MINING PLAN

(Submitted for Approval under Rule 16 of MCR, 2016)

For

"DEVADARI IRON ORE MINE"

(V S Lad & Sons, ML No. 2290)

Village: Lakshmipura

Taluka: Sandur, District: Ballari, State: Karnataka

(Open Cast - Category A - Fully Mechanized- Captive Mine)

Type of Land: Devadari Reserved Forest

Lease Area: 100.54 Ha.

of

M/s. JSW STEEL LIMITED

IBM Registration No.: IBM/432/2011

Prepared by

B.P. Pandey

B. Tech (Mining)

Qualified Person

MINE DESCRIPTION

INTRODUCTORY NOTE:

V.S Lad & Sons, ML No. 2290 Block, located in Lakshmipura village, Sandur Taluka, Ballari District, over an extent of 100.54 Ha area of Forest Land of Kumarswamy range (Devadari gudda) is an iron ore mining lease area proposed to be granted to JSW Steel Limited as per the Letter of Intent of Govt of Karnataka after e-auction **(Annexure-I).**

Pursuant to the Hon'ble Supreme Court(SC) order dated 29th July 2011 and 26th August 2011, the mining operations and transportation of the iron ore from mining leases in the districts of Ballari, Tumkur and Chitradurga had been suspended except, in the case of two mining leases M/s NMDC namely, ML no. 1111 and ML no. 2396. Central Empowered Committee (CEC) was constituted by SC, in order to unravel the violations carried out by mining companies in Karnataka. As per the CEC's joint team survey, ML No. 2290, previously held by M/s V.S Lad & Sons has a total encroachment area of 21.17 Ha [under mining pit (0.23 Ha), OB dumps (15.94 Ha) and others category (5.00 Ha)]. Based on their findings, the lease has been categorized under "C" category.

Further, the Hon'ble Supreme Court by its orders dated 5th August 2011 and 26th August 2011 directed the Government of Karnataka to submit the Reclamation and Rehabilitation(R&R) Plan(s) for the districts of Ballari, Tumkur and Chitradurga within three months of judgement. Subsequently, the Government of Karnataka vide letter dated 29th September, 2011 assigned the task of preparation of R & R Plan to the Indian Council for Forest Research and Education (ICFRE).

As per letter No.1-26/CEC/SC/2013-Pt XXXXXIV dated 24-10-2014; the CEC of the view that before finalizing the R&R plans of any of the Category 'C' mining leases, it may be appropriate to avail the details of mineral reserves, based on the exploration data undertaken by the State Government. Accordingly, the Government of Karnataka has entrusted the exploration work to M/s. Mineral Exploration Corporation Limited (MECL), a Government of India Enterprise, Nagpur, to assess the mineral reserves in all "C" category mines in Ballari, Chitradurga and Tumkur Districts of Karnataka State.

M/s. MECL has conducted Exploration in this Mining Lease area of Devadari Iron Ore Mine by Geological mapping, core drilling and RC drilling etc. As per report submitted by MECL the total geological reserves are 28.61 Million tonnes.

Hon'ble Supreme Court had directed Government of Karnataka to commence the auction of 'C' category iron ore mines in which, only the end-user engaged in production of Sponge Iron and / or Pig Iron and/or Steel and/or Pellets will be eligible to take part in the auction. The end users will include Public Sector Undertakings.

To ensure raw material self-sufficiency, JSW Steel Limited, having its integrated steel plant with an installed capacity of 18 Million Tons (i,e 12 Million Tons at Vijayanagar, Karnataka, 5 Million Tons at Dolvi, Maharashtra & 1 Million Ton at Salem, Tamilnadu), also decided to take part in aforesaid auction. JSW Steel Limited had been awarded this mining block vide **LOI** no. DMG/MLS/CCA/12/2290/2016-17 **(Annexure-I).**

