International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 07 | July 2020 www.irjet.net p-ISSN: 2395-0072

A Brief Overview on Different Stages in a Overall Life of Mine

A. Sandeep kumar[1], A. Krishna[2], A. Bhagavan[3], K. Siva kumar[4], B. Anand prasad[5]

[1]Assistant Professor, Dept. of Mining Engineering, Godavari institute of Engineering & Technology (Autonomous), Rajahmundry, Andhra Pradesh, India.
[2,3,4,5]B. Tech Final Year Student, Dept. of Mining Engineering, Godavari Institute of Engineering & Technology (Autonomous), Rajahmundry, Andhra Pradesh, India.

Abstract: *Life cycle of mine begins with different stages (i.e., Prospecting, Exploration, Development, Extraction, Reclamation stage). The time period required for each stage decides the overall life of a mine. Every miner has huge burden before start a new mine. To start and which permissions have to take from government and other departments through-out overall life of mine. This study is carried out to know about different stages in mine life and their preliminary requirements. Majorly in mining field illegal activities are easily carried out against the Government rules. So, for legal mining which permissions needs to take from Government and other departments. In day to day working environmental (Mining or other fields) safety is the major aspect, for this safe working environmental every mine needs to follows some important plans in a day to day mine life. Finally, this paper covers a complete guide notes for every miner about different stages in mine life, permissions needs to take from the government, mine plans for safe working environment.*

Keywords: Mine life; Stages In Mine; Mine Permiss -ions; Forms; Plans;

1. INTRODUCTION

Mining is the life time process for extraction of valuable minerals (or) geological materials from the earth, usually from an ore body, lode, vein, seam, reef, (or) place deposit. These deposits form a mineralized package that is of economic interest to the miner. Everything we depend on is either made from minerals (or) relies on minerals for its production. Once look around us to observe the objects you're surrounding things, by which are not manufactured by plant-based resources. That is only happening by mining process. It rise and else man then utilize to other purpose. Mining industry supports every day in our life but also provides the foundations of engineering achievements for the decades to come. In this contemporary world we can't assume without industries, technology, automobiles and else. So we have to give support our mining industries. To extract these deposits, mining cyclic operations shall be occurred.

1.1. STAGES IN MINE LIFE

There are mainly five stages in a life of mine, they are

- PROSPECTION STAGE
- EXPLORATION STAGE
- DEVELOPMENT STAGE
- EXPLOITATION STAGE
- RECLAMATION STAGE

Prospecting Stage

It is the first stage in search of ore. In this stage we study the literature and maps of an area. This can be done by

1. Direct Method: It is limited deposit surface(or)near surface. It consists of visual examination of either outcrop(or)loose fragments that have weathered away from the outcrop. The samples are collected in laboratory. Video prospecting.

2. Indirect Method: This can be used for deeper deposits. They includes seismic radiometric, magnetic and many other method.

Exploration Stage

This is the second stage of mining. Core samples are obtained by diamond drilling. Different laboratory analyses are carried out to evaluate the grade and tonnage of deposit. Video core samples, diamond drill bit and core samples and diamond drilling.

Final conclusion's drawn regarding worth of the deposit. At the end of this stage feasibility study is carried out which helps to decide, whether to abandon(or)develop the deposit.

Development Stage

It is work of opening a mineral deposit for exploitation. In this stage mining rights are acquired. Ore handling and treatment plants constructed near the mine then access to deposit may be gained by

1. Stripping overburden(Surface mining).

2. By excavating opening from surface to more deeply buried deposit(Underground Mining).

Exploration / Extraction Stage

It is actual recovery of mineral. While development work continues throughout life of mine in exploitation stage main emphasis is on production. In this stage mining method is also selected.

Reclamation/Back filling stage

Reclamation is the process of restoring land that has been mined to a natural or economically usable state. Once mining is completed, the planning of mine reclamation activities occurs prior to a mine being permitted or started.

Mine reclamation creates useful and scopes that meet a variety of goals systems to the creation of industrial and municipal resources. In the United States, mine reclamation is a regular part of modern mining practices. Modern mine reclamation minimizes and mitigates the environmental effects of mining.

