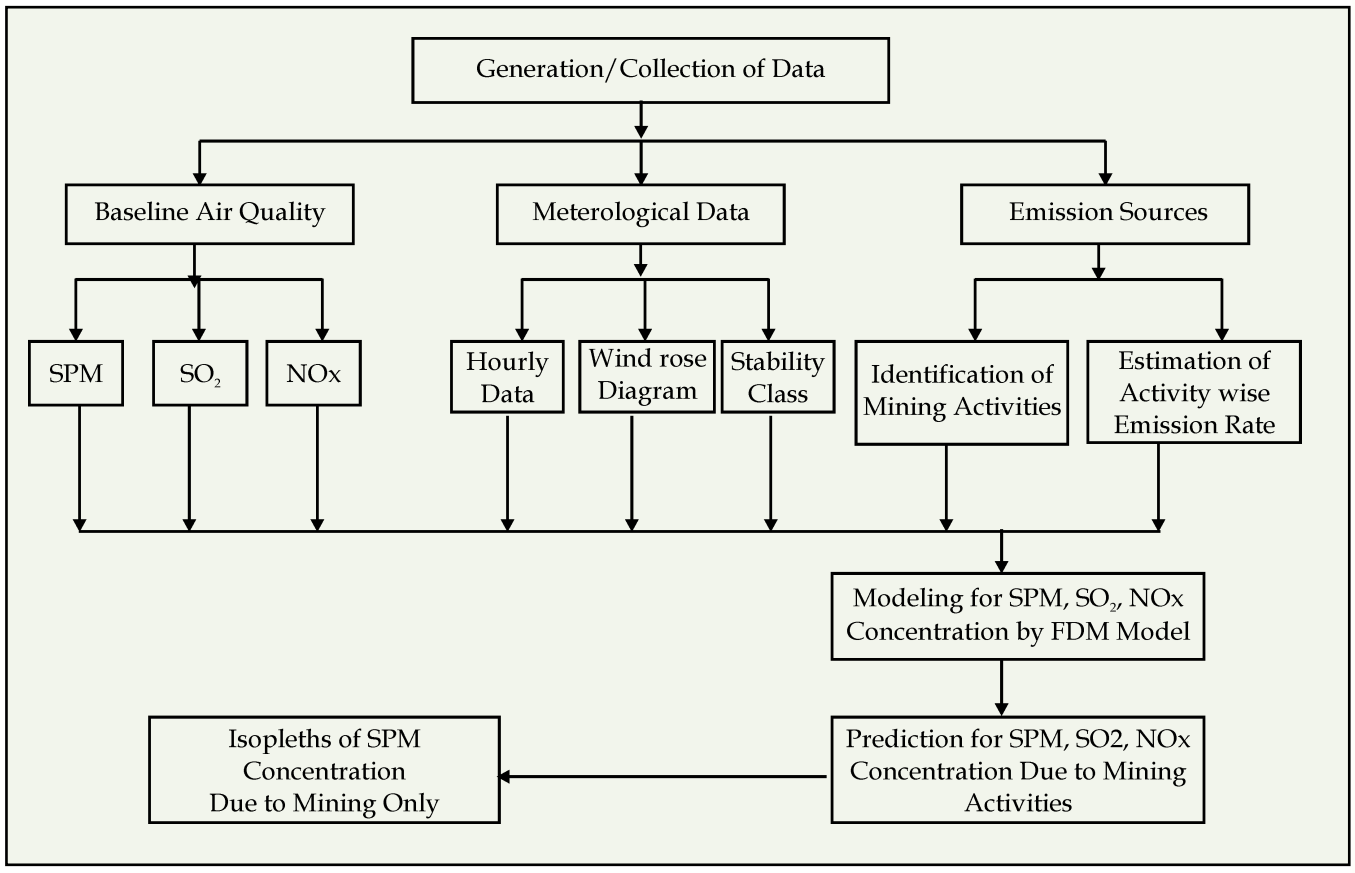


Fig 5.1 Emission Sources in Mining

Vehicle:

Vehicles travelling over paved or unpaved surfaces tend to crush surface particles and other debris. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents due to turbulent shear between the wheels and the surface. Dust particles are also sucked into the turbulent wave created behind the moving vehicles. The loads carried by trucks are also potential source of dust, either through wind entrainment or spillages. Mud and dust carry out from unpaved surfaces is another potential problem. Dust emissions due to vehicles can be minimized by:

- Avoid spillage from the loaded trucks.
- Optimize travel distances through appropriate site layout and design.
- Use wheel and truck wash facilities at site exits.
- Speed controls on vehicles have an approximately linear effect on dust emissions. In other words, a speed reduction from 30 km/hr to 15 km/hr will achieve about 50 per cent reduction in dust emissions.
- Vehicular emission of particulates, SO2, NOx, hydrocarbons can be minimized by proper training and maintenance of vehicles and other oil - operated equipments.

Material stockpiles

Top soil or overburden is susceptible to wind erosion speeds more than 5 m/sec. Dust emissions can also occur as material is dropped on the stockpile from a conveyor or during loading or unload by track / shovel / fornt-end loading by track / shovel / front-end loaded. There are a number of methods by which dust can be reduced from the stockpiles which are as follows:

- Wet suppression by using water sprinklers.
- Covered storage of mined out overburden or topsoil. This is an expensive option but should be seriously considered

Limiting the height and slope of the stockpiles can also reduce wind speed. For example, a flat shallow stockpile will be subject to less wind turbulence than one with a tall conical shape. However while designing the stockpile due consideration should be given to the effect of other site features such as most prominent wind direction. Some of the measures to reduce the dust impact from the material stockpile are as follows.

- Limiting drop heights from conveyors.
- Use of wind breaks (wind speed) near the pile is the primary factor affecting particle uptake from stockpiles. Although a large, solid wind break is the most effective configuration, the windbreaks can also be constructed by rapid vegetation.
- Sprinklers / fog with polyelectrolyte chemical
- Hood to cover the discharge point.

Conveyors

Dust emissions from open conveyors can be caused by wind and during loading, discharge point, and at transfer points. The following options should be considered for minimizing these emissions:

Dry Fog for Dust Suppression

- The use of enclosed conveyers.
- The use of water sprays or sprinklers at conveyor transfer points.
- Minimizing drop heights at transfer points.
- Regular clean up of spillages around the transfer points so that material cannot be picked up by wind.
- Enclosed transfer points with dust extraction system.

Biological method for dust control

Trees can act as efficient biological filters. The systematic and planned greenbelt development not only reduces the fugitive dust but also checks runoff and improves the aesthetic beauty of an area. It is essential that planning for greenbelt development should be done at the inception. It is a proven technology for waste dump stabilisation and restoration of mined out area.

Green belt of adequate width should be raised by planting native species around the mine lease area on both sides of haul road, near material handling plant, on external overburden dumps and backfilled quarry along undisturbed area and in and around the colony. Experimentally, it has been observed that some plant species have good efficiency in removing particulate matter. Central Pollution Control Board has recommended few plant species, which are very efficient for dust control (Annexure 16). Various air pollution control measures suggested are compiled in Annexure 17.

5.4 Noise

Anticipated Impact

Noise

Noise level increase due to mining activities such as excavation, drilling, blasting, handling and transportation of ore and overburden and operation of processing equipment. Impact on noise level on the nearby village may be predicted by using computerised noise prediction model and the results may be presented in format. The prediction of impact can be evaluated and discussed in Table 5.2.

The blasting cause ground vibration. The empirical equation used for assessment of peak particle velocity (PPV) is:

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

Where
V= Peak particle velocity in mm/s
D= Distance between location of blast and gauge point.

Q=Quantity of explosive per blasting

Any other formula for calculating blasting vibration in Indian condition may also be followed. However, detail reference is to be given.

The calculated vibration values should be presented in format (Table-5.3). The results are to be compared with the limiting values prescribed by Director General of Mine Safety (DGMS) (Annexure 18).

Mitigation Measures

The following mitigation measures can be adopted to control noise and vibrate

- Engineering noise controls by noise reduction at the source and by interruption of the / noise path from the source to the receiver.
- Administrative noise controls to the receiver
- Combination of one or all of the above control measures which can be technologically achievable

Engineering noise controls however offer the most effective permanent solution which 'prevents' occupational heaving loss A few of the noise control measures that may be adopted are:-

- Selection of new low-noise equipment from the manufactures failing which use of additional retrofits if available.
- Modifications of the older equipment or method by incorporating minor design changes
- Implementation of an effective planned preventive maintenance which reduces noise level by more than 50 %
- Use of noise barriers and total enclosures to block, redirect or reduce the flow of sound energy from all equipments including DG set and compressor before it reaches the receiver.
- Isolating continuous vibrating structuring by proper mounting securely
- When noise reduction at the source and in the transmission path fail to control excessive noise to the receive, it becomes necessary to develop administrative controls by
    - i) Altering the work schedule, moving the personnel further from the noise source
    - ii) Reduction of sight length
    - iii) Modifying equipment operation to eliminate on reduce sound, and
    - iv) Use of warring signs
    - v) When all controls fail to reduce the level of noise entering the ear, by use of personal hearing protection devices

- Developing green belts which act as pollution sinks
- Noise and ground vibration from blasting may be mitigated by the following measures:-

  i) By carefully designing a blast hole drilling pattern or blast geometry with appropriate burden distance, spacing as holes, hole size, hole depth, and stemming height, and powder factor. Established rules of thumb and experience in similar deposits in other mines may used.

  ii) Adopting shock tube (non-electrical) initiation system in blasting which allows short delay blasting using short delay detonators allowing in-hole as well as surface delay and bottom initiation of blasted rock, and results reduction of fly rock, reductions in noise and ground vibration levels to with in permissible limits.

- A blasting siren and warning notice boards should be used for public warning as safety measures.

5.5 Biological Environment

Anticipated Impact

The impact on biodiversity would be very high if the project is located close to a sensitive area. The impact on biodiversity is difficult to quantify because of its diverse and dynamic characteristics. Various issues relating to biodiversity are compiled for assessing the degree of impact in Annexure 19.

Mitigation Measures

In case, a mining project is likely to cause high impact on biodiversity, it is always desirable to conduct independent detail assessment. Development of a Biodiversity Action Plan (BAP) is a possible mechanism by which the objectives and target for biodiversity conservation can be achieved. Similarly, Species Action Plan (SAP) should also be prepared for protection of specific species and Habitat Action Plan (HAP) for protection of habitats of red and endangered species. However, Expert Appraisal Committee, constituted under EIA Notification, 2006 during scoping, can decide requirement of these studies. Many legislations, relating to forest and biodiversity are in force and deal with wide range of issues. The mine should comply with the provisions of such legislations. The level of compliance may be presented in the report.

5.6 Socio-economics

Anticipated Impact

The socio-economic impacts of mining are many. 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. Social Impact Assessment itself is an exhaustive study and may be taken up in case of mega project as decided by Expert Appraisal Committee. The major social impacts associated with mining are compiled in Annexure 20.

Mitigation Measures

Following mitigation measures are suggested:

- A welfare plan with funding from the project proponent should be prepared to provide assistance to affected people.
- Effective rehabilitation and resettlement schemes with basic infrastructure such as educational institutions, health care, roads, water supply should be drawn.
- The infrastructure facility (Educational Institute, Water Supply, Health Care etc.) developed by the project should also be extended to people without any cost or minimal cost.
- Various compensatory packages to be formulated for the improvement of socio-economic condition of people. They are:
  a. Monetary compensation
  b. Resettlement Plan
  c. Compensation in kind
  d. Site Remediation Insurance
- Training to locals to develop skill should be promoted by the project. All the above should be exhaustively dealt in the report.

5.7 Mine Waste Management

Removal of ore from earth generates large quantities of waste such as soil, debris, overburden etc. The bigger the scale of mining, greater is the quantum of waste generation. Open cast mines generate much higher quantities of waste as compared to the underground mines producing 8 to 10 times as much waste as underground mines. However, these are variable and depend on the type of deposit and geology of the project location. All types of mineral mining generate waste materials.

A waste audit will provide information on sources and types of all wastes produced, their characteristics, generation pattern, and cost of storage, treatment and disposal.

The waste rock generated from both opencast and underground mines varies every year and may require external dumping when opening up. In case of opencast mines progressing internal dumping may be resorted to as far as possible.

Active Overburden Dump

The anticipated impacts are

- Impact of run off from overburden, topsoil, low-grade ore and other stockpiles on water bodies (siltation, contamination etc)
- Loss of vegetation and wildlife habitat

- Impact on surrounding agricultural land
- Impact on groundwater quality due to leachate from stockpiles, tailings dam
- Sliding of waste dumps

The dumps should have the following protection measures:

- The individual dump should have maximum slope of 37^{o} and an overall slope not exceed 28^{o}.
- The external dump should have stretches of retaining wall at suitable locations.
- The wall should be constructed with suitable height and top surface. The wall will have weep holes to drain out water to the garland drain.
- The back-filled areas should be levelled to match with adjoining ground level.
- The completed dumps and the back-filled areas should be afforested in a planned way to increase their stability.
- Over burden in most cases are not contaminated. However, composition of the leachebility of heavy metals of over burden and low grade ore dumpsites are very important.
- Excavation of new pit should begin only after an existing pit is exhausted. This should ensure that the over burden and inter burden generated is use for back filling instead of being dumped elsewhere.
- The top soil prior to drilling and blasting should be stacked at designated area surrounded by embankment to prevent erosion.
- The over burden and top soil dumps should be stabilized by plantation and ankering with coir nets / blankets.
- Phase-wise waste management should be shown on surface plan in the mine leased area for the 5^{th} year, 10^{th} year, 15^{th} year 20^{th} year, 25^{th} year and 30^{th} year.

Overburden Dumps

- Waste generated from treatment of mine drainage, if normally designated as hazardous waste as per the relevant rules should be disposed off as landfill. Used oil should be stored properly and sold to registered reprocessor.
- The solid waste from the township should be subjected to aerobic composting or vermi composting to produce organic manure and the residues should be disposed off in landfill.
- The over burden disposal underground mines should be explored for putting it inside the void. The method of stowing should be worked out.

The mine waste management should be as per the approved mine plan.

5.8 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.

Mine Closure Criteria

The criteria involved in mine closure are discussed below:

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.

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 are 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.

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 plan should be as per the approved mine plan.

Stage wise mine closure plan with budget available financial / manpower should be prepared and implemented. Such plan with the approval of the competent regulatory authority should be made available to the MoEF and / or concerned State authority giving the environmental clearance.

ENVIRONMENTAL MONITORING PROGRAMME

6.0 General

This chapter should include details of mitigation measures to be followed. It should also include the technical aspects of monitoring the effectiveness of mitigation measures (including measurement methodologies, data analysis, reporting schedules, emergency procedures, detailed budget & procurement schedules). Guidance for assessment relevance and reliability of analytical methods and framework used for impact prediction - risk assessment is given in Annexure 22.

It should also include

- Summary matrix of environmental monitoring, during construction and operation stage
- Requirement of monitoring facilities and their onsite installation
- Frequency, location, parameters of monitoring
- Compilation and analysis of data, comparison with baseline data and compliance to accepted norms and reporting system
- Plantation monitoring programme

It shall also cover different statutory returns/ compliance reports to be submitted such as:

- Submission of half yearly compliance report in respect of the stipulated prior environmental clearance terms and conditions in hard and soft copies to the regulatory authority concerned, on 1st June and 1st December of each calendar year
- Submission of environmental statement for the financial year ending 31st March to the concerned state pollution control board on or before 30th September every year
- Format for maintaining records of hazardous waste in Form 3 as per Hazardous Waste (Management, Handling and Transboundary movement) Rules, 2008

6.1 Activities

Slope Failure

Regular inspection (frequency and mechanism to be established) should be carried out to examine slope stability, mine faces, overburden benches, ore and waste stockpiles etc. Possible slope failures by modern slope stability technologies should be monitored. Observations should also be made by regular checking for land erosion possibility in hill slopes / backfill area and underground mine voids.

Drainage

The effectiveness of drainage system depends upon proper cleaning of all drains and sumps. Regular checking should be carried out to find any blockage due to silting or accumulation of

loose materials. The drains should also be checked for any damage in lining / stone pitching etc.

Blasting Effects

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

Revegetation and Green Belt Development

Greenbelt development as per the scheduled plan should be reviewed every year. Post plantation status should also be regularly checked every season. Following plantation related data / information should be kept and compiled every year.

(a) Area under plantation / vegetation

(b) Period of plantation

(c) Type of plantation

  (i) Tree species

  (ii) Grass

  (iii) Any others

(d) Type of plant saplings / seedlings / grass species / scrub species planted

(e) Distance between plants (Different Areas)

(f) Type & amount of fertilizer used

(g) Interval of watering

(h) Method and period of post plantation care

(i) Survival rate

(j) Density of afforested area

  (i) Pre-mining condition

  (ii) Post-mining conditions

Water Quality Monitoring

Monitoring of surface run-off and ground infiltration should be a routine activity. Quality of groundwater treated and untreated mine discharge water and surface water should be monitored for the parameters prescribed in the consent conditions of State Pollution Control Board.

Air Quality Monitoring

Ambient air quality should be monitored both upwind & downwind directions along with adequate meteorological measurement for proper interpretation of data. The number of monitoring stations, air pollutants and frequency of monitoring should be decided. Meteorological stations to monitor wind direction and speed, rainfall, temperature and humidity and evaporation should be set up by large-scale mines.