The Department of Mines & Geology, in its LOI dated 26.10.2016, had directed M/s JSW Steel Limited to obtain all consents, approvals, permits, no objections and the like as may be required under applicable law before signing the MDPA. The Hon'ble Supreme court vide its judgement dated 30.07.2015 ordered to transfer the existing statutory clearances of previous lessees in favor of new lessees, who have obtained the blocks in the auction. Accordingly, the Director of Mines and Geology has furnished Forest Clearance **(Annexure-VI)** and Environmental clearance **(Annexure VII)** of previous lessee. Accordingly, the Mining Plan is being submitted for 1.165 MMTPA, as recommended in R & R Plan prepared by ICFRE and also duly concurred by Central Empowered Committee. Monitoring Committee has also issued a letter vide letter No.MC/R&R/CCA/2016-17/90/10690-698 **(Annexure II)** dated 23rd February 2017 prescribing the permissible annual production limit of iron ore.

The Mining Plan is prepared as per the new lease boundary finalized by joint survey team constituted by CEC and is being submitted to IBM Bengaluru, as per Rule 16 of MCR, 2016, in compliance of clause no 3.2 (a)(iv) of Letter of Intent (LOI) issued by Government of Karnataka and also prescribed under sec.5 (2)(b) of MMDR amendment act,2016 for grant of Mining Lease.

Salient Features of Approved R & R Plan:

The R&R plan is aimed to protect the environment from further degradation by implementing suitable site specific bio-engineering measures for the encroached areas, inactive overburden/ waste dumps, seasonal water courses/ nalas, etc., taking into consideration, the hydrological condition on the micro watershed basins and compatibility of the surrounding area, stability and drainage density. The plan includes enlisting of the existing as well as proposed engineering structures within and outside the ML area and their detailed cost estimation. Accordingly, a variety of engineering structures encompassing toe walls, garland drains, check dams, rainwater harvesting pits, silt settling tanks, etc., have been proposed for the protection of inactive and encroached waste dumps and the nalas in the lease area. Biological measures for management of overburden dumps, mine pit area, refractory sites, mine drainage, haul roads, etc., are suggested by providing an exhaustive list of indigenous species having multiple uses suitable for afforestation in these areas.

The R & R plan will also provide the essential insight into environmentally safe planning of mining activities in future. The engineering and biological measures have been proposed in this connection like, retaining walls at the toe of waste dumps, garland drain all terraces, fixing geo textile in outer surfaces of waste dumps. As a part of water surface management, gully plugs, masonry check dams, rock filled check dams, stone masonry settling tanks are being proposed. Afforestation for stabilization of waste dumps, green belt in safety zone has been also suggested.

R & R programme is aimed to produce an ecosystem which fulfils and encourages the development of flora, fauna and soil characteristics similar to that of the pre mining stage. Regular monitoring of the all the measures taken in the lease area is essential for achieving the true spirit of Reclamation and Rehabilitation.

Based on the availability of Mineral reserves, dump capacity, volume of traffic and further planning for the resources, annual production levels are fixed. In case of this lease, an annual production level of 1.165 Million Tonnes per annum is considered as the feasible production level based on the reserves capacity, which is lowest amongst all the criteria considered. Accordingly, the waste generated will be accommodated in active dump and stabilization of the dump will be as per R & R plan. Criteria for estimation of permissible production limit are as below:

Sl. No.	Criteria	Feasible Production Limit (Million Tonnes Per Annum)
1	**Reserves**	**1.165**
2	Dump Capacity	1.29
3	Road Capacity	2.00

The indicative cost estimate for the implementation of engineering and biological measures for reclamation and rehabilitation plan is 413.84 Lakh Rs. (Approx.). The cost for implementation of social management plan, bio diversity management plan, monitoring and implementation of R & R Plan, capacity building of the person involved, infrastructure etc. shall be met from allocating of 10% of the annual sale proceeds from the mines.

The indicative cost proposed for engineering structures and others may increase or decrease based on the common scheduled rates of Karnataka State Government and availability of material and local conditions.