1.2. Objective

The main objectives of **A brief overview on different in a life of mine**. To start a new mine beginner's has huge burden to start a mine. How to start and which permission have to take from government and other department through-out overall life of mine. The main aim of this project to make a proper guide notes to all the beginner's. For this purpose the following objectives are addresses :

- To study about the various stages involved in Overall life of the mine.
- To study about various plans involved in mine life.
- To understand the permissions needed to be take from government to start a new mine.

2. CASE STUDY

The life cycle of mining begins with exploration, continues through production, and ends with closure and post mining land use. New technologies can benefit the mining industry and consumers in all stages of this life cycle. The three major components of mining (exploration, mining, and processing) overlap somewhat. After a mineral deposit has been identified through exploration, the industry must make a considerable investment in mine development before production begins. Further exploration near the deposit and further development drilling within the deposit are done while the mining is ongoing. The overall sequence of activities in modern mining is often compared with the five stages in the life of a mine.

The mining industry operates through a sequence of stages: exploration, discovery, development, production and reclamation. All stages of this Mining Cycle provide direct economic stimulus. Exploration can take place in many forms, by both prospectors and exploration.

The companies and usually begins with research to select target areas. Once the targets are selected, geological mapping as well as many types of geochemical and geophysical surveys can take place. This type of activity, even in its simplest form, can lead to discoveries of the economic mineral deposits that society requires for much of the raw materials and manufactured products that we use every day. Exploration activity on a property rarely leads to a new mineral discovery.

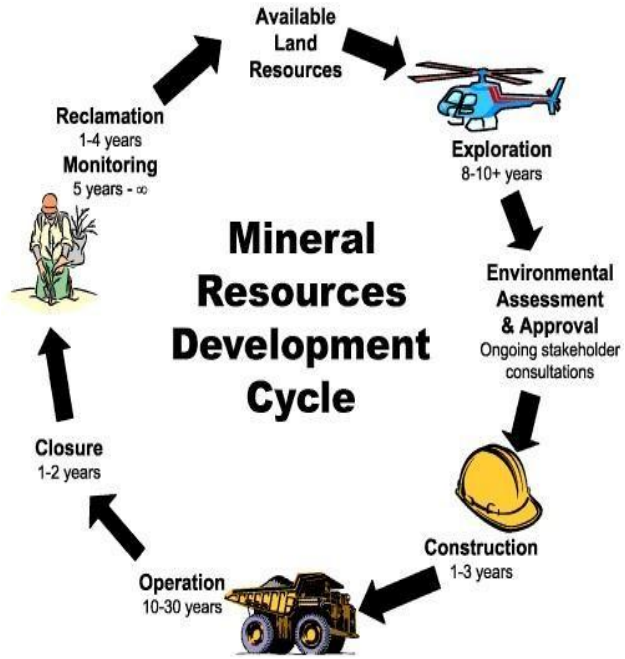


Fig. 1. Life cycle of mine.

Discovery happens when something of value is found. Discoveries rely on good field work, quality geoscience, investment and planning to bring them to the development stage. New discoveries are crucial because our growing society increasingly consumes more manufactured products, and our known mineral deposits become depleted. Very few discovered mineral deposits become producing mines. At this stage permits, leases, and licenses are required and the project may be referred for environmental assessment. To learn more about permitting and licensing.

The mine development stage includes feasibility, geoscience and engineering studies. If all of these outcomes are favorable and all approvals are in place, the company then decides if they will go ahead with the project. At this stage the company raises money in order to begin construction and develop a mine. This is the most expensive phase of the mining cycle. production

phase includes extraction, milling and processing of raw materials, such as coal, metals, industrial minerals and aggregate. The length of time a mine is in production depends on the amount and quality of the mineral or metal in the deposit and profitability of the operation.

Mine site reclamation and protection of the environment starts at the beginning of a project and continues after closure. Mines must have closure and reclamation plans and are required to post a bond for the estimated cost of reclamation. The reclamation plan and bond amount must be approved by the Department of Natural Resources and Department of Environment. In many cases mine site reclamation can add significant value to land.