Occupational Health and safety

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

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

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

The report should also cover

- Laboratory facilities to be developed
- Action plan and updation for implementation of EMP
- Budget for Environmental Management and monitoring
- Monitoring of quality of water, air, noise, vibration and occupational health status of project personnel and surrounding habitations.
- Planned monitoring program to evaluate the effectiveness of various /specific aspects of technological / mitigation measures.
- Environmental audit of various activities including budgeting and financial management with reference to environmental management.
- Hydro-geological monitoring for the entire mine life and restrictive monitoring during reclamation.
- Plantation monitoring programme to ensure survival and growth rate of plantations.
- Evaluation and analysis of data, its interpretation (any additional studies to be carried out if required
- Monitoring the implementation of the progressive/post-mine closure plan including financial and other aspects
- A plan for monitoring health of workers and community in vicinity should be drawn and submitted along with financial allocation.

7

ADDITIONAL STUDIES

7.0 General

TOR to be adopted for mining of minerals as commonly applicable is prepared and attached to this manual as Annexure 1. It may however, be necessary to consider specific issues as applicable to individual projects. The EIA report and EMP should therefore address such issues also.

7.1 Items identified by the proponent

The proponent may be able to identify issues beyond those included in the common TOR as may be specifically considered by him important from environmental point of view for the proposed project or site selected. In such cases the proponent shall include such issues as additional studies under TOR and pursue them in the EIA study after the regulatory authority approves TOR.

7.2 Items identified by the regulatory authority

During the scoping process, the regulatory authority may direct specific issues, beyond those included in the TOR proposed by the proponent, as may be specifically considered important from environmental point of view. In such cases the proponent should pursue those issues as additional studies in the EIA report after the regulatory authority approves TOR.

7.3 Items identified by the public and other stakeholders

After completion of the public consultation, the applicant shall address all the material environmental concerns expressed during the process, and make appropriate changes in the draft EIA and EMP. The final EIA report, so prepared, shall be submitted by the applicant to the concerned regulatory authority for appraisal. The applicant may alternatively submit a supplementary report to draft EIA and EMP addressing all the concerns expressed during the public consultation. A statement of the issues raised by the public and the comments of the applicant shall also be prepared in the local language and in English and annexed to the proceedings.

7.4 Risk Analysis and Disaster Management Plan

Risk Assessment is all about prevention of accidents and to take necessary steps to prevent it happening. The main objectives of preparing a disaster management plan in mining project include:

- To protect workers in mines from accident
- To prevent or reduce the incidence and severity of injury during mining operations
- To respond immediately and adequately in case of a serious accident

Drilling Risks

Drilling is common to the mining of hard rocks / ores. The main hazards associated with are:

- Drill Falling from the edge of a bench
- Dust created during the drilling operations
- Noise produced during drilling

The highest risk will occur during the drilling of the first line of holes parallel with the working edge of the bench. Measures that can be taken to reduce the risk of falling off the edge of the bench is to provide suitable portable rail fencing which can be erected between the drill and the edge of the bench and direction by the supervisor fro guidance of the driller.

Face Stability and Loading

Face instability gives rise to rock falls or slides and this can arise because of adverse geological conditioning or poor work practices. The main hazard associated with excavation / loading is rock falling on to the driver and falls while gaining access to operating cabins.

Failure of Slope in the Pit

In order to allay dangers due to open cast slope failure, final pit, slope stability estimations have to be made for the existing mines after determining various physical parameters of the ground mass like uniaxial compressive strength, triaxial compressive strength, cohesion, angle of friction, specific gravity of the rock, water pressure etc. Besides, all the structural discontinuities have been plotted in wedge failure. Even then, factor of safety should be determined against overall slope failure as well as against individual bench slope by circular failure, planer failure, and wedge failure. Besides determining factor of safety, the slopes should be monitored at regular intervals by using real time slope stability radar system, to monitor for any possible failure. The well-developed drainage system over the lease area should ensure that storm water does not accumulate in the lease area and therefore hydrostatic pressure remains at a low level.

Fly Rock and Vibrations Due to Blasting

Trial blasting results of a nearby mine (with similar geo-mining characteristics) may be used to arrive at the field empirical equations based on which the charge per delay can be regulated to protect the nearby structures. All precautions related to control of fly rock should be taken during the blasting operations. Safety zone of 300 m as per statutes should be maintained.

Spillage of High Speed Diesel (HSD) and resultant fire constitutes a potential risk. The quantity of the maximum oil, which can spill, is not much and can be easily controlled. Sufficient number of portable fire extinguishers should be provided at strategic locations to take care of any eventuality. Dry and foam type portable fire extinguishers should be provided at the electrical substation and control room.

Regulations laid down by DGMS should be fully adopted.

The major risks associated with mining are:

- Drilling risks
- Scope failure
- Fly rock and vibration due to blasting
- Storage of explosives
- Toxic fumes from blasting
- Water ingression in underground mine workings
- Subsidence

Risk analysis involves systematic identification and assessment of major damage potential credible risk scenerios to help management to make objective decisions on hazard reduction or avoidance measures meeting regulatory requirements and develop a structured management framework for an effective Disaster Management Plan (DMP) including emergency preparedness and contingency plans.

Advantages of risk analysis include:

- Systematic identification of credible risk scenerios, frequency of their failure modes and fatality consequences.
- Estimation of each event frequency by using, relevant historical data, accident statistics 'fault tree' or 'event tree' analysis techniques. These techniques may be used individually or jointly.
- Quantification of major individual risks per annum for each operation.
- It provides a basis for a rational planned preventive maintenance.

Technological hazards:

These include disastrous events or hazards occasioned by manor man's impact on the environment and technical causes.

They may be divided into

1. Noise hazard from intense noise sources on operating equipment like drilling, excavation / loading, transportation and processing equipment auxiliary and supporting facilities. Blasting noise is of very short duration achieving a peak level of 140 dB.

2. Blasting – of produces
   - Ground vibrations
   - Excessive toxic fumes which may typically include CO, NO, NO_2 and NH_3 and organics
   - Danger of explosives hazards from their use
   - Fly rock injuries and fatalities in surface mining due to inadequate blast area security
3. Occupational injuries and fatalities in drilling and rock bolting in underground metal / non-metal mines
4. Ground falls / rock burst hazard in underground mines
5. Instability of spoil dumps, tailings, dams, bench/pit and slopes in surface mines which may cause injuries and fatalities
6. Flammable and toxic gas emissions as continuous emissions and blowers and gas outbursts in mines
7. Sudden inundation of water in underground mine workings trapping miners
8. Fires and explosions hazard in underground mines
9. Fires on large surface vehicles through ignition of fuel/hydraulic fluids.
10. Fire in surface coalmines due to spontaneous heating and processing plants.
11. Chemical hazards in beneficiation plants
12. Storage and disposal of hazardous materials
13. Injuries and fatalities during storage and transport of bulk materials to areas by road or rail; structural failures
14. Contamination of groundwater quality with water on mine site raw mine drainage, leach ate from old mine dumps, stockpiles and seepage from setting pond and tailings dams
15. River/stream pollution with silt, acids, dissolved substances
16. Surface damage due to subsidence: damage to structures, buildings, infrastructure, agricultural land, forests/ wildlife, alteration of drainage pattern, etc causing human distress
17. Injuries and fatalities due to impact and collisions of heavy vehicles due to mechanical and human failures, pit wall and land slides

Mine Disaster Management Plan:

A disaster is a catastrophic event in which personnel working in the affected area are immediately planed into a chaotic situation, which demands their immediate rescue, medical and social case to restore normalcy. It creates a major emergency inside the plant requiring an Emergency response in accordance with a Mine Disaster Management Plan formulated by the management.

A detailed DMP for handling emergencies includes

1. Identification and assessment of major credible risk scenarios anticipated at a particular workplace / activity (Slope failure, subsidence, fly rock fragments, fires, toxic / hazardous / flammable Gas Release / Explosion, inundation etc.)

2. Setting up an Emergency response organization identified key personnel at the mine with assigned duties and responsibilities for incident response and emergency response.
3. Emergency actions plans with implementation procedures by emergency response personnel for each scenario after emergency warning.
4. Details of safety measures to prevent accident and disaster.
5. Emergency notification by sending warning messages to identified agencies for liaison and stake holders.
6. Setting up a permanent organization for completion of emergency and restoration of normalcy by complying with health, safety, and environmental laws and regulations
7. Disaster management plan for safe mining particularly for underground mines where toxic fumes and other risks are involved.
8. Supplementary response plans under mutual aid
9. Any other stipulations made by regulatory agencies for handling emergency situations that may arise either from natural or manmade

The Indian MIINES RESCUE RULES 1985 under Coal Mines Regulation1975 which may be referred to prescribe organization for conducting rescue operations at underground mines ensuring safety of life, property and environment and safe rehabilitation of the affected area.

7.5 Natural Resource Conservation

The plan of action for conservation of natural resources and recycle of waste materials should be formulated and included in the EIA report. The conservation strategy should be prepared both for mine development and exploitation phases. Energy efficiency and green house gas emission reduction programme of the project, if any, should also be highlighted.

7.6 Rehabilitation & Resettlement (R & R)

Detailed R&R plan with data on the existing socio-economic status of the population in the study area and broad plan for resettlement of the displaced population, compensation to affected people, site for the resettlement colony, alternative livelihood concerns/employment for the affected people, civil and housing amenities being offered, etc and the schedule of the implementation of the project specific R&R Plan if any is to be given. Details of financial provisions (capital & recurring) for the project specific R&R Plan and monitoring mechanism for the implementation of the plan should be highlighted.

Details of Corporate Social Responsibility activities and cost provisions (capital and recurring per annum over the life of the project) should be worked out. The community development programme proposed by the proponent for the surrounding population should be recorded. This programme should be prepared on the basis of findings of socio-economic survey. The implementation mechanism of R & R Action plan should be clearly spelt out and recorded.

8

PROJECT BENEFITS

8.0 General

This chapter should include benefits accruing to the locality, neighbourhood, region and nation as a whole. It should bring out details of benefits by way of:

- Improvements in the physical infrastructure of project and ancillary industries that may come up on account of the project.
- Improvements in the social infrastructure like roads, railways, townships, housing, water supply, electrical power, drainage, educational institutions, hospitals, effluent treatment plants, waste disposal systems, improved environmental conditions, etc.
- Employment potential of skilled; semi-skilled and unskilled labour both during construction and operational phases of the project with specific attention to employment potential of local population as well as necessity for imparting any specialized skills to them to be eligible for such employment in the project on a long term basis i.e., during operational and maintenance stages of the project.
- Tangible benefits like improved standard of living, health, education etc.
- Other direct and indirect economic benefits of the area.

9

ENVIRONMENT MANAGEMENT PLAN

9.0 General

The environmental management must be integrated into the process of mine planning so that ecological balance of the area is maintained and adverse effects are minimized. Environmental Management Plan (EMP) requires multidisciplinary approach. EMP can further be modified / upgraded time to time by taking advice from experts in the respective fields (forests, soil chemistry, ground water etc.), as the mining of minerals progresses. The changes warranted as per site specific conditions are to be accounted for during actual implementation.

EMP covers all phases of the project considering the impacts with mitigation measures and monitoring programme. The plan outlines the measures that will be undertaken to ensure compliance with environmental legislations and to minimize adverse impact.

EMP should essentially include monitoring programs and management control strategies for minimizing the adverse impacts:

- Subsidence
- Acid Mine Drainage
- Air Pollution
- Water Pollution
- Noise, Vibration and fly rock during blasting
- Biological reclamation measures
- Land use planning and mine closure
- Occupational Safety and Health
- Socio-economic and cultural environment

9.1 Subsidence

The damages and consequential effects of subsidence can be alleviated or countered by undertaking precautionary measures on surface for protecting installation(s) in subsidence prone areas or by adopting appropriate modifications of the mining method adopted to minimize deformation of the surface and by filling the abandoned mine/non-working mines where possible by slowing in a carefully planned manner.

a. Structural units in the mining area should include safety designs.

b. Sites of such structures should be away from natural geological weak points such as faults, thrusts, fissures or fractures etc.

c. Structures should be designed in subsidence prone areas taking rigidity, flexibility factors into consideration.

d. If the mining in a subsidence prone area is inevitable the operations should be planned to permit controlled subsidence over the entire overlying ground.

e. Mine planners can possibly modify extraction methods and sequence(s) of operations to keep the damage within acceptable limits.

f. Adequate support should be provided in the underground workings, (especially in areas closer to surface) to control subsidence. In case of worked out mines stowing should be carried out if technically and economically feasible.

g. The worked out areas, specially for steeply dipping metalliferous ore bodies, should be filled with sand or other suitable packing materials.

h. The procedures and plans drawn for mine closure operations, which is now mandatory, adequate attention should be given to prevent subsidence of land in underground mine workings in future.

i. The magnitude of surface strain, ground movement and slope change can be predicted with empirical models or with finite element computer simulations. Scientific data for such models should be collected before the actual mine operations are started.

9.2 Acid Mine Drainage

Acid mine drainage is the outflow of acidic mine waters from active and inactive abandoned coal and metal mines as well as from the surface mining waste dumps, coal refuse, coal stacks, and beneficiation and large constructions activities. The acidic water generated from the surface sources is termed acid rock drainage which term is preferred over the term acid mine drainage to emphasize the general nature of the problem. Oxidation of associated metal sulphide (often iron sulphide) present in the deposit or surrounding rocks in the presence of air and water.

The sulphide minerals which undergo oxidation are Pyrrhotite (Fes), chalcocite (cu_2s), arsenopyrite (Fe As S), sphalerite (ZnS), Corellite(CuS), Pyrite (FeS_2) and chal (Cu Fe S_2). Bacteria naturally occurring in the rock accelerate the decomposition of the metal ions. In the case of Iron Sulphide (Pyrite/marcasite), the acid – generating chemical reaction can be simplified to;

$$Fe\,S_2 + 15/4\,O_2 + 7/2\,H_2O \quad \rightarrow \quad Fe\,(OH)_3 + 2\,SO_4^{2-} + 4\,H^+$$

In the presence of oxygen and water, pyrite oxidizes to form ferric hydroxide, sulphate and hydrogen ions. The liberation of hydrogen ions lowers the PH and causes increased acidity in water passing. Prediction of acid mine drainage (AMD) also called acid rock drainage (ARD) will help the mining operations and planning the strategy to control pollution of ground & surface waters and entry of TOXIC metallic components in the environment. The mining authorities should try to prevent formation of acid drainage at source. For this they may adopt modified mining methods, sealing of mine or a part of it after closure, surface reclamation, water diversion to prevent he exposure of ground water to sulphide bearing rocks and subsurface dams. Control of acid generation can be achieved by limiting the availability of at least one of the three essential components of the acid generating process, namely, sulphide mineral, air or water.

Control of acid mine drainage

- The segregation of acid generating material and encapsulation within materials, which will generate alkalinity will be best alternative.
- Blending thoroughly Potentially Acid Forming (PAF) material, with non- acid consuming (NAC) materials to take advantage of inherent neutralization capacity.
- Depending on site conditions wet / dry covers can be utilized to minimize oxygen entry into the waste body. Water flux through the waste or both. A cover of compacted clay or dead ore or rock can be used.
- Controlled placement and compaction of thin layers can be adopted to achieve high level of control for dumps in sensitive environment(s). The outer layers of such compaction will include a compacted oxygen barrier and a single or multi layered re-vegetation plan.
- To employ standard waste water treatment method for neutralization and removal of dissolved solids. The technique generally adopted followed is lime or limestone addition during the construction stage and to bring down the PH to below 5.5 use of bactericides were also practiced to control ARD at some coal mines.
- Prevention of ARD should be the primary goal at new mines, collection and treatment as a mitigation method on a long term basis. The method adopted should include line / limestone treatment followed by aeration or oxidation process to convert ferrous iron to ferric iron, neutralization with soda ash, Caustic soda etc reverse osmosis / ion exchange, evaporation, ozone oxidation, iron sulphide removal and microbial control.
- Introducing bactericides that reduce the activity of the catalyzing bacteria utilizing specialized biotechnological processes for recovery of heavy toxic metals from the mine drainage water.

The sludge emanating from the treatment being a hazardous waste should be disposed off in an approved manner.

9.3 Air Pollution Control

There are various sources of fugitive dust emission during mining. The environmental management for air pollution control include;

- Wet drilling operation should be practiced to control dust. Drill pits are also required to be regulated as per the manufacturer's guideline.
- Over charging of blast holes should be avoided and spread of dust from blasting should be checked by using suitable explosives.
- Haul roads are the major source of

Wet Drilling

fugitive emission. Following measures should be taken to reduce dust from haul roads.

a) The main haul roads should be made metal road.

b) The unmentalled haul roads should be adequately compacted before being put into use.

c) Periodically, water should be sprinkled on these roads to wet the surface.

d) Over loading of transport equipments should be avoided to prevent spillage.

e) Transportation of fines and dust should be in covered vehicles to prevent fugitive dust emission.

f) The road should be properly maintained.

Water Sprinkling on Road for Dust Suppression

- Water should be sprinkled on stakes of ore.
- Once the over burden dumps has reached the designed size, it should be covered with a layer of top soil and water should spread on the soil.
- Grasses should be immediately planted on the dump.
- Diesel Generator set if any should have accoustic enclosures with adequate stack height.
- Regular checking and maintenance of vehicles should be conducted and pollution under control certificate be obtained.

9.4 Water Management and Water Pollution Control

- Drainage in the core zone should be planned in such manner, so that there should be minimum impact on surface water bodies and the overall drainage pattern of the area is not affected.
- The mine water based on its composition should be adequately treated before discharged to outside. The treatment plant should be accordingly designed.