2.1. Prospecting by Geo-physical methods

The most valuable scientific tool employed in the indirect search for hidden mineral deposits is geophysics, the science of detecting anomalies using physical measurements of gravitational, seismic, magnetic, electrical, electromagnetic, and radiometric variables of the earth.

The methods are applied from the air, using aircraft and satellites; on the surface of the earth; and beneath the earth, using methods that probe below the topography. The following Methods are used for geo-physics methods.

- Seismic tomography to locate earthquakes method.
- Reflection seismology and seismic refraction to map the surface structures of region.
- Geodesy and gravity techniques, including gravity
- gradiometer.
- Magnetic techniques, including aeromagnetic surveys to map magnetic anomalies.
- Electrical techniques, electrical resistivity
- Tomography and induced polymerization.
- Electromagnetic methods, such magnetotellurics.
- Ground penetrating radar and SNMR.
- Borehole geophysics, also called well logging.
- Remote sensing techniques including hyperspectral imaging.

2.2. Field Exploration by Geologist

A very important part of such a summary form is the for a statement setting out the purpose and justification of the hole and what it is expected to encounter. To be of any value, this statement should be written down in advance of drilling. The graphical scale logging form of Plate 1 is divided into columns. In order to describe how to record drill core observations on to the form, the columns will be referred to in numbered order from left to right.

- COLUMN 1 (Hole depth) the hole depth in meters is marked off along this column according to the scale chosen. A scale of 1:100 will allow 20 m to be logged per page, a scale of 1:50 will allow 10 m to be logged per page, and so on.
- It is recommended that the entire hole be logged initially at a semi detailed scale (1:100 has been found by practice to be a good general scale). If necessary, areas of interest can be separately re-Logged at a more detailed scale such as 1:50 or 1:100
- COLUMN 2 (Core recovery) This column is used to mark the advance of each barrel of core. The percentage recovery from each advance is then recorded in this interval.

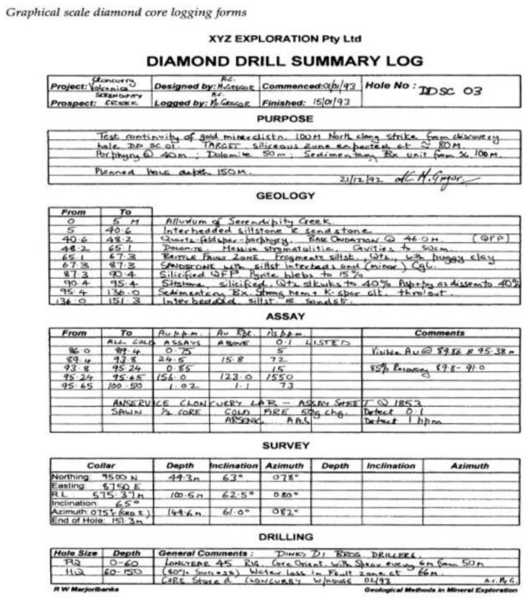


Fig. 2. Core details.

3. STATUTORY PERMISSIONS OF GREY GRANITE (PARADISO) MINE PVT. LTD

Common Boundary Permissions under Regulation No.111(3)

- HR-2/SCZ/Perm-111(3)/11/3559-62 Dated: 30-08-2011 With ANAND GRANITESGRANITE.
- H-2/SCZ/Perm-111(3)/12/299-302 Dated: 25-.01-2012 with POKARNA-II.
- HR-2/SCZ/Perm-111(3)/NLR/2010/1736-39 Dated: 02-07-2010. With MADHUCON GRANITES.
- HR-2/SCZ/Perm-111(3)/NLR/2010/1723-26 Dated: 02-07-2010. With JUBILEE GRANITES.

HEMM Permission Under Regulation No.106(2)B

- HR2/SCZ/106(2)B/102(17)2017/1998.

Explosive License

- License no E/SC/AP/22/1094(E47477). Valid up to 2022.

Diesel storage bunk license

- License No. P/SE/AP/15/237 (P37389).

Environmental Clearance issued Reg.

- SEIAA/AP/PKM-92-2013/.

Pollution Control Board

Consent and Authorisation

- Consent order no:P-109/PCB/Z0 VJA/CFO/W&A/2013- 739.