Mine Drainage Water

- Since there is always change of location of mine drainage water discharge points, as the mine progresses, suitable networking for pumping mine drainage water to the treatment system / plant should be ensured.
- A monitoring network of dug wells should be established to monitor the ground water level. It may be explored if the treated mine drainage water can be utilized for agricultural purpose in the surrounding.
- The wastewater generated from workshop and the colonies should be treated by appropriate treatment method based on the composition and quantity.
- Monitoring of water quality of mine discharge to local river/nallah and domestic water should be conducted to evaluate the performance of the mitigation measures.
- Pieozemeteric studies closed to the mining area should be conducted regularly.
- The water management should be worked out and shown in drawings of the mining area.

9.5 Noise Control

- Noise level should be maintained below 90 dB(A) in workplace (for 8 hour exposure).
- All machineries should be maintained as per maintenance schedule to prevent undesirable noise.
- Blasting should be carried out only in day time.
- Hearing protection devices (Ear plugs and ear muffs) should be provided to the drill machine operators and dumper drivers.

9.6 Control of Vibration and Fly rock generation during blasting

The following measures should be taken to reduce vibration and fly rock generation.

- Blasting should be carried out only during daytime and fly rock not be carried out in storming and rainy weather or during lightening.
- The distribution ratio of cast booster to column charge may be maintained at 1:3.
- Maximum permissible charge per delay should be decided on the basis of the distance of structure to be protected from the blasting.
- Stock tubes should be used for connections and initiation of detonation in holes and on the surface.
- Maximum period of blast should preferably be less than 600 ms to minimize cut off.
- The number of rows in a blast should not be more than four so that fly rock generation and ground vibration are reduced.
- Attempts should be made to have one large blast with less frequency then to have several small blasts.

9.7 Biological Management

Greenbelt Development

Greenbelt is an important sink of air pollutants including noise. Green cover in mining area not only help in reducing pollution level, but also improves the ecological conditions and prevent

soil erosion to great extent. It further improves the aesthetics and beneficially influence the microclimate of the surrounding. It also helps to stabilize the slope of external overburden dumps. Many a times, it attract the animals to re-colonize the area when the mine is abandoned. However, green belts may be developed with plant species suitable to the area. Plant species, selected for greenbelt should have rapid growth, ever green, large crown volume and small/pendulous leave with smooth surface. All these characteristics are difficult to get in a single species. Therefore a combination of these is sought while selecting trees for vegetation cover.

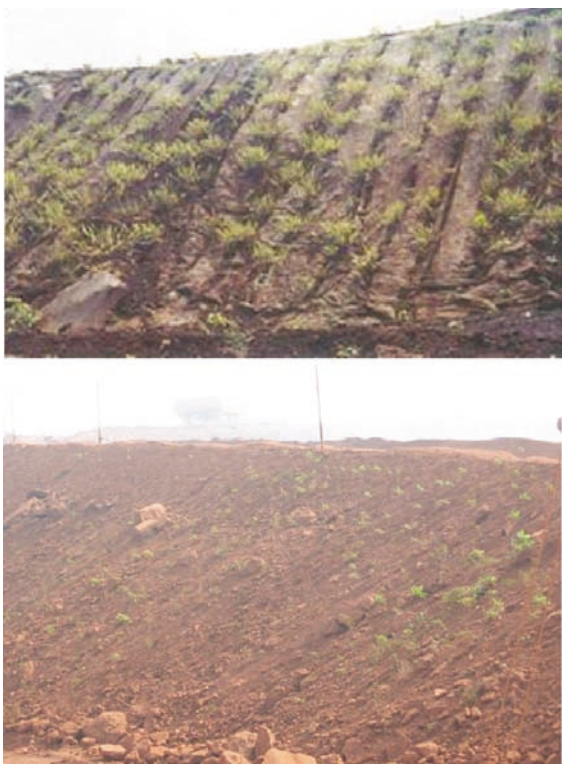
Greenbelt should be developed in following areas:

- Along mine lease boundary
- Around office buildings, garages, stores etc.
- Along the side of major roads
- On external overburden dump
- On backfill areas
- Upper benches / slope of mine pits

The species of plantation should be selected considering the soil quality, place of plantation, chances of survival, commercial value etc. Only indigenous species should be planted. Mixed plantation should be done keeping optimum spacing between the sapling. The species suitable and guideline for greenbelt development given in Central Pollution Control Board's publication "Guidelines for Development of Greenbelt CPROBES/75/1999-2000" should be followed. In order to supply of seedlings for the continuing greenbelt development plan, a nursery may be developed. Sapling may be done from seeds or seedling collected from nearby forest areas.

Plantation along mining lease boundary

In case of open cost mine, green belt of suitable width should be developed all along the mining lease boundary. The row of plants facing mine should be of smaller species and those facing outside should be of taller species. Seeds may also be sown in rows for plants with low survival rate (Example - Sal). In underground mines, plantation along the boundary of mine entry should be taken up.



Plantation on Overburden Dumps

Plantation around Office Building, Colony & Road

Plantation should be done around the built up areas and space available in the township. Extensive plantation should also be done along the sides of connecting roads.

Plantation on external dumps

Plantation on the overburden dumps can only be taken up after dumping activity is stopped and the site is

proposed for plantation. A layer of topsoil should be spread over the area and roughly leveled. Coir net / blanket should be spread and native grass seed mix should be broadcasted uniformly on prepared slope.

Plantation on Top of Overburden

Trenches of 45cm x 45cm should be dug on the flat top of the dump and excavated materials should be used to form bund on the dip side of the trenches to retain water during rain. Suitable benches should be made on the waste dump. Pits of size 60cm x 60cm should be dug on the benches at 2-3 meters intervals. The pits should be filled with a mixture of top soil, organic manure and phosphate fertilizer. Saplings should be planted in these pits during monsoon to ensure maximum survival.

Plantation on Dump Slopes

Plantation on slope of the dump should start after the benches are ready. The terraces on the slopes should be sloped inward. Pits of size 60cm x 60cm should be dugs at 1.5m interval and filled with a mixture of topsoil, organic manure and phosphate fertilizer.

The slopes and terraces should be covered with a layer of soil held with coir net blanket. Seeds of grass and small scrubs of local varieties should be sprinkled on the soil covering the dump slope. Seedling of the plants should be planted in pit in the slopes.

Plantation on Backfill areas/Mine Benches

Plantation on the mining benches can also be taken up once the active pit is closed for mining. The abandoned pit, after backfilling and leveling, a layer of top soil should be spread. Grass seed / seedlings should be planted on the soil layer to stabilize the soil. Plants selected for plantation on mining benches should be draught hardy, with fast growth rate and with glabrous/ pendulous leaves.

Trenches of 60cm x 60cm should be dug on the flat top of the backfilled mine pits. Where backfilling is not possible (mining in hills), the trenches should be dug on mining benches. The excavated materials should be utilized to construct bund on the dip sides of the pit to retain water. Contour trenches at 2-3 meter intervals should be dug on the backfilled mine pits/mining benches for soil and moisture conservation. The pits should be filled with a mixture of topsoil, organic manure a phosphate fertilizer.

Masonry drains sloping along the mining benches to facilitate conveying of water from higher benches to the next lower benches should be constructed. Before the commencement of the monsoon, the side slopes of mining benches should be covered with a layer of soil by means of mechanical binders like coir net / blanket and sprinkle with water. Seeds of grass and scrub of indigenous variety should be sprinkled on the soil covering the bench side slopes.

Phase wise Plantation for afforestation

Stretches of open land in lease area, which are not covered by any activity should also be identified and afforestation programme should be taken up. Plantation in these locations can start from the initial year of excavation and plantation should be expected in such areas in progression stages.

The green belt development plan with the progressive plantation programme and land availability and requirement of saplings should be shown in maps. This also should be presented in tabular format (Table-10.1).

Post Plantation Care

Post plantation care is very important and should be an integral part of mine management. A dedicated cell in the mine should be established for post plantation care, which include, regular watering, manuring, protective measures etc. Diseased and dead plants should be uprooted and replaced by fresh saplings. Regular monitoring on survival rate and remedial action should be done in an organized and planned manner.

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 is discussed in the respective chapters should be strictly followed. The blasting is to be carried out during day time only. The migrating routes of wild animals should 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.

The strong light in the project premises during night may cause some disturbance to fauna of nearby forests. The light posts along the ML boundary should face inwards and downwards with reflector facing downward, so that light do not spread outside ML area.

9.8 Landuse Planning and Mine Closure

Future landuse planning of post mining should be for forestry. Because the man made forest developed on abandoned quarry area, over burden dumps should match with the existing forest in the area and hill slopes. Restoration of forest cover may attract (back) some of the impacted fauna after closure of the mine.

Progressive land area degradation vis-à-vis biological reclamation plan should be estimated and presented in tabular form (Table – 10.2).

9.9 Occupational Safety and Health

Occupational safety and health is very closely related to productivity. The mining is directly associated with health and safety of the work force. It is established that the mining activities have several health risk. Some of the occupational hazards associated with mining are:

- Hearing impairment
- Skin diseases
- Eye diseases
- Job stress because of working in accident prone mining environment.
- Respirable diseases
- Materials like asbestos, silica, chrome dust etc. are hazardous to mine workers.

Safety of employees during operation of mines should be as per the mines rules and as per guideline of Director General of Mines Safety (DGMS). The following measures relating to safety and health should be incorporated.

- Provisions of rest shelter for mine workers with facility of drinking water.
- Awareness on safety and ensure using of personal protective equipments (PPE) by workers.
- Regular maintenance and testing of equipments.
- Periodical medical examination of all workers.
- First Aid facility and training to workers.
- Safety measures and risk assessment in underground mining.
- Conduct of mock drill
- Safe storage & handling of explosives.

9.10 Socio-economic Conditions of the Region

Social welfare activities should be taken up on a large scale. The social welfare activities can be planned in the following areas:

- Medical assistance;
- Primary education;
- Animal husbandry;
- Rural water supply;
- Agricultural improvement;
- Vocational training; and
- Assistance in utilizing government programs.

Medical Assistance

Services of health care facilities developed by the mine should be extended to the general public.

Education

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

- Repair/Rebuilding of village schools;
- Institution of scholarships and prizes;
- Encouraging pre-primary schools education; and
- Supporting adult education programs.

Training of personnel

In order to improve the skill and self employment of locals, following promotional activities may be taken up.

- Tailoring/embroidery classes for women; and
- Orientation programs for self-employment in collaboration with District Industries Centre and Rural Development Agencies.

Agricultural Improvement

The locals in the area should be benefited by following social programme.

- Organising, with the help of Agricultural Department, training programs for farmers in relevant areas such as animal husbandry, dairy development, modern cultivation, scientific storage of grain, water conservation etc;
- Help to organize veterinary camps;
- Help in arranging in association with nearby agricultural department for soil testing and technical inputs for increasing yield.

Assistance in Utilizing Government Programs

Collecting and disseminating information pertaining to various government schemes and providing guidance and assistance to eligible persons for making good use of these schemes e.g. getting loans for setting up small businesses.

Employment

Preference should be given to local population while inducting the man power (both skilled and unskilled). Necessary training may be provided to locals to improve their skill.

Communication

The mine roads to the project site from nearest state/district/village roads should be constructed and maintained. The facilities like post office, telephone booth etc. should be available near the mine office.

10

SUMMARY AND CONCLUSION

10.0 General

Summary EIA should be a summary of the full EIA report condensed to ten A-4 size pages at the maximum. It should necessarily cover in brief the following chapters of the full EIA report.

- Introduction
- Project description
- Description of the environment
- Anticipated environmental impacts & mitigation measures
- Additional studies
- Project benefits and costs evaluation
- Important Aspects of the Environmental Management Plan and
- Important Aspects of the Environmental Monitoring Programme
- Disclosure of consultants engaged

11

DISCLOSURE OF CONSULTANTS ENGAGED

11.0 General

The EIA consultants shall have accreditation with Quality Control of India (QCI)/ National Accreditation Board of Education and Training (NABET) as per office memorandum dated 2nd December 2009 of MoEF. This chapter shall include the names of the consultants engaged with their brief resume and nature of consultancy rendered. The consultants shall include the copy of the accreditation certificate and data provided by the other organizations / laboratories including their status of approvals etc.

BIBLIOGRAPHY

- APELL for Mining, Awareness and Preparedness for Emergencies at Local Level, Technical Report No. 41, UNEP 2001
- Final_Lit_Review_AMD_08-22-08.pdf
- http://europe.osha.eu.int/good_practice/risks/ds/oel/ accessed Jan 2009
- http://www.bls.gov/iif/ and accessed Jan 2009
- http://www.cdc.gov/niosh/mining/mining/illum/. Accessed December 2008
- http://www.cdc.gov/niosh/npg/ accessed November 2008
- http://www.osha.gov/pls/oshaweb owadisp.show_document?p_table =STANDARDS & p_id=9992 accessed October 2008
- International Council for Mining and Metals (ICMM), 2006. Good Practice Guidance for Mining and Biodiversity . London, UK. Available at: http://www.icmm.com/uploads/1295GPG.pdf
- MAC, 2003. Developing an Operations, Maintenance and Surveillance Manual for Tailings and Water Management Facilities.
- Samad, M. A., and E.K. Yanful. (2005). "A design approach for selection the optimum water cover depth for subaqueous disposal of sulfide mine tailings." From http: pubs.nrc-cnrc.gc.ca/rp/rppdf/t04-094.pdf.
- Skousen, J. G., and P.F. Ziemkiewicz (1996). "Acid Mine Drainage Control and Treatment." Second Edition. Morgantown, W.V., West Virginia University and the National Mine Land Reclamation Center.
- U.S. Department of the Interior, Office of Surface Mining. Acid Mine Drainage Prevention and Mitigation (2007) available at: http://www.osmre.gov/amdpvm.htm
- UNEP, 2001. APELL for Mining, Awareness and Preparedness for Emergencies at Local Level, Technical Report No. 41.
- UNEP. (2002). "Chronology of Major Tailing Dam Failures." United Nations Environmental Program, Division of Technology, Industry and Economics. From http://www.mineralresourcesforum.org/incidents/index.htm.
- United Nations Convention on the Law of the Sea (1982) Available at: http://www.un.org/Depts/los/index.htm

- United Nations Environment Programme (UNEP) Mineral Resources Forum http://www.uneptie.org/pc/mining/mrfvision.htm accessed October 2008
- United States (US) Environmental Protection Agency (EPA). 2005. 40 CFR Part 60, Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units, Clean Air Mercury Rule. Washington, DC: US EPA..
- Warner, R. W. (1971). "Distribution of biota in a stream polluted by acid mine drainage." Ohio Journal of Science 71(4): 202-215.
- Younger, P. L., S.A. Banwart, and R.S. Hedin (2002). "Mine Water: Hydrology, Pollution, Remediation." NY, NY, Springer Pub.

TABLES

Table – 2.1 Ancillary Features of Mines

Sl No.	Ancillary Activities	Location	Area in Ha	Existing Landuse
1.	Township			
2.	Conveyor			
3.	Water reservoir			
4.	Magazine			
5.	Crushing and greening plant			
6.	Tailing Dam			
7.	Mine water treatment plant			
8.	Waste dump			
9.	Waste treatment facilities			
10.	Beneficiation plant if any			
	• Haul road			
	• Green belt			
	• Topsoil dump			
11	Canteen			

Table 2.2 Characteristics of Ore

Sl. No.	Ore type	Chemical constituents in percentage				

Table-2.3 Ore Production and Overburden Generation (Anticipated)

Sl. No.	Year	Ore Production (T)	Overburden cum
1.	First 5 years		
2.	5 – 10 years		
3.	10-15 years		
4.	15-20 years		
5.	20-25 years		
6.	25-30 years		
	Total		

Table-2.4 Inventory of Explosives

Sl. No.	Class	Commercial Name	Quantity stored	Likely period of storage
1.				
2.				
3.				
4.				

Table-2.5 Inventory of Fuel Oil

Sl. No.	Fuel	Type of Storage	Monthly Requirement
1.			
2.			
3.			
4.			

Table-2.6 Yearwise Excavation (Initial Five Years)

Year	Top Soil (m^3)	Overburden (m^3)	Normal Grade Ore (Tonnes)	High Grade Ore (Tonnes)	Low Grade Ore (Tonnes)	Ratio of Ore / Overburden
1						
2						
3						
4						
5						
Total						

Table-2.7 Water Requirement

Sl. No.	Activities	Average Demand (m^3/day)	Peak Demand (m^3/day)
1.	Mine a. Drilling and spraying b. Dust suppression c. Equipment / Vehicle washing d. Pit head bath e. Drinking water at mine site		
2.	Township Drinking		
3.	Crushing / Screening Dust Suppression a. Road b. Ore Stack		
4.	Green Belt		
5.	Ore beneficiation (if any)		

Table-2.8 Manpower Requirement During Mine Development and Operative Phases

Sl. No.	Category	Mine Development Phase		Operative Phase	
		Direct	Contractual	Direct	Contractual
1.	Administrative				
2.	Supervisory				
3.	Workers				
4.	Security				
5.	Others				

Table-4.1 Description of Soil Sampling Locations

Station No.	Location	Distance & Direction from project area	Project area / study area	Environmental Setting

Table-4.2 Physical Properties of Soil

Station Code	Colour	Texture	Water Holding capacity (%)	Porosity (%)	Sand (%)	Salt (%)	Bulk Density gm / cc	Permeability ml
S1								
S2								
S3								

Table-4.3 Chemical Properties of Soil

Parameters	Samples					
	S1	S2	S3	S4	S5	S6
pH						
Conductivity						
Chloride						
Sodium Absorption Ratio						

Table-4.4 Description of Ground Water Sampling Locations

Station No.	Location	Distance & Direction from project area	Project area / study area	Environmental Setting

Table-4.5 Analysis of Ground Water

S. No.	Parameters	Unit	Result			Standards
			GW1	GW2	GW3	

Table-4.6 Description of Surface Water Sampling Locations

Station No.	Location	Distance & Direction from project area	Project area / study area	Environmental Setting

Table-4.7 Analysis of Surface Water

S. No.	Parameters	Unit	Result			Standards
			SW1	SW2	SW3	

Table-4.8 Ambient Air Quality Monitoring Stations

Sl. No.	Location	Station Code	Distance & Direction from the lease	Zone (Core / Buffer)	Remarks

Table-4.9 Ambient Air Quality Monitoring

Monitoring Stations Category (R,I,S)	Category of Station	Min.	Max.	Mean	95 Percentile	Min.	Max.	Mean	95 Percentile	Min.	Max.	Mean	95 Percentile	Min.	Max.	Mean	95 Percentile	Min.	Max.	Mean	95 Percentile

SPM : Suspended particulate matter
RSPM : Respirable particulate matter
SO_2 : Sulphur dioxide
NOx : Oxides of nitrogen
CO : Carbon monoxide

R - : Residential Area
I : Industrial Area
S : Sensitive Area

Table 4.10 Description of Noise Monitoring Stations

S. No	Location	Environ-mental Setting*	Average Day noise level (dBA)	Average Night noise level (dBA)	Day time (6.00 A.M. to 10.00 P.M)	Day time (10.00 P.M. to 6.00 A.M)
					Standard (L_{eq} in dBA)	Standard (L_{eq} in dBA)

*Industrial area/ Commercial area /Residential area /Silence zone

Table-4.11 Shrubs/Trees Growing in Core & Buffer Zones

Sl. No.	Plant species	Abundance		Average		Minimum	
		Core Zone	Buffer Zone	Core Zone	Buffer Zone	Core Zone	Buffer Zone
1.							
2.							
3.							
4.							
5.							
	Total						

Table-4.12 Natural Vegetation in Core Zone

Sl. No.	Plant species	Abundance		Average		Minimum	
		Core Zone	Buffer Zone	Core Zone	Buffer Zone	Core Zone	Buffer Zone
1.							
2.							
3.							
4.							
5.							
	Total						

Table-4.13 List of Plants in Study Area

Sl. No.	Plant species	Common Name	Habitant	Family Average	Abundance	Average	Minimum
1.							
2.							
3.							

Table-4.14 Forest Type Patches in Study Area

Sl. No.	Forest Name / Nearest Location	Distance (km) from Project Site	Direction
1.			
2.			
3.			

Table-4.15 Wildlife Species / Avifauna in Study Area

Sl. No.	Common Name	Local Name	Scientific Name	Schedule list as per Wildlife Protection Act

Table-4.16 Demographic Profile

Particulats	With in the project site	With in 1 km from the project boundary
Polulation		
No. of villages		
Number of hoseholds Village-wise		

Table-4.17 Population & Occupational Pattern

Sl. No.	Demographic Feature	Study Area		Share in total Population (%)
		Core Zone	Buffer Zone	
1.0	Population			
2.0	Households			
3.0	Occupation			

Table-4.18 Distribution of Households by Holding size

SL. No.	Holding Size (Acre)	Household %	
		Core Zone	Buffer Zone
1.	Marginal (<2.5)		
2.	Small (2.5-5.0)		
3.	Medium (5.0-10.0)		
4.	Large (= 10.0)		

Table-4.19 Employment and Income

SL. No.	Occupation	Percentage	
		Core Zone	Buffer Zone
1.	Cultivation		
2.	Service		
3.	Private Business		
4.	Wage Laborer		
5.	Others		

Table-5.1 Air Quality (Actual Monitored Date and Predicted Data)

Parameters	Monitoring Station	Station Type	Distance and Direction from the Project Site	Background Concentration in µgm / m^3	Predicted Concentration in µgm / m^3	Resultant Concentration in µgm / m^3	Air Quality Standard µgm / m^3

Table-5.2 Noise Level Prediction

Sl. No.	Village	Background	Nearest	Distance in M	Noise Contribution (dBA)	Result & Noise Level (dBA)
1.						
2.						
3.						

Table-5.3 Calculated Vibration in Nearby Villages

Sl. No.	Village	Nearest Quarry	Distance in Meter	PPV mm / Sec
1.				
2.				
3.				

Table-6.1 Environmental Monitoring Programme

Sl. No.	Environmental Parameter	Nos. of Stations		Frequency of Monitoring
		Core Zone	Buffer Zone	
1.0	Air Quality			
2.0	Meteorology			
3.0	Water Quality			
	a. Surface Water			
	b. Ground Water			
4.	Noise			
5.	Vibration			
6.	Traffic			
7.	Soil Quality			

Table-10.1 Phase wise Greenbelt Development Programme

Sl. No.	Years of Mining	Available land for plantation	Area in ha	Requirement of sapling	Types of Trees proposed
1.	5th Year				
2.	5th to 10th year				
3.	10th to 15th year				
4.	15th to 20th year				
5.	20th to 25th year				
6.	25th to 30th year				

Table-10.2 Biological Reclamation

Sl. No.	Mining	Land Degradation in ha	Afforestation (in ha)				Types of Plants Proposed to be used
			Internal Dump	External Dump	Selected Patches	Total	
1.	5th Year						
2.	5th to 10th year						
3.	10th to 15th year						
4.	15th to 20th year						
5.	20th to 25th year						
6.	25th to 30th year						

ANNEXURES

Annexure 1

Terms of Reference (TOR) for Environmental Impact Assessment of Mining of Minerals Sector

Objectives

Terms of Reference (TOR) for preparation of Environmental Impact Assessment (EIA) and Environmental Management Plan for "Mining of Minerals" as per the EIA Notification, 2006 has been devised to improve the quality of the reports and facilitate decision-making transparent and easy. TOR will help the project proponents and consultants to prepare report with relevant project specific data and easily interpretable information. TOR for mining of minerals is expected to cover all environmental related features.

General Information

Mining of stone and metals has been done since pre-historic times. Mining is the extraction of valuable minerals or other geological materials from the earth, which are processed and / or used for production of materials of economic value. Mining of minerals plays a positive role in the process of country's economic development. In addition to the contribution towards economic growth, mining can also be a major source of degradation of physical as well as social environment, unless it is properly managed.

Environmental impacts can arise during all activities of the mining process. Minimizing the damage due to mining operations depends on sound environmental practices in a framework of balanced environmental legislation. The potential adverse effects of mining activities include air pollution, surface and groundwater pollution, noise and vibration, damage to local ecology, natural topography and drainage, depletion of water resources etc. All these environmental components are required to be considered while selecting a proper methodology of mining, mitigation measures to reduce pollution load, conservation of natural resources etc.

1.0 Introduction

This chapter should cover purpose of the project, project proponent, brief description of the project name, nature, size, location of the project and its importance to the region / country. As per the EIA notification of 14th September 2006 and its amendment dated 1st December 2009, mining projects are divided into two categories as mentioned below:

Project Activity	A Category	B Category	General Condition
Mining of Minerals	=50 ha of mining lease area in respect of non-coal mine lease >150 ha of mining lease area in respect of coal mine lease Asbestos mining irrespective of mining area	<50 ha = 5 ha of mining lease area in respect of non-coal mine lease = 150 ha = 5 ha of mining lease area in respect of coal mine lease	Any project or activity specified in category B will be treated as category A, if located in whole or in part within 10 km from the boundary of: (i) Protected areas notified under the Wildlife (Protection) Act, 1972; (ii) Critically polluted areas as identified by the Central Pollution Control Board from time to time; (iii) Eco-sensitive areas as notified under section 3 of the Environment (Protection) Act, 1986, such as, Mahabaleswar Panchangi, Matheran, Pachmarhi, Dahanu, Doon Valley and (iv) inter-state boundaries and international boundaries Provided that the requirement regarding distance of 10km of the inter-state boundaries can be reduced or completely done away with by an agreement between the respective states or U.Ts sharing the common boundary in the case the activity does not fall within 10 kilometers of the areas mentioned at item (i), (ii) and (iii) above

Profile of the Project Proponent, name and contact address, Implementing Organization, Organizational Chart, Project Consultants etc., should be mentioned clearly.

Land description- plot / survey / khasra numbers, village, tehsil, district, state and extent of the land must be mentioned clearly. The project site should conform to the CRZ guideline or modifications or stipulations made by the Central / State Govt., as applicable.

The proponent should confirm that the project meets all Centre / State / Local regulations and standards applicable for mining of minerals and allied activities.

Any litigations pending against the proposed project and / or any directions or orders passed by any court of law / any statutory authority against the project are to be detailed out.

In case of expansion / modernization of the project, the environmental compliance status for the existing project should be explained.

The EIA-EMP report should be based on maximum mineral extraction capacity and it should be based on generic structure given in Appendix III of EIA Notification, 2006 for the project or its expansion based on the proposed maximum mineral extraction capacity.

The mining projects linked to associated projects such as coal to power plant, limestone to cement plant etc., located within the impact zone are required to take up integrated EIA.

The report, the page numbers of various chapters, sections and sub-sections, tables, appendices, drawings and figures, source of data incorporated should be clearly mentioned etc., with titles should be clearly indicated under the heading contents.

2.0 Project Description

The chapter contains the broader details of the basic activities, location, lay out and implementation schedule of the project.

Background of the Project:

- Location of the project (Longitude, Latitude, revenue village, Tehesil, District, State, nearest Railway station, airport, and MSL)
- Objective of the project (captive mine, standalone etc) whether it is new or expansion (Increase in ML area or increase in annual production) or modernization. Proposed use of minerals (sale, use as intermediates or raw materials). Any change in technology proposed should be specified.
- Significance and relevance of the project highlighting the benefit to surrounding area and economic development of the Local / State / Country.
- Location of National Park, Wildlife sanctuary, migratory routes of wild animals etc. with in 10 km of mine lease area should be authenticated by the Chief Wildlife Warden.

Project details should include:

- Overall note on mineral reserves, rated capacity, life of the mine
- If the lease area / buffer zone is ecologically fragile, a detailed justification is to be given.
- Period of mining lease and calendar programme of ore and waste production.
- Status and stages of other regulatory clearances like approval of mining plan, forest clearance, consent to establish from State Pollution Control Board etc.
- In case of expansion / modernization, compliance of the statutory conditions given by SPCB, MoEF, DGMS, FC etc.
- Solid waste dumping strategy and management
- Energy demand / specific energy consumption
- Water requirement and reliability of its supply
- Manpower recruitment
- Capital cost estimate
- Market conditions vis a vis validity of the project

Essential Toposheets / Maps to be Provided with TOR Application

Topographical map

A topographical map 1:25,000 scale (if not available in 1:50000) of the study area (core zone and 10 km area of the buffer zone from boundary of the core zone) delineating the major topographical features such as land use, drainage, locations of habitats, major constructions including roads, railways, pipelines, major industries if any in the area are to be mentioned.

A topographical map, covering aerial distance of 15 km from the proposed project location and delineating environmental sensitive areas as specified in Form I of EIA Notification dated 14th Sep 06. In the same map the details of environmental sensitive areas present within a radial distance of 1 km from the project boundary should be specifically shown

Remote Sensing Imagery

Land use and land cover map of the study area in 1: 25,000 scales based on recent satellite imagery of 5.6 m or higher resolution of multispectral sensor delineating double crop, single crop, agricultural plantation, scrub land , land with or without shrub, forest land – dense, open, degraded, forest blank, waste land, water bodies, builtup area is to be shown.

Digital Elevation Model (DEM) / slope / Contour maps

- Contour / slope map, as required for the study of core zone and site plan of the area showing the various proposed break-up of the land.
- Description of the project site, geology, topography, hydrology, climate, transport and connectivity, demographic aspects, socio-cultural and economic aspects, villages, settlements, meteorological data.
- Notified restrictions and limitations from environmental considerations etc., if any.
- Environmental data relating to history of natural calamity such as cyclones, storms surges Coastal areas), tornado, flood, etc. should be discussed,

The project description should include

- Geology (Regional and Local)
- Reserves and quality of the ore with chemical composition (Grade or Percentage). Associated minerals, if any, should be mentioned.
- Deposit condition such as ore strength, host rock strength, shape, grade, dip, size, uniformity and depth.
- General description of the project with ancillary operations such as crushing, beneficiation etc.
- Surface geological plan in the leasehold area, transverse section of mineral deposits, contour maps at intervals of not more than 03 meters
- Breakup of land use of leasehold area
- Project falling on Coastal Zone for mining in coastal area. Details of Coastal Zone Classification, Low Tide Line (LTL), High Tide Line (HTL), characteristics of beach
- Drawing (Digitized) showing project layout, components of project, leasehold area

- Type (Open cast, Underground or Both) and method of mining (Manual, Semi-mechanized or mechanized)
- Nearness to a large water body.
- Mode of transportation of ore and waste
- Hydrology of the area and calculation for mine seepage water and Groundwater drawdown

Open Cast Mining

- Deposit conditions
- Maximum allowable stripping ratio (ratio of overburden in m3 to mineral in ton), thickness of top soil and overburden (minimum, maximum and average),
- Working depth (below ground level and Mean Sea Level)
- Mining Plan (Height and Width of the benches in overburden, ore body, proposed inclination / slope of the sides),
- Surface plan showing mine working 5rd year, 10th year, 15th year, 20th year, 25th year, 30th year as per the approved mine plan.
- Type of blasting, drilling and explosives
- Detail of machineries (mining ,transportation, and material handling) with production capacity
- Plan for backfilling of mine pit.
- Overburden dumps stability study and reclamation.

Underground Mining

- Deposit conditions
- Mode of entry to the mine (Shaft, Adit, Incline)
- Details of machineries in underground and on surface
- Method of mine development and stoping
- Subsidence (Maximum predicted subsidence, max. slope change, impact on surface features like natural drainage pattern, houses water bodies, water table etc.)
- Mine drainage water management details
- Ventilation system for adequate control of quality and quantity of air underground

General Features

- Surface drainage pattern at mine site (modification / diversion in the existing drainage pattern)
- Mineral transportation outside mining lease area (road, rail, conveyor, Rope way, waterway, pipeline, others etc.)
- Beneficiation, Crushing, Processing etc. (process flow)

- Township description, (area, dwelling units, distance from mine, distance of water bodies)
- Power and water supply

3.0 Analysis of alternatives

This should be project specific and decided during the scoping process.

4.0 Description of the Environment/ Baseline Environmental Status

Environmental data to be collected in relation to proposed mining would be: (a) land (b) water (c) air (d) biological (e) noise and vibration (f) socio economic (g) health environment etc.

Study area:

Study area for the mining projects should be defined as follows:

- Mine lease area should be the "core zone"
- 10 km radius from the boundary limits of the mine lease area of more than 50 hectares should be the "buffer zone".
- 5km radius from the boundary limits of mine lease area of 5-50 hectares should be "buffer zone".
- Maps (appropriate scale) of the study area (core and buffer zone), clearly delineating the locations of various monitoring stations (air / water / noise / soil), superimposed on locations of habitats are to be shown.
- Indicate 2km, 5km distance from the boundary limits of mine lease by appropriate line.
- Monitoring and testing should be done as per guidelines of CPCB / MOEF.

Baseline information is required to be collected by field survey, monitoring etc. Secondary data with source should be clearly mentioned. Normally, one season monitoring data (excluding monsoon) are to be collected. However, Expert Appraisal Committee (EPC) may specify collection of baseline data for a longer period base on the nature, size and location of the project.

4.1 Land Environment

Pre-mining land use pattern of (agricultural land / forest land / grazing land / wasteland / water bodies / settlement) of the area is to be detailed out. Details of mineral resources, geological status of the study area and the deposit to be worked, ultimate working depth and progressive stage wise working plan / scheme until the end of the mine life should be mentioned on the basis of the approved rates capacity and calendar plan (s) of production. From the approved mining plan, geological maps should be drawn.

Land

Baseline data on land, of mine leased-area is to be described. Total land available and proposed utilization for different purposes including built-up area be given. Justification of the use of area is to be given.

Topography

Topography the study area through topographical maps (1: 50000), showing all relevant details required for assessment of the proposed activities. Description in relation to following be given

- Slope and elevation
- Natural drainage pattern and water bodies
- Land use pattern (habitation, cropping, forest cover, ecologically sensitive features etc. by employing remote sensing techniques (If available)

Geology

Geology of the area is to ascertain seismic sensitivity. It also defines the layers of geological formations, from which the permeability and possible faults and fissures can be known.

Soil

The study should include

- Soil quality at representative monitoring stations (type, classification, soil characteristics etc.)
- Fertility status of soil samples
- Pre-mining land use pattern, cropping pattern, vegetation cover etc. (remote sensing data)

4.2 Air Environment

The study should include the following;

- Climate and meteorology (temperature (max. and min.), relative humidity, and rainfall) indicate the nearest IMD meteorological station from which climatological data have been obtained.
- Wind rose (Wind directions and speeds, 24 hourly data)
- Air quality monitoring data in respect of SPM, RSPM, SO2, NOX, CO, Heavy Metals in SPM (Mineralogical Fe, Mn, Pb etc.), any other project specific pollutants. Monitoring should cover one full season except monsoon. Frequency and methodology adopted should be as per CPCB/MOEF guidelines.
- Monitoring stations are to be located based on dominating wind directions, habitations and terrain features in the study area. The monitoring stations should cover upwind, downwind, crosswind, core zone, habitations and sensitive areas.