Consent Order for Establishment

- Consent Order No: 152/PCB/ZOVJA/CFA/2013-976.

3.1. List of Records and Registers Maintaining At grey granite (paradiso) mine Pvt. Ltd.,

Table-1. List of Registers Maintained in Mine.

1	FORM - A
2	FORM - B
3	FORM - D
4	FORM - E
5	FORM - F
6	FORM - G
7	FORM - H
8	FORM - I
9	FORM - J
10	FORM - K

3.2. List of Statutory Permissions for a Mine

Table-2. List of Statutory Permissions for a Mine.

Departments	**Statutory Requirements**	
	Forms/ Documents	Under Rule
Indian Bureau of Mines	Mining Plan/ Scheme	Rule 22, MCR: 9,12 MCDR
	PMCP - Mandatory with MP/MS	Rule 23 B, MCDR
	F1 - Monthly Returns	Rule 45,MCDR
	H1 - Annual Returns	Rule 45,MCDR
	Form I - Notice of Appointment/termination	Rule 46, MCDR
	Form J-Notice of sinking boreholes	Rule 47, MCDR
	Proposed and achieved EPM	Rule 23 E(2)
	Machinery Details	Rule 63, MCDR 1988
	Rehabilitation & Reclamation	Rule 63, MCDR 1988
	Environment Monitoring Data	
	CSR Undertaken	Rule 63, MCDR 1988
	Self - Appraisal Note for Lease	Rule 63, MCDR 1988
Directorate of Mines Safety	Notice of Opening/ Re-opening	Rule 3, 7, MMR 1961
	Permission to Work with HEMM	MMR, Rule 106 (2)(b)
	Permission to Work The Common Boundary	MMR, Rule 111
	Form II - Quarterly Returns	Rule 4, MMR 1961
	Form III - Annual Returns	Rule 5, MMr 1961
	Annexure 10 - Electrical Returns	Rule 72(2), MMR, 1961
	Form J - Reportable Accidents	Rule 76(1), Sec 23(1)(a)
	Form K - Minor Accidents	Mine Rule 76(2),Sec 23(3), Mines Act
	Static and Personal Dust Survey	Rule 124, MMR 1961
	Medical Appliances, 1st Aid Station intimation	Sec 21, Mines Act
	Vocational Training - Initial & Periodical	Mine VT Rules, Rule 6 & 8
	Portability tests results	10th Conference on Mines safety
	Conservancy	Sec 20, Mine Act
	Appointment of Workmen's Inspector	Mine Rule, 29 Q
	Medical Examination (Initial & Periodical)	Mine Rule 29 B
	First Aid Training of Personnel's	Mine Rule, 40
	Form D - Persons employed in Opencast	Mine Rule 48(3) and 78