4.3 Water Environment

Sources of water (river, groundwater, mine water, other surface water), their requirement, and utilization for various operational need of the project, at different stages are to be discussed.

A detailed water balance should be provided. The breakup of water requirement as per different activities in the mining operations should be given separately. Approval of competent authority for utilization of ground and surface water should be provided.

Surface Water

The study should cover the following;

- Locations of representative monitoring stations showing direction and distance from the mine lease site
- Details of rivers, springs, lakes, reservoirs and drains up to first order in study area.
- Physio-chemical analysis including heavy metals, biological, bacteriological characterization for assessment of water quality. Water quality of water body with respect to upstream and downstream should be covered.
- Delineation of water sheds and water drainage pattern in the study area using remote sensing satellite imageries
- Surface water balance (Withdrawal of surface water and release of mine drainage water)
- Lean season flow of the nallah from where water is drawn

Groundwater

Since the mining is excavation of the earth, the groundwater is affected to a great extent.

The study should include;

- Groundwater potential, recharge and budgeting
- Hydrogeology and aquifer characteristics of the area
- Groundwater quality, groundwater potential of the area and its availability, groundwater table (pre monsoon and post monsoon)
- The details of locations of groundwater observation wells with respect to core zone should be described.
- The monitoring stations should cover the whole study area

Additional Information

- Water bodies existing and water bodies likely to be created due to mining activities
- Water requirement and waste water generation from various activities of mine, including township, beneficiation etc.
- Waste water treatment, recycling and reuse

4.4 Noise Environment

The study should include

- Locations of monitoring stations for noise measurements in accordance with the direction and distance from the sources and habitations.
- Day-time and night-time noise level monitoring (leq)
- Vibration and air over pressure, caused due to blasting, transport and process equipments, wherever applicable

4.5 Biological Environment

Information on flora and fauna within the study area should be given separately

Flora

- Detail description of vegetation type in core and buffer zone (include photograph)
- Assessment of plant species with respect to their dominance, density, frequency, abundance, diversity index, similarity index, importance value Index.
- Quantitative estimation of forest and non-forest flora
- Type of forest in study area and its conservation status.
- Information on the dependence of local people on minor forest products
- Location of National Parks, Sanctuary, Biosphere Reserve, Tiger Reserve, Elephant Reserve, wild life migratory routes in core and buffer zones

Fauna

- Assessment of fauna and avi-fauna.
- List out endangered and endemic species as per the schedule of the Wildlife Protection Act, 1972
- Information on breeding and hibernating sites in core and buffer zone.

4.6 Socio- Economic Environment

The baseline study should cover the following

- Data on demography, traditional skills, sources of livelihood within the study area
- Socio-economic profile of the people with in 2, 5 and 10 km from the mine.
- Human settlement, health status, sources of livelihood
- Data relating to historically, culturally and ecologically important places in core as well as buffer areas
- Information on notified tribal settlements, if any
- Details of private lands with ownership in the core area indicating financial loss annually
- Health status of the population in the study area

4.7 Waste Generation

The report should cover the following

- Solid waste from mining and processing operations, their quality and quantity (overburden, low-grade ore etc.) Quantity and quality of associated minerals and possible recovery
- Top soil quantity , quality and its management
- If waste contain any hazardous / toxic / radioactive substances or heavy metals, then details
- Recovery and recycling possibilities
- Site features of locations of waste storage and disposal

- Leaching properties of overburden and other solid waste
- Solid waste generation from Effluent Treatment Plant township, hospitals etc.

Any specific inputs which are likely to be added the site and its surroundings. Salient feature of the area, which require specific study.

Specific Condition	Study Required
Nearness to Water Body / reservoir	Detail Hydrogeology and Hydrology
Nearness to Forest /	Detail Conservation Plan
Nearness to Township	Blasting Vibration Study
Groundwater Scarcity Area	Details of Groundwater Recharge

5.0 Anticipated Impacts and Mitigation Measures

This chapter should describe the likely impact on each of the identified environmental component by adopting methods such as mathematical model, empirical method, reference of previous studies etc., Details of mitigation measures proposed in the project (site specific) to minimize the adverse effect, should be discussed. The information should cover mine development, operation and closure phases of the project, as applicable.

5.1 Land Environment

Anticipated Impact:

- Impact on topography, drainage pattern, land use with respect to agriculture, forestry, built-up area etc.
- Impact on soil quality and agriculture
- Soil erosion
- Subsidence
- Visual Impact on surrounding environment

Mitigation Measures:

- Plan for restoration / rehabilitation of mined-out area
- Technological measures to prevent soil erosion from core and buffer zones
- Plantation / afforestation of local varieties of plants
- Measures to control and conserve runoff from various locations.
- Landscaping, plantation, aforestation to minimize adverse visual and noise impact

5.2 Air Environment

Impact of mineral transportation within and outside the lease. The entire sequence of mineral production, transportation, handling, transfer and storage of minerals and wastes and the impacts on air quality is to be shown in a flowchart with specific points where fugitive emissions can arise and specific pollution control / mitigative measures are proposed to be put in place. The adequacy of roads existing in the area and if new roads are to be laid the impact of the construction of roads particularly if it is crossing forest lands.

Anticipated Impact:

- Emission Inventory of SPM, RSPM, SO2, NOX, and site specific pollutants
- Prediction of fugitive dust emissions due to mining activities, crushing and cleaning plants, loading and unloading, transportation by rail, road or conveyor.
- Impact of fugitive dust emission on flora and fauna

Prediction of impact on ambient air quality using appropriate mathematical model (area, point and line sources). Description of model, input requirements and reference of derivation. Isopleths distribution of major pollutants and their analysis and presentation in tabular form / base map.

Mitigation Measures:

- Measures to reduce the emissions of pollutants during mining, loading, unloading, transportation, drilling, blasting, crushing etc to maintain the air quality
- Adoption scientific mining methods to reduce dust emission from point and line source
- Planned green belt development

5.3 Water Environment (surface and groundwater)

Impact of mining on hydrology, changes of natural drainage, diversion and channeling of the existing rivers / water courses flowing through the mine lease and adjoining area and its impacts on existing users and mine operations.

Impact of water drawal and mine water discharge on the hydrogeology and use of groundwater regime in the core zone and buffer zone are to be detailed out. Long- term modeling studies on the impact of mining on the undergroundwater regime should be carried out.

Anticipated Impact:

- Impact on groundwater regime / streams / lake / springs due to mining, to be assessed from hydro-geological study
- Impact of water drawal on surface and groundwater resources
- Impact on surface and groundwater quality due to discharges from mining, tailings pond, workshop, township, leachate from solid waste dumps etc.
- Ingress of sea water, particularly for mining projects in coastal areas.

Mitigation Measures:

- Measures to minimize contamination of surface and groundwater
- Construction of gully checks, check dams, sedimentation ponds, settling tanks, water weirs, retaining walls etc. with design and site features for control of run-off
- Mine water treatment for meeting the prescribed standard
- Slope stabilization by constructing retaining walls, vegetation etc.
- Steps to minimize impact on water table if mining intercepts groundwater regime.
- Wastewater treatment for township sewage, workshop(s), tailing pond overflow etc.

5.4 Noise Environment

Anticipated Impact:

- Prediction of noise level by using mathematical modeling at different representative monitoring stations
- Impact of vibrations including damage to materials/structures due to blasting
- Impact on ambient noise level due to rock excavation, transportation, processing equipments and ancilliaries.

Mitigation Measures:

- Measures for noise abatement including point source and line source
- Measures to minimize effect by blasting
- Lay out planning to minimize the impact on receiving environment
- Planned preventive maintenance
- Selection of low noise equipment failing which use of retrofit for existing equipment

5.5 Biological Environment

Anticipated Impact (Flora and Fauna):

- Impact on forest resources, economically important plants, medicinal plants and threat to rare, endemic and endangered species
- Impact on terrestrial and aquatic biodiversity
- Impact on wildlife including avi-fauna
- Impact on wildlife habitat and migratory corridors
- Impact on flora and fauna due to air emissions, noise, vibration, illumination, vehicular movement, waste water discharges, changes in land use, township etc.

Mitigation Measures:

- Measures to compensate the loss of forest coverage
- Regeneration of rare and endangered plants of economic importance including medicinal plants.
- Measures for protection and conservation of wildlife species
- Green belt and its raising schedule
- Progressive afforestation in overburden, reclaimed mined out areas

5.6 Socio- Economic Environment

Anticipated Impact:

- Displacement of human settlements during the life of the mine
- Positive and negative impacts on present status of livelihood in the area
- Impact on the cropping pattern and crop productivity in the buffer zone
- Impact on community resources such as grazing land

Mitigation Measures:

- Rehabilitation and resettlement of land oustees and displaced people
- Compensation for loss of land and crops
- Training to locals for employment in the project
- Employment opportunities and access to other amenities such as education, health care facilities to be extended to locals

5.7 Mine Wastes

Anticipated Impact:

- Impact of runoff from overburden, top soil, low-grade ore and other stock piles on water bodies (siltation, contamination etc)
- Loss of vegetation and wildlife habitat
- Impact on surrounding agricultural land
- Impact on groundwater quality due to leachate
- Sliding of waste dump
- Impact of hazardous wastes and liquids

Mitigation Measures:

- Land reclamation and mine closure plan
- Overburden dumps stabilization to minimize impact due to runoff
- Overburden utilization for back-filling and other purposes. Simulation model with 5 years projection with digitized maps
- Municipal solid waste management in township
- Measures to control runoff from waste dumps and mining surface.
- Hazardous waste management as per regulatory guidelines

6.0 Environmental Monitoring Program

In order to focus on environmental management during project implementation and execution stage, the project proponent is required to spell out detailed plan and should include the following;

- Monitoring of quality of water, air, noise, vibration and occupational health status of project personnel and surrounding habitations.
- Planned monitoring program to evaluate the effectiveness of various / specific aspects of technological / mitigation measures.
- Environmental audit of various activities including budgeting and financial management with reference to environmental management.
- Hydrogeological monitoring for the entire mine life and restrictive monitoring during reclamation.
- Plantation monitoring programme to ensure survival and growth rate of plantations.

- Analysis of data, its interpretation and evaluation (any additional studies to be carried out if required)
- Mine closure plan along with the fund requirement for implementation of the activities proposed there under.

7.0 Additional Studies

7.1 Public consultation

Public hearing with the issues raised by the public and the response of the project proponent in tabular form should be discussed

7.2 Risk Assessment (RA) and Disaster Management Plan (DMP)

Mining activities are always associated with risk relating to hazards and accidents. Therefore risk analysis and risk mitigation should be clearly indicated in the report. This should include the following:

- Identification and type of risk associated with mining (slope failure, subsidence, fly rock fragments, fires, toxic / hazardous / flammable gas release / explosion, inundation etc.)
- Details of safety measures to prevent accident and disaster
- Disaster management plan and emergency response system with proper organizational setup to deal with such situation.
- Disaster management plan for safe mining particularly for underground mines where toxic fumes and other risks are involved.
- Occupational health risks

7.3 Natural Resource Conservation

Plan of action for conservation of natural resources and recycle waste materials due to the project activity in the construction and operational phase of the project is to be discussed. Energy efficiency measures in the activity are to be drawn up.

7.4 R & R Action Plan

Detailed R & R plan with data on the existing socio-economic status of the population in the study area and broad plan for resettlement of the displaced population, site for the resettlement colony, alternative livelihood concerns / employment for the displaced people, civil and housing amenities being offered, etc and the schedule of the implementation of the project specific R & R Plan if any is to be given. Details of provisions (capital and recurring) for the project specific R & R Plan and monitoring mechanism for the implementation of the plan. Details of Corporate Social Responsibility activities and cost provisions (capital and recurrent per annum over the life of the project)

8.0 Project Benefits

This section describes the improvements in physical and social infrastructure. It details out the employment potential and other benefits that are accrued.

9.0 Environmental Cost-Benefit Analysis

The environmental cost-benefit analysis is to be taken up if recommended in the scoping stage.

10.0 Environmental Management Plan (EMP)

- Administrative and technical set up for management of environment
- Mechanism of self monitoring for compliance with environmental regulations
- Institutional arrangements proposed with other organizations / Govt. authorities for effective implementation of proposed environmental management plan
- Conservation plan for the endangered / endemic flora and fauna found in the study area and for safety of animals visiting / residing in the study area and also those in the migratory corridor.
- Integrating in the environmental management plan measures for minimising use of natural resources – water, land, energy etc.

11.0 Summary and Conclusion (Summary EIA)

The summary should be a clear presentation of the finding of critical environmental issues and their resolutions. Whenever possible, the summary should make use of base maps, tables and figures. Information should be succinct with meaningful presentations. It must be able to stand alone as a document. It should necessarily cover the following:

- Introduction
- Project description and Project benefits
- Anticipated environmental impacts and mitigation measures
- Additional studies
- Environmental Monitoring Program
- Environmental Management Plan
- Risk Assessment (RA) and Disaster Management Plan (DMP)

12.0 Disclosure of Consultants Engaged

The team of consultants engaged in this project is to be given.

Enclosures

Feasibility Report /Questionnaire / Photos and plate of the Project Site

Annexure 2

Land Use / Land Cover Classification System

Level -I	Level -II	Level -III
1. Built – up land	1.1. Built –up land	1.1.1. Urban (towns & cities)
2. Agricultural land	2.1. Crop land	2.1.1 Irrigated crop land
	(i) Kharif (ii) Rabi (iii) Double cropped	2.1.2. Unirrigated crop land
	2.2. Fallow	2.2.1. Fallow
	2.3. Plantation	2.3.1. Types of plantation, casuarina, coconut, tea etc.
3. Forest	3.1 Evergreen / semi-evergreen	3.1.1. Dense / closed
		3.1.2. Open
	3.2. Deciduous	
	3.3. Degraded scrub land	
	3.4. Forest blank	3.4.1 Degraded forest
		3.4.2. Forest blank
	3.5. Forest plantation	3.5.1. Types of plantatin eg. teak, sal etc.
	3.6. Mangrove	
4. Wastelands	4.1. Salt affected land	
	4.2. Water logged land	
	4.3. Marshy / swampy land	
	4.4. Gullied / ravinous land	
	4.5. Land with or without scrub	
	4.6. Sandy area (coastal & desertic)	Minimum mappable unit IS 2.25 hectares on 1:50,000 scale
	4.7. Barren rocky / stony waste / sheet rock areas	
5. Water bodies	5.1. River / stream	
	5.2 Lake / reservoir / tank / canal	
6. Others	6.1. Shifting cultivation	6.1.1. Current
		6.1.2. Old / abandoned
	6.2. grassland / grazing land	6.2.1. Grassland / grazing land
	6.3. Snow covered / glacial area	6.3.1. Snow covered / glacial area
	6.4. Mining area	6.4.1. Mining dumps

Note: Land use / Land cover categories at different levels and corresponding scales for mapping are as follows:

Level – I	–	categories	–	1:1000,000 scale
Level – II	–	categories	–	1:250,000 scale
Level – III	–	categories	–	1:50,000 scale and 1:25,000 scale

(Sources: Description and classification of land use / land cover : NRSA – TR – LU & CD – 01 –90)

Annexure 3

Sampling, Frequency & Method of Baseline Environment Monitoring

Attributes	Sampling		Measurement Method	Remarks
A. Air Environment	Network	Frequency		
Meteorological ▸ Wind speed ▸ Wind direction ▸ Maximum temperature ▸ Minimum temperature ▸ Relative humidity ▸ Rainfall ▸ Solar radiation ▸ Cloud cover ▸ Environmental Lapse Rate	1 site in the project area	1 hourly continuous	Mechanical / automatic weather station Max / Min Thermometer Hygrometer Rain gauge As per IMD specifications As per IMD specifications Mini Sonde / SODAR	IS 5182 Part 1-20 Site specific primary data is essential Secondary data from IMD CPCB guidelines
Pollutants ▸ PM (10)	Nos. of sampling location to be decided	24 hourly twice a week	As per CPCB guidelines	Monitoring Network ▸ Minimum one locations in upwind side, two sites in downwind side / impact zone
▸ PM (2.5)		@4 hourly. Twice a week, One non monsoon season		▸ All the sensitive receptors need to be covered for core zone and buffer zone
▸ SO_2		8 hourly, twice a week		
▸ NO_x				
▸ Lead in PM		24 hourly, twice a week		
B. Noise	Network	Frequency		
▸ Hourly equivalent noise levels	Identified study area	Once in season	Noise level meter	IS:4954-1968 as adopted by CPCB
▸ Peak particle velocity	150-200m from blast site	Once	PPV meter	

Attributes	Sampling		Measurement Method	Remarks
C. Water				
Parameters for water quality ▸ pH, temperature, turbidity, magnesium hardness, total alkalinity, chloride, sulphate, nitrate, fluoride, sodium, potassium, salinity ▸ Total nitrogen, total phosphorus, DO, BOD, COD ▸ Heavy metals ▸ Total coliforms, faecal coliforms ▸ Phyto plankton	▸ Set of grab samples for ground and surface water		Samples for water quality should be collected and analysed as per : ▸ IS : 2488 (Part 1-5) methods for sampling and testing of Industrial effluents ▸ Standard methods for examination of water and wastewater analysis published by American Public Health Association.	
D. Land environment				
Soil ▸ Organic Matter ▸ Texture ▸ pH ▸ Electrical conductivity ▸ Permeability ▸ Water holding capacity ▸ Porosity	Sample from villages (soil samples be collected as per BIS specifications)	One season	Collected and analysed as per soil analysis reference	Analysis be done as per BIS specifications

Adopted from: EIA manual 2001, Ministry of Environment and forests, New Delhi

Annexure 4
Ground Water Estimation Committee Report (GEC – 1997)

Sl. No	Stage of ground Water Development	Category
1	<65%	Safe
2	>65% to <85%	Semi-critical
3	>85% to <100%	Critical
4	>100%	Over exploited

Source:- Report of Groundwater estimation committee, groundwater resource estimation methodology, 1997, Ministry of Water Resources, Government of India, New Delhi.