	during week	
	Form E - Persons employed above ground during week	Mine Rule 48(3) and 78
	Form F - Register of Compensatory Days of Rest	Mine Rule 49 (4)
	Form - B Employee Record	Mine Rule 48(3), 51, 77,77A(2)
	Form G - Register of Leave Account	Mine Rule 53
	Form H - Register of Leave Wages	Mine Rule 53
	Form I - Register of Overtime Wages	Mine Rule 59
	Form L - Employee Leave	Rule 54, Mine Rules 1955
State Pollution Control Board	Consent to Establish Industry	Rule 25(I) (a) Water (P & COP) Act, 21 (1) Air
	Form I - Consent to Operate under Air Act	Rule 21, Air (P & COP) Act
	Form IV (b) - Consent to Operate under Water Act	Rule 25 Water (P & COP) Act
	Hazardous Waste Authorization	Rule 5, HW Rules, 2008
	Form 1 - Water Cess Returns	Rule 5(1), Water Cess Rules 1978
	Form IV - Hazardous Waste Returns	Rule 5(6) & 22 (11), HWR 2008
	Production & Rejection Returns	Consents Compliance
	Form I - Return of water Consumed	Rule 4, Water Cess Rules 1978
	Form V - Environment Statement	EPR 1986, Rule 14
	Pumping Schedule	Consents Compliance
Ministry of Environment, Forest & Climate Change		
EC under EP Act,1986	Environment Monitoring Data	EC Compliance
	Six Monthly Compliance	EC Compliance
	Chief Wildlife Permission	EC Compliance
	Wildlife Management Plan	EC Compliance
FC Act, 1980	Reclamation & Rehabilitation	FC Compliance
	Diversion Of Forest Areas	Rule 6, FC Rules 2003
	Payment of Fees in respect of NPV/CA/SZ	Compliance
State Forest Department	Felling Of Trees in Revenue/ Pvt - Non Forest Areas	Rule 4.1, Goa Daman & Diu
	Afforestation Of Trees/ Submission of Bonds	Preservation of Trees Act, 1984
	Compliance of FC Conditions	FC Compliance
	Reclamation & Rehabilitation	FC Compliance
Directorate of Mines & Geology	Form J - Lease Renewal	Rule 24 A, MCR
	Demarcation of Boundary/ Erection of Pillars	27(g) of MCR, 1960
	Form F1 - Monthly Returns for Production	Rule 45
	Form N - Monthly Returns for Traders	Rule 45
	Form O - Annual Returns for Traders	Rule 45
	Form H - Annual Returns	Rule 45
	Surface Rent/ Dead Rent/ Royalty	Sec 9, 9A MMDR
	Form J-Notice of sinking boreholes	Rule 47, MCDR
Water Resource Department	Registration of New Wells/	Rule 5
	Renewal of Well registrations	Goa Ground Water Regulation Act, 2002
Explosive Department	Form LE 9 - Possess and Use of Explosives	Rule 1 Explosive Rules, 2008
	Form RE 1 - Renewal of Explosives License	Rule 1 Explosive Rules, 2008
	Form LE 1 - Manufacturing of ANFO	
	Form LE 5 - Account of Explosives Use	Rule 24, Explosive Rules, 2008
	Form RE 3 - Account of Receipt of Explosives	
	Form 36 - Monthly Returns	
	Form RE 7 - Quarterly Returns	

Revenue Department	Form I - For regulating the mining dumps	Vide official Gazette
Commissioner of Labor & Employment	Form II - Registration of establishment	Rule 17 (1)
	Form XII - Registers of Contractors	Rule 74
	Form VI B - Notice of Commencement/ completion of Work	Rule 81(3)
	Form XXV - Annual Return	Rule 82 (2)
	Form IV - Application for Contractor license	Rule 21 (1)
	Form VII - Renewal of Contractor License	Rule 25 (1)
	Form XIV - Employment Card	Rule 76
	Form XVII - Register of Wages	Rule 78 (1)(a)(i)
	Form XIX - Wages Slip	Rule 78 (1) (b)
	Form XXIV - Annual Returns of Contractors	Rule 82 (1)
	Form V - Muster Roll for Employer	Rule 26 (5)
	Form X - Register of Wages	Rule 26 (1)
	Form XI - Wage Slip	Rule 26 (2)
	Form III - Annual Returns	Rule 21 (4A)

4. MINE PLANS

Before start a new mine (or) stage, it needs some important plans for safe working environment. These plans should prepare by as per governments rules. The following plans has to be maintain at every mine from starting stage to mine closure.

LIST OF PLANS

Table- 3.0 Mine plans.

Sl.no	Type of plan	Plane no	Scale
1	Location plan	I	Not to scale
2	Key map	IA	Not to scale
3	Key Plan	IB	Not to scale
4	Satellite Image	IC	Not to scale
5	Satellite Image	ID	Not to scale
6	Mine Lease Plan	II	1:1000
7	Surface Plan	III	1:1000
8	Geological Plan	IV	1:1000
9	Geological Sections	IV-A	Hor: 1: 1000 Ver:1:500
10	Year wise Development and Production Plan	V	1:1000
11	Year wise development production Sections	V-A	Hor: 1:1000 Ver:1:500
12	Conceptual/Final mine closure plan	VI	1:1000
13	Conceptual/ Final mine closure Sections	VI-A	Hor: 1:1000 Ver:1:50
14.	Mine Layout, Land Use & Afforestation Plan	VII	1:1000
15	Environmental Plan	VIII	Plan-1: 5000

4.1. MINE CLOSURE PLAN

Mine Closure Plan (MCP) will have two components namely progressive or concurrent mine closure plan and final mine closure plan. Progressive MCP would include various land reclamation, activities to be done continuously and sequentially during the entire period of the mining operations, whereas the Final MCP activities would start towards the end of mine life and may continue even after the reserves are exhausted and / or mining is discontinued till the mining area is restored to an acceptable level to create a self sustained eco system.

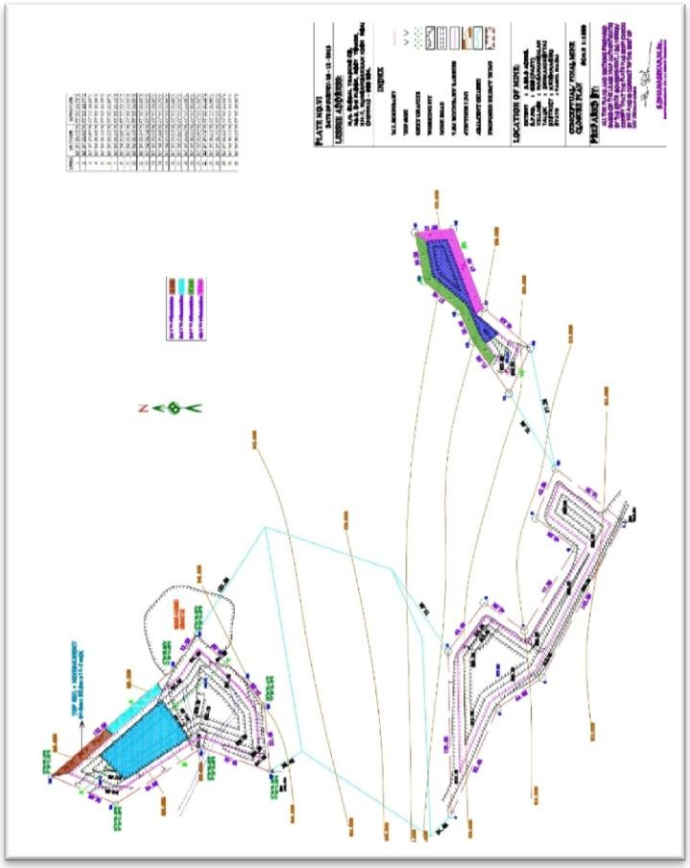
Mine closure planning needs to be carried out before the commencement of mine operations and requires periodic reviewing and modification, if needed, during its life cycle to ensure safety and to cope up with social & environmental challenges. Various objectives of the mine closure planning are as follows:

- To allow sustainable and productive after-use of the site which is acceptable

to the mine owner and the regulatory authorities.

- To eliminate environmental damage and encourage environmental sustainability.
- To protect the flora and fauna of the area.
- To protect public health and safety.
- To minimize adverse socio-economic impacts.

Fig.3. Mine closure/Reclamation plan.



4.2. ENVIRONMENT MANAGEMENT PLAN(EMP)

INTRODUCTION

Environment Management Plan (EMP) aims at the protection of environment by of inbuilt pollution abatement facilities at the proposed site. The EMP aims at controlling pollution at the source to the possible extent with the available and affordable technology followed. The EMP presented in this chapter discusses the administrative aspects of ensuring that the mitigation measures are implemented and monitoring of its effectiveness. The major impacts referred on the air quality and land use.

4.2.1. EMP IMPLEMENTATION, INSPECTION AND MONITORING

Environmental monitoring is critical to understanding whether the quality of our environment is getting better or worse. Information gathered through environmental monitoring is important to many decision makers, outside and inside the organization.

i. INSPECTIONS :

Site inspections to verify compliance with the EMP, Environmental Clearance conditions, conditions imposed in Forest clearance, Ground water clearance, Consent for Establishment and other environmental clearance performance requirements will be undertaken and documented for the construction and operational phases. Site inspection checklists will be developed for the construction and operational phases. Where inspections determine that the existing measures are not effective, corrective and preventative measures will be implemented.