Annexure 5

Criteria for Raw Water used for Organized Community Water Supplies (Surface and Ground Water) Primary Parameters

Parameters	Range/Limiting Value		Note
	Use with only disinfection	Use after conventional treatment	
1. pH	6.5 to 8.5	6.0 to 9.0	To ensure prevention of corrosion in treatment plant and distribution system and interference in coagulation and chlorinating.
2. Colour Pt. scale Hz Units	< 10	< 50	Color may not get totally removed during treatment
3. Suspended Solids mg/l	< 10	< 50	High SS may increase the cost of treatment.
4. Odour, dilution factor	< 3	< 10	May not be tackled during treatment.
5. DO, (%saturation)	90-100	80-120	May imply higher chlorine demand.
6. BOD, mg/l	< 3	< 5	Same as above.
7. TKN, mg/l	< 1	< 3	Same as above.
8. Ammonia, mg/l	< 0.05	< 1	Same as above.
9. Faecal coliform MPN/ 100 ml	< 200	< 2000	Not more than 20% samples show greater than limit.
10. EC, µm/hos/cm	< 2000	< 2000	High conductivity implies dissolved high solids making water unpalatable.
11. Chloride, mg/l	< 300	< 300	May cause physiological impact and unpalatable taste.
12. Sulphates, mg/l	< 250	<250	May cause digestive problems
13. Phosphates, mg/l	< 0.7	< 1.0	May interfere with coagulation
14. Nitrate, mg/l	< 50	< 50	May cause methamoplobinemea
15. Fluoride, mg/l	< 1.0	< 1.5	Higher value shall cause fluorosis and lower value shall carries.
16. Surfactants, mg/l	< 0.2	< 0.2	May impair treatability and cause foaming.

Additional Parameters for Periodic Monitoring (Seasonal – Only to be done when there are known natural or anthropogenic sources in the upstream catchment region likely or apprehended to contribute or other well founded apprehensions)

Parameters	Desirable	Acceptable	Note
Dissolved Iron mg/l	< 0.3	< 0.5	Affect taste and cause stains
Copper, mg/l	—	< 1.0	May cause live damage
Zinc, mg/l	—	< 5.0	Cause bitter stringent taste
Arsenic, mg/l	< 0.01	< 0.05	Cause hyperkeratosis & skin cancer
Cadmium, mg/l	< 0.001	< 0.005	Toxic
Total Chromium, mg/l	< 0.05	< 0.05	Toxic
Lead, mg/l	< 0.05	< 0.05	Physiological abnormality
Selenium, mg/l	< 0.01	< 0.01	Toxic symptoms similar to arsenic
Mercury, mg/l	< 0.005	<0.0005	Carcinogenic and poisonous
Phenols, mg/l Cyanides, mg/l	< 0.001 < 0.05	< 0.001 < 0.05	Toxic and cause taste and odour problem Physiological abnormality
PAH, mg/l	< 0.0002	< 0.0002	Carcinogenic
Total Pesticides, mg/l	< 0.001	< 0.0025	Trend to bioaccumulates & carcinogenic

(Source: Ecological Impact Assessment Series: EIAS/03/2002-03 Published by CPCB)

Use based classification of surface waters in India

Designated-Best-Use	Class of water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	1. Total Coliforms OrganismMPN/100ml shall be 50 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 6mg/l or more 4. Biochemical Oxygen Demand 5 days 20oC 2mg/l or less
Outdoor bathing (Organized)	B	1. Total Coliforms Organism MPN/100ml shall be 500 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 5mg/l or more 4. Biochemical Oxygen Demand 5 days 20oC 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	1. Total Coliforms Organism MPN/100ml shall be 5000 or less 2. pH between 6 to 9 3. Dissolved Oxygen 4mg/l or more 4. Biochemical Oxygen Demand 5 days 20oC 3mg/l or less
Propagation of Wild life and Fisheries	D	1. pH between 6.5 to 8.5 2. Dissolved Oxygen 4mg/l or more 3. Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	1. pH between 6.0 to 8.5 2. Electrical Conductivity at 25oC micro mhos/cm Max.2250 3. Sodium absorption Ratio Max. 26 4. Boron Max. 2mg/l

(Source: Guidelines for Water Quality Management –CPCB 2008)

Annexure 6

National Ambient Air Quality Standards

S. No	Pollutants	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Areas	Ecologically Sensitive Area (notified by Central Government)	Methods of Measurement
1.	2.	3.	4.	5.	6.
1	Sulphur Dioxide (SO_2), $\mu g/m^3$	Annual*	50	20	Improved west & Gaeke
		24 hours**	80	80	Ultraviolet fluorescence
2	Nitrogen Dioxide (NO_x), $\mu g/m^3$	Annual*	40	30	- Modified Jacob &
		24 hours**	80	80	Hochhieser (Na-Arsenite) - Chemiluminescence
3	Particulate Matter (size less than 10 ìm) or PM_{10}, $\mu g/m^3$	Annual*	60	60	- Gravimetric
		24 hours**	100	100	- TOEM - Beta Attenuation
4	Particulate Matter or (size less than 2.5 ìm) $PM_{2.5}$, $\mu g/m^3$	Annual*	40	40	- Gravimetric
		24 hours**	60	60	- TOEM - Beta Attenuation
5	Ozone (O_3), $\mu g/m^3$	8 hours**	100	100	- UV Photometric
		1 hour**	180	180	- Chemiluminescence - Chemical method
6	Lead (Pb), $\mu g/m^3$	Annual*	0.50	0.50	- AAS/ICP method after
		24 hours**	1.0	1.0	sampling on EPM 2000 or equivalent filter paper - ED-XRF using Teflon filter
7	Carbon Monoxide (CO), mg/m^3	8 hours**	02	02	- Non-Dispersive Infra
		1 hour**	04	04	Red (NDIR) Spectroscopy
8	Ammonia (NH_3), $\mu g/m^3$-	Annual*	100	100	- Chemiluminescence
		24 hours**	400	400	Indophenol blue method
9	Benzene (C_6H_6), $\mu g/m^3$	Annual*	05	05	- Gas Chromatography based continuous analyzer - Adsorption and Desorption followed by GC analysis
10	Benzo(O)Pyrene Particulate phae only, ng/m^3	Annual*	01	01	- solvent extraction (BaP) – followed by HPLC/GC analysis

11	Arsenic (As), ng/m^3	Annual*	06	06	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni), ng/m^3	Annual*	20	20	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper

* 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 8 hourly or 1 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.

Note:

Whenever and wherever monitoring takes place for two corrective days exceeds and the limit as specified above for the respective category, it shall be considered adequate reason to institute regular/continuous monitoring for further investigations.

(Source: CPCB notification Dated 18th November 2009)

Annexure 7

Ambient Air Quality Standards in respect of Noise

Area code	Category of Area	Limits in db (A) Leq	
		Day time	Night time
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silence zone	50	40

Note:

1. Day time shall mean from 6.00 a.m. to 10.00 p.m.
2. Night time shall mean from 10.00 p.m. to 6.00 a.m.
3. Silence zone is an area comprising not less than 100 meters around hospitals, educational institutions, courts, religious places or any other area, which is declared as such by the competent authority.
4. Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority.

* dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

A "decibel" is a unit in which noise is measured.

"A", in dB(A) L_{eq}, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

L_{eq}: It is an energy mean of the noise level over a specified period.

(Source: Noise pollution (Regulation and control) Rules, 2000)

Annexure 8
Parameters of Impacts

SL. No.	Parameter of Impact	Description
1.	Type	Positive & Negative
2.	Nature	Direct, Indirect,
3.	Magnitude	Low, Moderate, High
4.	Timing	Short time, Longtime, Intermittent,
5.	Duration	Temporary / Permanent
6.	Reversibility	Revisable / Irreversible
7.	Significance	Local, regional & global

Annexure 9
Potential Impact of Mining on Land

Sl. No.	Impact	Significance
1.	Site Features Human habitation in core & buffer zone.	If human settlement is high, the impact due to displacement is significant.
2.	Forest in core and buffer zone	The significance of impact depends on following ▸ Area supporting unique habitat, endemic, threatened & declining spices. ▸ In case of degraded forest, impact on land would be less compared to dense forest.
3.	Quantity and characteristics of top soil	Impact is significant
4.	Contour of core zone.	Decides the runoff pattern. Change in topography and drainage pattern.
5.	Direction of run off in the mine lease and nearest river and water bodies.	The direction also indicate the type of land area (Agricultural field etc.) & Magnitude of impact on land can be assessed.
6.	Erosion Potential and terrain	If the proposed mine is located on hill / hillock & foothill has human habitation and agricultural land, the impact is high.
7.	Stripping Ratio	High stripping ratio indicates requirement of more land for storage of over burden.
8.	Depth of Mine and type of mining	Subsistence / Mine drainage water discharge.
9.	Characteristics of waste and mine drainage water	If mine waste contains heavy metals, leachate (acidic mine drainage waste) likely to have significant impact on land.

Annexure 10
Potential Impact of Mining on Water Regime

Sl. No.	Impact	Significance
1.	Mine in immediate catchment area of river.	Impact on water regime is high.
2.	Interruption of natural drain	Impact on disturbance in natural drainage is considered to be high. Realignment for diversion requires special attention.
3.	Rainfall & contour of mining area	The nearby nallah is likely to experience high siltation. The contour decide the runoff pattern of catchment area. Also indicate erosion potential. All have significant impact on water resources.
4.	Overburden quality and characteristics of waste	High risk of water pollution if it contains toxic metal or acidic.
5.	Surface water source	Impact on surface water due to water drawl for mining and township.
6.	Ground water sources	(a) Mines have significant impact on ground water resources. (b) If natural perennial springs are located in study area, the impact is likely to be high.
7.	Discharge of mine drainage water	Composition of mine drainage water and volume is considered to estimate the degree of probable contamination in receiving water body.
9.	Discharge of sewage from township / offices etc.	The sewage discharge from township & services have significant impact on water quality.

Annexure - 11

General Standards for Discharge of Effluents

S. No	Parameter	Standards			
		Inland surface water (a)	Public sewers (b)	Land for irrigation (c)	Marine coastal areas (d)
1	Color & odour	*	–	*	*
2	Suspended solids mg/l, Max	100	600	200	1. For process waste water-100 2. For cooling water effluent 10% above total suspended matter of inffluent
3	Particle size of suspended solids	Shall pass 850 Micron IS sieve	—	—	1. Floatable solids max. 3 mm 2. Settleable solids max. 850 microns
4	pH Value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
5	Temperature	Shall not exceed 5^0 C above the receiving water temperature	—	—	Shall not exceed 5^0 C above the receiving water temperature
6	Oil and grease mg/l Max.	10	20	10	20
7	Total residual chlorine mg/l Max.	1.0	—	—	1.0
8	Ammonical Nitrogen (as N), mg/l Max.	50	50	—	50
9	Total Kjeldahl nitrogen (as NH_3), mg/l Max.	100	—	—	100
10	Free ammonia (as NH_3), mg/l Max.	5.0	—	—	5.0
11	Bio-chemical oxygen demand (3 days at 27^0 C), mg/l max.	30	350	100	100
12	Chemical oxygen demand, mg/l max.	250	—	—	250
13	Arsenic (as As), mg/l max.	0.2	0.2	0.2	0.2
14	Mercury (as Hg), mg/l max.	0.01	0.01	—	0.01
15	Lead (as Pb), mg/l max.	0.1	1.0	—	2.0
16	Cadmium (as Cd), mg/l max.	2.0	1.0	—	2.0

S. No	Parameter	Standards			
		Inland surface water (a)	Public sewers (b)	Land for irrigation (c)	Marine coastal areas (d)
17	Hexavalent chromium (as Cr +6), mg/l max.	0.1	2.0	—	1.0
18	Total chromium (as Cr), mg/l max.	2.0	2.0	—	2.0
19	Copper (as Cu), mg/l max.	3.0	3.0	—	3.0
20	Zinc (as Zn), mg/l max.	5.0	15	—	15
21	Selenium (as Se), mg/l max.	0.05	0.05	—	0.05
22	Nickel (as Ni), mg/l max.	3.0	3.0	—	5.0
23	Cyanide (as CN), mg/l max.	0.2	2.0	0.2	0.2
24	Fluoride (as F), mg/l max.	2.0	15	—	15
25	Dissolved phosphates (as P), mg/l max.	5.0	—	—	—
26	Sulphide (as S), mg/l max.	2.0	—	—	5.0
27	Phenolic compounds (as C_6H_5OH), mg/l max	1.0	5.0	—	5.0
28	**Radio active materials**: a. Alpha emitter micro curie/ml	10^{-7}	10^{-7}	10^{-8}	10^{-7}
	b. Beta emitter micro curie/ml	10^{-6}	10^{-6}	10^{-7}	10^{-6}
29	Bio-assay test	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent
30	Manganese (as Mn), mg/l	2	2	—	2
31	Iron (as Fe), mg/l	3	3	—	3
32	Vanadium (as V), mg/l	0.2	0.2	—	0.2
33	Nitrate nitrogen, mg/l	10	—	—	20

* All efforts should be made to remove colour and unpleasant odour as far as practicable
- These standards shall be applicable for industries, operations or processes other than those industries, operations or process for which standards have been specified of the Environment Protection Rules, 1989

Source: *G.S.R 422 (E) dated 19.05.1993 and G.S.R 801 (E) dated 31.12.1993 issued under the provisions of E (P) Act 1986*

Annexure 12
Standards for Iron Ore Mines

Sl. No.	Parameter	Standards
1	pH	6.0 – 9.0
2	Suspended Solids	50 mg/l
		200 mg/l - during monsoon
3	Oil & Grease	10 mg/l
4	Dissolved iron as Fe	2 mg/l
5	Manganese as Mn	2 mg/l

Source: CPCB, Effluents discharge standards, Comprehensive industry document on Iron ore mining, comprehensive industry document series CDINDS / -/ 2007-2008

Annexure 13
Sources of Air Pollution in Mines

Sl. No.	Activities in Mines	Air Pollutants
1.	Drilling	SPM
2.	Blasting	SPM, SO_2, NOx
3.	Loading & Unloading	SPM
4.	Haul Road	SPM
5.	Transportation	SPM, SO_2, NO_x
6.	Crushing of ore	SPM
7.	Waste / Top soil handling	SPM
8.	DG Set	SO_2, NO_x, SPM

SPM – Suspended Particulate Matter
SO_2 – Sulphur Dioxide,
NOx – Oxide of Nitrogen

Annexure 14
Factors That Influence Air Pollution Impact

	Parameters / Instrument	Significance or importance
Existing air quality	SPM, RSPM	Provide picture of ambient air quality before mining is initiated.
		In case of existing project, indicates whether air quality has improved, remain constant or deteriorated over a period of time.
Wind speed and direction	Measured by instrument called anemometer. It an automatic device installed at 10 meter above the ground.	Indicates predominant direction in which pollutant will move.
		Helps in designing air quality monitoring network.
		Helps determine the direction and season during which impact on air will be maximum.
		Helps in planning infrastructure such as colony.
Health survey –	Primary heath survey and collection of secondary information from the health department.	Diseases like bronchitis; asthma are induced by Particulate emission due to mining activities. Health survey data of an area would reveal disease prevalent in the area prior to the proposed mining activity.
		Post surveys would indicate whether mining activities have induced diseases or it has remained constant or deteriorated over a period of time.
Level of mechanisation	Review the project proposal – such as type of mining, transportation of material, storage of mined out material, proposal for waste storage and handling, proposed management practices for fugitive dust control	Gives primary sources and intensity of air pollution
High stripping ratio	It is ratio of quantity of ore versus waste material.	High stripping ratio means larger quantity of handling and transportation of waste materials and will give indication of potential traffic density and emissions associated with it.

Annexure 15

Dust Collection Efficiency based Low, Moderate and High Dust Capturing Herbs, Shrubs and Trees

Dust Collection Efficiency	Plant Species		
	Herbs	Shrubs	Tees
Low <10%	1. Amaranthus hypchondriceus (chaluai) 2. Gardenia Jasminoides (Crape Jasmine) 3. Cestrum noctumum (Rat ki Rani) 4. Chrysanthemum species	1. Thuja Species (Mayur Pankhi) 2. Ravuvoifia serpentine (sepagandha) 3. Withani Somnifera (Ashawagandha) 4. Acanthus Species (Acanthus)	1. Nyctanthese arbotritis (Harsingar) 2. Abis Pindrwo (Silver fire) 3. Accade nelotica (Babool) 4. Holarrhena antidysentrica (Kurchi) 5. Clerodenrum ineme (Glorry bower) 6. Ficus bengalensis (Banyam) 7. Miliusa tomentoss (Kari leaves) 8. Thespesia populania (ran Bhindi)
Medium 11 to 20 %	1. Lilium Species (Lily) 2. Draceana species 3. Halianthus Annus (Sunflower) 4. Tegetes Patula (Genda) 5. Pothus areus (Money plant)	1. Babbusa species (Baboo) 2. Lagerstomia indica (Crape Myrtle) 3. Nerium Indicum (Kaner pink) 4. Corium varigetu (Croton) 5. Thevetia peruviana (Kaner Yellow) 6. Wrightia arborea (Dudhi) 7. Rosa Indica (Rose) 8. Ipomea nil (Beshrum) 9. Tabermaemon ana divaricate (chandani) 10. Acalypha hispide (Copper leaf) 11. Plumeria acuminate (Temple tree)	1. Luecena leucophloea (Shoe Babol) 2. Pinus Gerardiana (Chilgoja) 3. Ficus elastice (Indian Rubber) 4. Annaona Squamosa (Sugar Apple) 5. Mangifera Indica (Mango) 6. Argyreia roxburghira (Wooly Morning Glorry) 7. Ficus religiosa (peepal) 8. Acacia famesiana (Vilayati Kikkar) 9. Psidium guava (Amrood) 10. Prunus comminis (plums) 11. Syzgium cumuli (Jamun) 12. Tectona grandis (Teak) 13. Citrus lamina (Lemon) 14. Morus alba (Mulberry) 15. Archis sapota (chikoo) 16. Anthosephalus cadamba (kadam) 17. Shorea robusta (sal) 18. Delonix regiosa (Gulmohar) 19. Albizzia lebbek (Siris) 20. Artocarpus integrifolia (Jack fuit) 21. Ixore parviflora (Torch Tree) 22. Bauhinia Vangata (Kanchnar) 23. Moninge Olieifera (Drum Stick) 24. Aegle famesiana (Beal) 25. Pithocolobium dule (Jangali jalabi)

Dust Collection Efficiency	Plant Species		
	Herbs	Shrubs	Tees
High >20%	1. Colocasia antiquorum (Elephants Ear) 2. Celocia Argentie (Cock scomb)	1. Hibiscus rosa sinenesis (Gurhal) 2. Bougainvillea glavra (Bougainvillea)	1. Cassia fistula (Amaltas) 2. Pinus Contora (Pine) 3. Bombax ceiba (Samal) 4. Butea monosperma (Palas) 5. Alstonia Scholaris (Satani) 6. Azardirachta indice (Neem) 7. Polyalthia longifolia (Ashoka) 8. Callistemon citrinus (Bottle brush) 9. Termanilia catappal (Jangal Badam) 10. Terminalie arjuna (Arjun) 11. Melia Azedarch (Melia) 12. Phoenix dactylifera (Khajoor) 13. Ficu infectoria (Pikan) 14. Holiptelia integrifolia (papadi) 15. Eucalyptus globules (Blue Gum) 16. Medhuca Indica (Mahua) 17. Citrus maxim (Chaktora) 18. Populous tremuloides (Quacking aspect)

Annexure 16
Air Pollution Control Measures in Mines

Potential sources of air pollution	Magnitude of air pollution	Control measures
Drilling	High dust generation Risk of occupational hazard	Wet drilling technology or dry drilling fitted with bag filter. Driller shall be equipped with closed cabin personal protective gear to reduce occupational hazard.
Blasting	High dust generation (Impact lasts for short period)	By improvising blasting technique and adopting controlled blasting methods Water spray prior to blasting No blasting should be allowed in the areas close to human habitation – Rock breakers should be employed instead of blasting
Loading of material on dumper	Air emission	Air conditioned cabin for loading operator Water spray on mineral ore / overburden material prior to loading.
Transportation	High dust potential	Both dumper and conveyor transportation. Provision for automatic water sprinkle system on permanent road and water spray by tankers on temporary road. Covering of the material with turpentine in case of long haulage or in case the road is passing through in close proximity of habitation Green belt of trees with good footage on both side of haul road. Provision of water spay on the dumper to arrest fine dust before it is transported to crusher.
Crushing of ore	High potential of dust and occupational hazard	Automatic water spray in crusher hopper and unloading point. Suitable enclosure for the conveyor system. Provision of bag filter in crusher unit Barrier in form of greenbelt all around in the vicinity of the crusher to trap fugitive dust.
Storage of ore	High potential and occupational hazards.	Covered storage yards with greenbelt of adequate width all around

Annexure 17

Permissible Peak Particle Velocity (PPV) at the foundation level of structures in mining areas in mm/sec.

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

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

Annexure 18
Significance of Impact on Biological Environment

Issues	Method of Assessment
Proximity to national park / wildlife sanctuary / reserve forest / mangroves / coastline / estuary / sea	Marks are allotted on the basis of proximity (i.e. between 0 to 20 km) to any eco-sensitive area. A scale of 0 to 10 is being considered - 0 marks indicate very high impact, and 10 marks indicate low impact. Between 0 and 10 marks, a linear scale will be used. For instance, if the project is located 5 km away from an eco-sensitive area, then marks allotted will be 2.5.
Activities of the project affects the breeding / nesting sites of birds and animals	Interaction with Forest Department, local villagers and primary survey of the site.
Located near an area populated by rare or endangered species	Collection of data from Forest Department, identification of flora and fauna present in the study area and comparing it with scheduled listed species and IUCN red data book. Local stakeholders provide valuable information on species inventory and provide sound information on environmental and economic value and medicinal value of species.
Proposed project restricts access to waterholes for wildlife.	Interaction with forest people and survey of site
Proposed mining project impact surface water quality that also provide water to wildlife	Physiochemical estimation of water bodies and monitoring of aquatic biodiversity are important to understand the water characteristic and diversity of aquatic sources.
Proposed mining project increase siltation that would effect nearby biodiversity area.	If runoffs originate from the site follows the direction of biodiversity area.
Risk of fall / slip or cause death to wild animals due to project activities	If mining site is surrounded by forest having diverse wild animals, there would high risk of drowning / death to wild animals in the in the mine pit.
The project release effluents into a water body that also supplies water to a wildlife	Physiochemical estimation of water bodies of aquatic sources.
Mining project effect the forest based livelihood / any specific forest product on which local livelihood depended	Assessment of forest based livelihood and assessment of economic importance of forest in term of revenue.
Project likely to effect migration routes	Interaction with forest department and area characteristic input from the local villagers.
Project likely to effect flora of an area, which have medicinal value.	Assessment of flora by taxonomist is the best method. Moreover, local stakeholder input is vital in identifying the medicinal value of plant species.
Forestland is to be diverted, has carbon high sequestration	This related with climate change – The trees act as carbon sink; they absorb CO_2 from the atmosphere and release oxygen. Detailed accounting of carbon sink potential of forest should be done.
The project likely to affect wetlands, fish breeding grounds, marine ecology	Primary survey of area and input from the local stakeholder.

Annexure 19
Socio-Economic Impact of Mining

Sl.	Socio-Economic Issues	Impact Due to Mining	Significance
1.	Human Habitations	a. Habitation(s) in core zone (Displacement) b. Habitation(s) in buffer Zone	Impact is High. Well designed R & R plans will help in minimizing adverse impacts. a. Positive impact because of better job & business opportunity b. Negative impact due to pollution & displacement of people
2.	Pollution	a. Air Pollution b. Water Pollution c. Leachate d. Land Degradation	Negative. Depends on the location of villages.
3.	Livelihood	Higher the percentage of landless people, higher impact on livelihood	Positive impact on employment opportunities
4.	Economic Loss	Calculated on the basis of existing landuse pattern with marks. ▸ Double Crop Agricultural land – 01 ▸ Single Crop – 2.5 ▸ Forest Land – 0 ▸ Waste Land for grazing – 5 ▸ Non Productive Waste land – 10 Calculation Percentage double crop x 0 + percentage of single crop x 2.5 + percentage of productive waste land x 5 + percentage of unproductive wasteland x 10/100 Lower the score, higher will be economic impact	
4.	Infrastructure	Better communication, health care, education facilities	Positive impact

Annexure 20

List of critically polluted industrial cluster/area identified by CPCB

S. No.	Critically Polluted Industrial Area and CEPI	Industrial Clusters/Potential Impact Zones
1	Ankleshwar (Gujarat) *CEPI-88.50* (*Ac_Wc_Lc*)	GIDC Ankleshwar and GIDC, Panoli
2	Vapi (Gujarat) *CEPI-88.09 (Ac_Wc_Lc)*	GIDC Vapi
3	Ghaziabad (Uttar Pardesh) *CEPI-87.37* (*Ac_Wc_Lc*)	**Sub-cluster A** • Mohan nagar Industrial area • Rajinder nagar Industrial area • Sahibabad Industrial area **Sub-cluster B** • Pandav nagar Industrial area • Kavi nagar Industrial area • Bulandshahar Road Industrial area • Amrit nagar • Aryanagar Industrial area **Sub-cluster C** • Merrut road Industrial area **Sub-cluster D** • Loni Industrial area • Loni Road Industrial area • Roop Nagar Industrial area **Sub-cluster E** • Hapur Road Industrial area • Dasna • Phikua **Sub-cluster F** (other scattered Industrial areas) • South side of GT road • Kavi Nagar • Tronica city • Anand Nagar • Jindal Nagar • Prakash Nagar • Rural Industrial estate
4	Chandrapur (Maharashtra) *CEPI-83.88* (*Ac_Wc_Lc*)	Chandrapur (MIDC Chandrapur, Tadali, Ghuggus, Ballapur)
5	Korba (Chhatisgarh) *CEPI-83.00* (*Ac_Ws_Lc*)	a) Industrial areas and their townships of NTPC, BALCO, CSEB (East) & CSEB (West) b) Korba town
6	Bhiwadi (Rajassthan) *CEPI-82.91* (*Ac_Wc_Ls*)	a) RIICO Industrial areas Phase I to IV b) Bhiwadi town c) Other surrounding industrial areas: Chopanki, Rampura Mundana, Khuskhera Phase I to III.
7	Angul Talcher (Orissa) *CEPI-82.09* (*Ac_Wc_Lc*)	a) MCL Coal Mining Area, Angul – Talcher region b) Industrial Area (60 km x 45 km) Following blocks of Angul District: - Kohina block - Talcher block - Angul block - Chhendipada block - Banarpal block And Odapada block of Dhenkamal District
8	Vellore (North Arcot) (Tamilnadu) *CEPI-81.79 (Ac_Wc_Lc)*	Ranipet, SIPCOST Industrial Complex
9	Singurauli (Uttar Pradesh) *CEPI-81.73* (*Ac_Wc_Ls*)	Sonebhadra (UP) • Dala-Tola • Obra • Renukoot • Anpara • Renusagar • Kakri • Dudhichuwa • Bina • Khadia • Shakti Nagar • Rihand Nagar • Bijpur Sigrauli (Madhya Pradesh) Vindhyachal Nagar and Jayant, Nigahi, Dudhichua, Amlohri & Jhingurdah townships

S. No.	Critically Polluted Industrial Area and CEPI	Industrial Clusters/Potential Impact Zones
10	Ludhiana (Punjab) *CEPI-81.66* (*Ac_Wc_Ls*)	Ludhiana Muncipal limits covering industrial clusters: • Focal Point Along with NH_I_Tota Eight Phase • Industrial Area-B-From Sherpur chowk to Gill road & Gill road to Miller Kotla road (left Side of Road) • Mixed Industrail Area – Right side of Gill road • Industrial area – C (near Jugiana Village) • Industrial Area A & Extension: Area between old GT Road and Ludhiana by pass road • Industrial Estate : Near Dholwal chowk • Mixes Industrial Area (MIA) Miller gunj • MIA-By pass road • Bahdur Industrial Area • Tejpur industrial Complex.
11	Nazafgarh drain basin, Delhi *CEPI-79.54* (*As_Wc_Lc*)	Industrial areas : Anand Parvat, Naraina, Okhla and Wazirpur
12	NOIDA (Uttar Pradesh) *CEPI-78.90* (*Ac_Wc_Lc*)	Territorial jurisdiction of : • Noida Phase - 1 • Noida Phase - 2 • Noida Phase – 3 • Surajpur Industrial Area • Greater Noida Industsrial Area • Village-Chhaparaula
13	Dhanbad (Jharkhand) *CEPI-78.63* (*Ac_Ws_Lc*)	Four blocks of Dhanbad district: • Sadar (Dhanbad Municipality) • Jharia (Jharia Municipality, Sindri Industrial Area) • Govindpur (Govindpur Industrial Estate) • Nirsa
14	Dombivalli (Maharashtra) *CEPI-78.41*(*Ac_Wc_Ls*)	MIDC Phase-I, Phase-II
15	Kanpur (UttarPradesh) *CEPI-78.09* (*Ac_Wc_Ls*)	• Industrial areas: • Dada Nagar • Panki • Fazalganj • Vijay Nagar • Jajmau
16	Cuddalore (Tamilnadu) *CEPI-77.45* (*As_Wc_Lc*)	SIPCOT Industrial Complex, Phase I & II
17	Aurangabad (Maharashtra) *CEPI-77.44* (*Ac_Wc_Ls*)	MIDC Chikhalthana, midc Waluj, MIDC Shendra, and Paithan Road industrial area
18	Faridabad (Haryana) *CEPI-77.07* (*Ac_Ws_Lc*)	• Sector 27 - A, B, C, D • DLF Phase – 1, Sector 31, 32 • DLF Phase – 2, Sector 35 • Sector 4, 6, 24, 25, 27, 31, 59 • Industrial area Hatin • Industrial Model town Ship
19	Agra (Uttar Pradesh) *CEPI-76.48* (*As_Wc_Ls*)	Nunihai Industraial Estate, Rambag Nagar, UPSIDC Industrial Area, and Runukata Industrial Area
20	Manali (Tamilnadu) *CEPI-76.32* (*Ac_Ws_Ls*)	Manali Industrial Area
21 22	Haldia (West Bengal) *CEPI-75.43* (*As_Wc_Ls*) Ahmedabad (Gujarat) *CEPI-75.28* (*Ac_Ws_Ls*)	5 km wide Strip (17.4 x 5.0 km) of industrial area on the southern side of the confluence point of Rivers Hugli and Rupnarayan, covering Haldia Municipa Area & Sutahata Block-I and II • GIDC Odhav • GIDC Naroda
23	Jodhpur (Rajasthan) *CEPI-75.19 (As_Wc_Ls*)	• Industrial areas including Basni Areas (Phase-I & II), Industrial Estate, Light & Heavy industrial areas, industrial areas behind new Power House, Mandore, Bornada, Sangariya and Village Tanwda & Salawas. • Jodhpur city
24	Greater Coach (Kerala) *CEPI-75.08* (*As_Wc_Ls*)	Eloor-Edayar Industrail Belt, Ambala Mogal Industrial areas
25	Mandi Gobind Garh (Punjab) *CEPI-75.08* (*Ac_Ws_Lc*)	Mandi Govindgarh municipal limit and Khanna area
26	Howrah (West Bengal) *CEPI-74.84* (*As_Ws_Lc*)	a) Liluah-Bamangachhi Region, Howrah b) Jalah Industrial Complex-1, Howrah
27	Vatva (Gujarat) *CEPI-74.77* (*Ac_Wc_Ls*)	GIDC Vatva, Narol Industrial Area (Villages Piplaj, Shahwadi, Narol)

S. No.	Critically Polluted Industrial Area and CEPI	Industrial Clusters/Potential Impact Zones
28	Ib Valley (Orissa) *CEPI-74.00* (*Ac_Ws_Ls*)	Ib Valley of Jharsuguda (Industrial and Mining area)
29	Varansi-Mirzapur (Uttar Pradesh) *CEPI-73.79* (*As_Wc_Ls*)	• Industrial Estate, Mirzapur • Chunar • Industrial Estate, Chandpur Varanasi • UPSIC, Industrial Estate, Phoolpur • Industrial Area, Ramnagar, Chandaull
30	Navi Mumbai (Maharashtra) *CEPI-73.77* (*Ac_Ws_Ls*)	TTC Industrial Area, MIDC, Navi Mumbai (including Blocks-D, C, EL, A, R, General, Kalva)
31	Pali (Rajasthan) *CEPI-73.73* (*As_Wc_Ls*)	a) Existing industrial areas: Mandia Road, Puniyata Road, Sumerpur b) Pali town
32	Mangalore (Karnataka) *CEPI-73.68* (*Ac_Ws_Ls*)	Baikampady Industrial Area
33	Jharsuguda (Orissa) *CEPI-73.34* (*Ac_Ws_Ls*)	Ib Valley of Jharsuguda (Industrial and Mining area)
34	Coimbatore (Tamil Nadu) *CEPI-72.38* (*Ac_Ws_Ln*)	SIDCO, Kurichi Industrial Clusters
35	Bhadravati (Karnataka) *CEPI-72.33* (*Ac_Ws_Ln*)	KSSIDC Industrial Area Mysore Paper Mill & VISL Township Complex
36	Tarapur (Maharashtra) *CEPI-72.01* (*Ac_Ws_Ls*)	MIDC Tarapur
37	Panipat (Haryana) *CEPI-71.91* (*As_Ws_sc*)	Panipat Municipal limit and its industrial clusters
38	Indore (Madhya Pradesh) *CEPI-71.26* (*As_Ws_Ls*)	Following 09 industrial areas: • Sanwer Road • Shivaji Nagar • Pologround • Laxmibai Nagar • Scheme No. 71 • Naviakha, • Pipliya • Palda • Rau • Indore city • Other surrounding industrial areas : Manglia, Rajoda, Barlal, Asrawad, Tejpur Gadwadi
39	Bhavnagar (Gujarat) *CEPI-70.99* (*As_Ws_Ls*)	GIDC Chitra, Bhavnagar
40	Vishakhapatnam (Andhra Pradesh) *CEPI-70.82* (*As_Ws_Ls*)	Bowl area (the area between Yarada hill range in the south to Simhachalam hill range in the north and sea on the east and the present NH-5 in the West direcdtion)
41	Junagarh (Gujarat) *CEPI-70.82* (*As_Ws_Ls*)	Industrial Areas: • Sabalpur • Jay Bhavani • Jay Bhuvneshwari • GIDC Junagarh (I&II)
42	Asansole (West Bengal) *CEPI-70.20* (*As_Ws_Ls*)	Burnpur area surrounding IISCO
43	Patancheru- -Bollaram (Andhra Pradesh) *CEPI-70.07* (*As_Ws_Ls*)	Industrial Area: • Patancheru • Bollaram

Note: Names of identified industrial clusters/ potential impact zones are approximate location based on rapid survey and assessment and may alter partially subject to the detailed field study and monitoring. Detailed mapping will be made available showing spatial boundaries of the identified industrial clusters including zone of influence/buffer zone, after in depth field study.