ii. MONITORING :

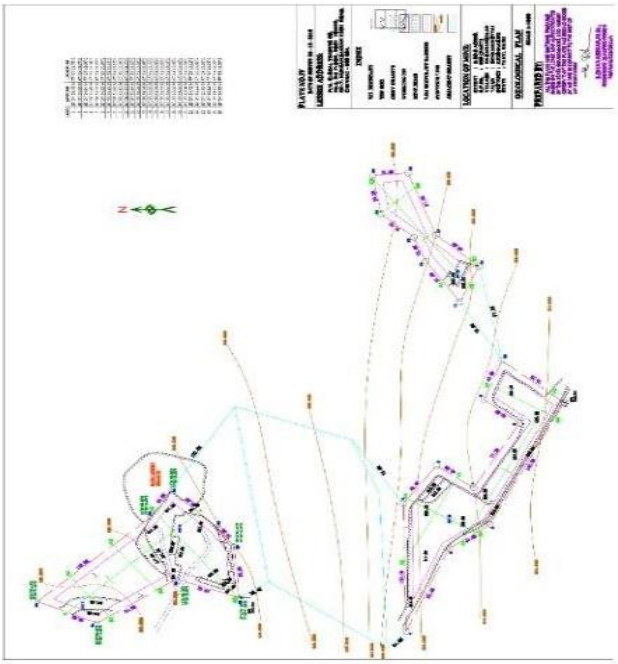


Fig.4. EMP Plan.

Environmental monitoring programs will be developed for the construction and operational phases of the project. These monitoring programs will address the conditions imposed in clearances, commitments given in the EMP and cover areas such as Air, Water, Land, Flora and Fauna, Noise and Socio-Economics.

5. RESULT AND ANALYSIS

5.1. Field observation

5.1.1. Observations for mineable granite

Table-4. Observations for mineable granite

Section	Bench	length in (m)	Width in (m)	Depth in (m)	Volume In (M3)	Mineable reserves in (m3)	Black Granite 20% Recovery in (m3)
XY-A1B1	I	26	19	1	494		
	II	26	18	5	2340	2340	468
	III	26	13	5	1690	1690	338
	IV	43	25	5	5375	5375	1075
	V	38	22	5	4180	4180	836
	VI	33	12	5	1980	1980	396
	VII	28	2	5	280	280	56
	VIII	23	2	5	230	230	46
		TOTAL				16075	3215
XY-A2B2	I	39	45	1	1755		
	II	39	43	5	8385	8385	1677
	III	49	33	5	8085	8085	1617
	IV	50	23	5	5750	5750	1150
	V	50	13	5	3250	3250	650
	VI	50	3	5	750	750	150
	VII	50	3	5	750	750	150
		TOTAL				26970	5394

5.1.2. Observations regarding geological reserves

Table-5. Geological reserve observations

Section	Bench	length in (m)	Width in (m)	Depth in (m)	Volume In M3	Geological Resources in m3
XY-A1B1	II	50	26	15	19500	19500
	III	50	53	10	26500	26500
	TOTAL					46000
XY-A2B2	II	50	60	16	48000	48000
	III	50	60	15	45000	45000
	TOTAL					93000
XY-A3B3	II	44	23	10	10120	10120
	III	114	55	9	56430	56430
	TOTAL					66550
X1Y1-A4B4	II	98	46	18	81144	81144
	TOTAL					81144
X2Y2-A5B5	II	80	24	14	26880	26880
	TOTAL					26880
X3Y3-A6B6	II	87	66	15	86130	86130
	TOTAL					86130
X3Y3-A7B7	II	74	39	36	103896	103896
	III	61	33	33	66429	66429
	TOTAL					170325
	GRAND TOTAL					570029

5.2. ANALYSIS

5.2.1. Recoverable reserves

Concerning the above observations i.e. (Table -4 granite mineable reserve) from that, we have analyzed The Thickness of Top Soil noticed in this area is1.0mts and the total volume of Top Soil will be **3909m³**. The mineable reserves and the recoverable reserves are **43705 m³** and **9509m³** respectively,

5.2.2. Geological reserves

Concerning the above observations i.e. (Table -5 granite geological reserve) from that, we have analyzed. The Geological reserve is estimated as **570029M³** by area cross sectional method. The geological reserves were calculated and estimated as **13170m³**. The Mineable reserve were calculated as **6050m³**. Actually the Geological and Mineable reserves was calculated by applying recovery percentage of 10% and depth is taken up to only 18 mts.

6. CONCLUSIONS

From the field observations, calculations and results the following are the conclusions.

- According to field observations the overall life of mine is 40 years. For Prospecting stage 5 years and exploration stage 5 years and for development stage 5-7 years and extraction stage 15-25 years.
- We have analyzed the thickness of top soil noticed in that area is 1.0 mts. and the total volume of top soil will be 3909 m^3.
- The mineable reserves and the recoverable reserves are 43705 m^3 and 9509 m^3 respectively.
- Geological reserves is estimated as 570029 M^3 by area cross sectional method.
- Statutory permissions are followed by
  - I. Common boundary permissions under regulation no.111(3)
  - II. HEMM Permissions under regulation no. 106(2)B
  - III. Environmental clearance issued regulation no. 23(1)
  - IV. The following forms maintained in a mine as per GCDR1999, FORM-A, FORM-J, FORM-I, etc.,
- All the following standard permissions and plans are to be followed according to granite conservation and development rules 1999 and MCDR 1951.
- Hence, from the above conclusions, it is clear that the mine is running as per government approved procedure and maintaining plans in a safe condition.

ACKNOWLEDGMENT

Firstly, I am expressing my deep gratitude to honorable Head of the Mining Department, **Mr. K. Subbarao.,** for making me as a part of this project work, and his guidance and suggestions help me to complete this project.

We would like to express my special thanks with deep gratitude to my supervisor **Mr. A. Sandeep Kumar (M.Tech)**, for the support, suggestions, and help, which gave me towards the completion of this project. Most of the time he corrected us where we were wrong and guided us wherever necessary and leave to comments which are helpful in the progress of the project.

I thank and fortunate enough to get constant encouragement, support from my fellow friends to complete this project work.

REFERENCE

1. Reedem, F.C. (1979), Techniques in Mineral Exploration, Applied Science Publishers, London.
2. Hartman John Wiley and Sons, (1987), Introduction of Mining Engineering, Wiley Publications, Jamaica.
3. Peter, C.J. (1987), Exploration and Mining Geology, Springer Berlin Heidelberg publisher, Washington.
4. Dr. Samir Kumar Das, (1994), A Hand Book on Surface mining technology, lovely prakashan publisher, Dhanbad.
5. Granite Conservation and Development Rules 1999.
6. Peter Darling, (2011), SME Mining Engineering Handbook, SME publisher.
7. Nagamangalam Gray Granites (Paradiso) Mine Pvt. Ltd. Taluku (M.D), Krishnagiri (Dist.), Tamil Nadu State, India.
8. The Mine Act 1952, The Mines Rules 1955, Mine Regulations 1961, Mines Vocational training Rules 1966, The Mines Rescue Rules 1985, DGMS Circulars 2018, Govt. of India Publication.

BIOGRAPHIE

A. SANDEEP KUMAR (M.Tech): Assistant Professor, Dept. of Mining Engineering, Godavari institute of Engineering & Technology (Autonomous) Rajahmundry, Andhra Pradesh,

B. ANAND PRASAD: B. Tech Final Year Student, Dept. of Mining Engineering, Godavari Institute of Engineering & Technology (Autonomous), Rajahmundry, Andhra Pradesh,

A. KRISHNA: B. Tech Final Year Student, Dept. of Mining Engineering, Godavari Institute of Engineering & Technology (Autonomous), Rajahmundry, Andhra Pradesh,

A. BHAGAVAN: B. Tech Final Year Student, Dept. of Mining Engineering, Godavari Institute of Engineering & Technology (Autonomous), Rajahmundry, Andhra Pradesh,

K. SIVA KUMAR : B. Tech Final Year Student, Dept. of Mining Engineering, Godavari Institute of Engineering & Technology (Autonomous), Rajahmundry, Andhra Pradesh,