Aggregated Comprehensive Environmental Pollution Index (CEPI) scores of 70 and above are considered as critically polluted industrial clusters/ areas.

Source: Ecological Impact Assessment Series: EIAS/5/2009-10
Details of Critically Polluted Industrial Areas and Clusters/ Potential Impact Zone in terms of the Office Memorandum no. J-11013/5/2010-IA.II(I) dated 13.1.2010

Annexure 21

Guidance for assessment relevance and reliability of analytical methods and framework used for impact prediction: risk assessment

Relevance		Remarks
Name	Application	
EFFECT WHAZAN	• Consequence Analysis for Visualisation of accidental chemical release scenarios & its consequence • Consequence Analysis for Visualisation of accidental chemical release scenarios & its consequence	Heat load, pressure wave & toxic release exposure neutral gas dispersion
HEGADIS	• Consequence Analysis for Visualisation of accidental chemical release scenarios & its consequence	Dense gas dispersion
HAZOP and Fault Tree Assessment	• For estimating top event probability	Failure frequency data is required
Pathway reliability and protective system hazard analysis	• For estimating reliability of equipment and protective systems	Markov models
Vulnerability Exposure models	• Estimation of population exposure	Uses probit equation for population exposure
F-X and F-N curves	• Individual / Societal risks	Graphical Representation

Source: - http://envfor.nic.in/dimensions/iass/eia.annexure10.html EIA manual, 2001

QUESTIONNAIRE

QUESTIONNAIRE FOR ENVIRONMENTAL APPRAISAL OF MINING OF MINERALS PROJECTS

Note 1: All information to be given in the form of Annexures should be properly numbered and form part o this proforma

Note 2: No abbreviations to be used – Not available or not applicable should be clearly mentioned

I. General Information

1.1 Name of the Project :

(a) Name of the proponent :

Mailing Address :

E-mail :

Telephone :

Fax No. :

(b) Location of mine (s)

Village(s)	Tehsil	District	State

(c) Does the proposal relate to

(i) New mine Yes ☐ No ☐

(ii) Expansion Yes ☐ No ☐

- Increase in ML area Yes ☐ No ☐
- Increase in annual production Yes ☐ No ☐

(iii) Renewal of ML Yes ☐ No ☐

(d) Modernisation Yes ☐ No ☐

(e) Site Information

(i) Geographical Location

- Latitude
- Longitude
- Survey of India Topo sheet number
- Elevation above Mean Sea Level
- Total mining lease area (in ha.)

(ii) Dominant nature of terrain

- Flat Yes ☐ No ☐
- Undulated Yes ☐ No ☐
- Hilly Yes ☐ No ☐

1.2 Environmental sensitivity details within 10 km from the boundary of the project for applicability of "General Condition (GC)" as per EIA notification dated 14.9.2006 and amendments as on date

S.No	Item	Name	Aerial Distance (in Km)
1	Protected areas notified under the wild life (Protection) Act, 1972		
2	Critically polluted areas as identified by the CPCB		
3	Eco-sensitive areas as notified under section 3 of the E (P) Act 1986		
4	Inter-state boundaries and international boundaries		

1.3 Environmental sensitivity areas as mentioned at column 9(III) of EIA Notification 2006

S. No	Areas	Name/ Identity	Aerial distance (within 15 km) proposed project location boundary
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value		
2	Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests		
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, resting, migration etc.,		
4	Inland, coastal, marine or underground waters		
5	State, National boundaries		
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas		
7	Defense installations		
8	Densely populated for built-up area		
9	Areas occupied by sensitive man-made land uses *(hospitals, schools, places of worship, community facilities)*		
10	Areas containing important, high quality or scarce resources *(ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)*		
11	Areas already subjected to pollution or environmental damage *(those where existing legal environmental standards are exceeded)*		
12	Areas susceptible to natural hazard which could cause the project to present environmental problems *(earthquakes, subsidence, land slides, erosion, flooding or extreme or adverse climatic conditions)*		

*** 0.5 km from Railway lines/National / State Highway should be maintained**

1.4 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.

Description of the flora/vegetation in the project area

Description of fauna (non-domesticated) in the project area

1.5 Baseline data

Meteorological data

Ambient air quality data

Water quality data

Human Settlement

	With in the project site
Population*	
No. of villages	
Number of households village-wise	

1.6 Current land use of the proposed project site Area(in ha) :

Level –I
1. Built – up land
2. Agricultural land
3. Forest
4. Wastelands
5. Water bodies
6. Others
Total

2.0 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)

(b) Impact i.e. Damage to

- Life Yes ☐ No ☐
- Property Yes ☐ No ☐
- Existing mine Yes ☐ No ☐

3.0. 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													
2. Storage for top soil													
3. Overburden / Dumps													
4. Mineral storage													
5. Infrastructure (Workshop, Administrative Building)													
6. Roads													
7. Railways													
8. Green Belt													
9. Tailings pond													
10. Effluent treatment plant													
11. Coal handling plant / mineral separation plant													
12. Township area													
13. Other (Specify)													
TOTAL													

4.0 Township (outside mining lease)

(a) Total area (in ha) ☐

(b) No. of dwelling units ☐

(c) Distance from mine site ☐

5.0 Details of mineral reserves (as per approved Mining Plan)

		Quantity (in million tonnes)
(a)	Proved	☐
(b)	Indicated	☐
(c)	Inferred	☐
(d)	Mineable reserves	☐

6.0 Major geological formation / disturbances in the mining lease area

(a)	Geological maps submitted	Yes	☐	No	☐
(b)	Geological sections submitted	Yes	☐	No	☐
(c)	Contour map submitted	Yes	☐	No	☐
(d)	Whether the presence, if any, noted of				
	(i) Faults	Yes	☐	No	☐
	(ii) Dykes	Yes	☐	No	☐
	(iii) Shear Zone	Yes	☐	No	☐
	(iv) Folds	Yes	☐	No	☐
	(v) Other weak zones	Yes	☐	No	☐

(e) Source of data (Indicate) ☐

7. 0 Production of mineral(s) and life of mine

(a) Rated capacity of mine mineral wise (Tonnes / annum) ☐

(b) Life of mine at proposed capacity (Years) ☐

(c) Lease period (Years) ☐

(d) Date of expiry of lease (D /M /Y) ☐

(e) Indicate in case of existing mines ☐

(i) Date of opening of mine ☐

(ii) Production in the last 5 years from year…… to year …… in million tonnes. 1st year ☐ 5th year ☐

(iii) Projected production for the next 5 years from year …… to year ……..in million tonnes. 6th to 10th year ☐

(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. ☐

(f) Whether plans & sections provided? Yes ☐ No ☐

8.0 Type and method of mining operations

TYPE		METHOD	
Opencast	☐	Manual	☐
Underground	☐	Semi-mechanised	☐
Both	☐	Mechanised	☐

9.0 Details of ancillary operations for mineral processing

(a) Existing

(a) Additional

10.0 Mine details

(a) Opencast mine

(i) Stripping ratio (mineral in tonnes to over burden in m^3)

(ii) Ultimate working depth (in m bgl)

(iii) Indicate present working depth in case of existing mine (in m bgl)

(iv) Thickness of top soil (in m.)

- Minimum
- Maximum
- Average

(v) Thickness of overburden (in m.)

- Minimum
- Maximum
- Average

(vi) Mining Plan

- Height and width of the bench in overburden / waste.
- Height & width of the bench in ore body / coal seam.
- 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.
- 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 No

(vii) Type of blasting, if any, to be adopted.

(b) Underground mine

(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
- Adit
- Incline

(iii) Details of machinery

- On surface
- At Face
- For transportation
- Others

(iv) Method of stoping (metalliferrous mines)

- Open
- Filled
- Shrinkage
- Caving
- Combination of 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).

11.0 Surface drainage pattern at mine site

(a) Whether the pre-mining surface drainage plan submitted? Yes ☐ No ☐

(b) Do you propose any modification / diversion in the existing natural drainage pattern at any stage? 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. Yes ☐ No ☐

12.0 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.

(c) Impact of embankment on HFL and settlement around.

(d) Impact of weir on down stream users of water.

13.0 Vehicular traffic density (outside the ML area)

		Type of vehicles	No. of vehicles per day
(a)	Existing		
(b)	After the proposed activity		

(c) Whether the existing road network is adequate? Yes ☐ No ☐

If no, provide details of alternative proposal?

14.0 Loading, transportation and unloading of mineral and waste rocks on surface:

(a)	Manual	Yes ☐	No ☐
(b)	Tubs, mine cars, etc.	Yes ☐	No ☐
(c)	Scraper, shovels, dumpers / trucks.	Yes ☐	No ☐
(d)	Conveyors (belt, chain, etc.)	Yes ☐	No ☐
(e)	Others (specify).	Yes ☐	No ☐

15.0 Mineral(s) transportation outside the ML area

		Qty. (in TPD)	Percentage (%)	Length (in km)
(a)	Road			
(b)	Rail			
(c)	Conveyors			
(d)	Rope way			
(e)	Water ways			
(f)	Pipeline			
(g)	Others (Specify)			

16.0 Water requirement (m^3/day)

Purpose	Avg. Demand	Peak Demand
A. Mine site		
1. Mine operation		
2. Land reclamation		
3. Dust suppression		
4. Drinking		
5. Green Belt		
6. Beneficiation		
7. Washeries		
8. Fire Service		
9. Others (specify)		
B. Township		
1. Green Belt		
2. Domestic		
3. Other (specify)		
Total		

17.0 Source of water supply*

S. No.	Source	m^3/day
1	**River (name)**	
2	Ground water	
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.]

18.0 Lean season flow in case of pumping from river / nalla (cumecs) ☐

19.0 Ground water potential of the study area

19.1. Ground water availability

(a) Range of water table (m bgl)

(i) Pre-monsoon (April/May)

- Core Zone ☐
- Buffer zone ☐

(ii) Post-monsoon (November)

- Core Zone
- Buffer zone

(b) Total annual replenishable recharge (million m^3/ year)

- By ground water table fluctuation method
- By rainfall infiltration factor method

(c) Annual draft excluding estimated draft through mine discharge (million m^3/ year)

(d) Estimated draft through mine discharge (million m^3/ year)

(e) Net annual ground water availability (million m^3/ year)

(f) Stage of ground water development in %

19.2 Water demand - Competing users of the water source

S. No.	Usage	Present Consumption (m^3/day)		Additional proposed as per local plan		Total (m^3/day)	
		Surface	Ground	Surface	Ground	Surface	Ground
1.	Domestic						
2.	Irrigation						
3.	Industry						
4	Mining						
5	Others (specify)						
	Total						

20.0 Waste Water Management

Mine

(a) Daily average discharge (m^3/day) from different sources

(i) Mine water discharge during

- Lean period
- Monsoon period

(ii) Workshop

(iii) Domestic (mine site)

(iv) Beneficiation / Washeries

(v) Coal Handling Plant

(vi) Tailings 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 ☐

(ii) Lean season flow rate ☐

(iii) Aquatic life

(iv) Analysis of river water 100 meters upstream and 100 meters downstream of discharge point submitted. Yes ☐ No ☐

Township

(a) Waste water generation from township (m^3/day) ☐

(b) Are you planning to provide sewage treatment plant? Yes ☐ No ☐

(c) Usage of treated water

21.0 Attach water balance statement in the form of a flow diagram indicating source (s), consumption (Section-wise) and output.

22.0 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* a. Top Soil b. Over burden c. Others (specify)			
Effluent Treatment Plant (sludge)			
Total			

[* Annex layout plan indicating the dump sites.]

(b) (i) Does waste (s) contain any hazardous/ toxic substance/ radioactive materials or heavy metals? Yes ☐ No ☐

(ii) If yes, whether details and precautionary measures provided? Yes ☐ No ☐

(c) Recovery and recycling possibilities.

(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.

(in million m^3)

Solid waste (s)	Already accumulated (A)	To be generated (B)	% of A & B to be backfilled	
			A	B
Over burden				
Others (specify)				

Land reclamation Plan

(f) In case waste is to be dumped on the ground, indicate

(i) Associated environmental problems

(ii) Number & type of waste dumps

- No. of external dumps ☐
- Max. projected height of dumps (in m) ☐
- No. of terraces and height of each stage ☐
- Overall slope of the dump (degree) ☐
- Proposed reclamation measures ☐

(iii) Section of the waste dump in relation to the adjacent ground profile attached. Yes ☐ No ☐

23.0 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.		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			
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					
2.	LSHS					
3.	Other (specify)					

24.0 Storage of inflammable / explosive materials

S. No.	Name	Number of Storages	Consumption (in TPD)	Maximum Quantity at any point of time
1.	Fuels			
2.	Explosives			

25.0 Human Settlement

	Core Zone	Buffer Zone
Population*		
No. of villages		
Number of households village-wise		

[* As per 2001 census record or actual survey]

26.0 Lease -wise plantation details

		Existing mine	New mine
(a)	Lease area (in ha.)		
	(i) Area broken up		
	(ii) To be broken up		
	(iii) Area not to be broken-up		
(b)	Township area (in ha.)		

(c) Area afforested and proposed (in ha.)

	Peripheral	Dumps	Roads	Township	Others
(i) Existing					
(ii) Proposed					

(d) No. and type of trees planted and proposed

(i) Existing

- When plantation was started? Month / Year

No.of plant species planted	Number saplings (per ha.)

Survival rate %

- Avg. height

(ii) Proposed

No.of plant species planted	**Number saplings (per ha.)**

27.0 Environmental health and safety

(a) What major health and safety hazards are anticipated?

(b) What provisions have been made/proposed to be made to conform to health and safety requirements?

(c) In case of an existing mine

(i) Comprehensive report on health status of the workers as under the Mines Act annexed. Yes ☐ No ☐

(ii) Mineralogical composition of RPM (dust)

- Free silica
- Chromium* (Total as well as Hexavalent)
- Lead**

[* Only for Chromite mines]

[**Only for Base Metal mines]

(d) Information on radiation protection measures, if applicable.

28.0 Environmental Management Plan

a. Details of Pollution Control Systems:

	Existing	Proposed
Air		
Water		
Noise		
Solid Waste		

b. Expenditure on environmental measures:

S. No		Capital cost		Annual recurring cost	
		Existing	Proposed	Existing	Proposed
1	Pollution control (provide break-up separately)				
2	Pollution monitoring (provide break-up separately)				
3	Fire fighting & emergency handling				
4	Green Belt				
5	Training in the area of environment & occupational health				
6	Others (specify)				

c. Details of organizational set up/cell for environmental management and monitoring:

d. Details of community welfare/peripheral development programmes envisaged/being undertaken by the project proponent:

29. Mine closure

(a) Have you planned mine closure? Yes ☐ No ☐

(b) Submitted a conceptual mine closure plan. Yes ☐ No ☐

(c) If yes, indicate estimated amount for implementing the same (in Rs. Lakhs ☐

30. Amount earmarked for socio-economic welfare measures for the nearby villages other than R&R plans.

31. Compliance with environmental safeguards (for existing units)

a. Status of the compliance of conditions of Environmental Clearance issued by MoEF, if any enclosed Yes ☐ ☐ No

b. Status of compliance of 'Consent to Operate' issued by SPCB, if any, enclosed Yes ☐ ☐ No

c. Latest 'Environmental Statement' enclosed Yes ☐ ☐ No

32. Public Hearing

(a) Date of Advertisement ☐

(b) Newspapers in which the advertisement appeared ☐

(c) Date of public hearing (DD/MM/YYYY) ☐

(d) Public Hearing Panel chaired by & members present

(e) No. of people attended the public hearing meeting and number of people from the lease area.

(f) Summary/details of public hearing in tabular form.

Issues raised by the Public	Response/Commitment of Project Proponents	Suggestions made by the Public Hearing Panel

Date .....

Name and Signature of the Competent Officer/authority
E-mail:
Phone and Fax nos:

Given under the seal of organization on behalf of whom the applicant is signing

Note:

The project authorities are earnestly advised in their own interest to provide complete information on points, which they think are relevant to their proposal. Non-supply of required information may result in considerable delay in according environmental clearance.

All correspondence with MoEF shall be made by the authorized signatory only. The authorized signatory should also submit a document in support of his claim of being an authorized signatory for the specific project (refer notification No. SO. 3067 (E) dated 1st December 2009)