1.0 GENERAL

Table-1.1

a)

Name of lessee	M/s JSW Steel Limited Nominated Owner: Dr. Vinod Nowal Copy of Photo ID of Nominated Owner is enclosed as **Annexure V**
Mine code and Rule 45 registration no.	Not yet allotted IBM/432/2011 The copy of Certificate is Enclosed as **Annexure IV**
Address	JSW STEEL LIMITED, Mining Division, Near Talur Cross, Po: Vidyanagar, 583275 Taluk: Sandur
District	Ballari
State	Karnataka
Pin code	583275
Phone	08395-245956
Fax	08395-250132
Mobile	+91-9448286155
E-mail id	pandey.binay@jsw.in

b) Status of applicant/lessee:

Listed Public Limited Company

(Copy of Memorandum of Association & Registration of Company are enclosed **in Annexure XV & Annexure XVI** respectively**. (Annexure V** shows photo ID of nominated Owner). List of board of directors, Resolution to appoint nominated owner, Letter of authorization to represent the company is enclosed as **Annexure XIX.**

c) Mineral(s) which is are included in the prospecting license (for fresh grant):

Not applicable

d) Mineral(s) which is included in the letter of Intent / lease deed:

Iron Ore

e) Mineral(s) which the lessee intends to mine:

Iron Ore

f) Name of Qualified Persons preparing Mining Plan

Name	Mr. B P Pandey
Qualification	B. Tech (Mining) (Qualification and Experience certificate attached as **Annexure III**
Address	S-2/14, Po: Vidyanagar, JSW Steel Limited., Sandur (Taluk), Ballari (District)
Phone	08395-245956
Fax	08395-250132
Mobile	+91-9448286155
E-mail id	pandey.binay@jsw.in

2.0 LOCATION AND ACCESSIBILITY

a) Lease Details (Existing Mine)

Name of the mine	**Devadari Iron Ore Mine** **(V.S. Lad & Sons, ML No. 2290)**
Lat/long of any boundary point	LBS -1 Latitude - 15° 03' 40.3" Longitude - 76° 34' 51.8" There are 10 corner pillars and lat/long values of these pillars are given in the sketch enclosed as **Plate I(c)** also listed in **Table-2.1.**
Date of grant of lease	LoI grant date (26/10/2016)
Period/Expiry Date	50 years as per MMDR (Amendment) Act-2015
Name of the Lease Holder	M/s JSW Steel Limited.
Postal Address	JSW STEEL LIMITED., Mining Division, Near Talur Cross, Po: Vidyanagar, 583275 Taluk: Sandur
District	Ballari
State	Karnataka
Pin code	583119
Phone	08395-245956
Fax	08395-250132
Mobile	+91-9448286155
E-mail id	pandey.binay@jsw.in

b) Details of lease area with location map

Forest		**Non- Forest**	
Forest	Area (Ha)	Non-forest	Area
Kumaraswamy reserved Forest	100.54	i) waste land ii) Grazing Land iii) Agriculture Land iv) Others	-
CEC sketch as enclosed in **Plate Ic** Mahazar copy enclosed as **Annexure VIII**			

Total lease area	100.54 ha
District & State	Ballari Dist, Karnataka State
Taluka	Sandur
Village	Lakshmipur
Whether the area falls under Coastal Regulation Zone (CRZ)?	No

Existence of public road/railway line, if any nearby and approximate distance	One public road is passing at north of the lease area at around 1.5km. A Railway line is also passing towards north of the lease area at around 1.5km distance. Nearest Railway station for passenger traffic is Toranagallu, which is 21 Km from the mines
Topo-sheet No. with latitude & longitude of all corner boundary point/pillar	Topo sheet no –57 A/12 Lat. / Long values are given in table below

Table – 2.1: Latitude and longitudes of the corner pillars of the lease area (Datum WGS-1984)

Sl No	Boundary Pillar No.	Co-ordinates	
		Northing	Easting
1	LBS-1	N15^0 03’ 40.3’’	E76^0 34’ 51.8’’
2	LBS-2	N15^0 03’ 36.9	E76^0 34’ 42.2’’
3	LBS-3	N15^0 03’ 53.8	E76^0 34’ 25.8’’
4	LBS-4	N15^0 03’ 51.1	E76^0 34’ 20.3’’
5	LBS-5	N15^0 03’ 57.7	E76^0 34’ 13.9’’
6	LBS-6	N15^0 04’ 26.0	E76^0 34’ 04.1’’
7	LBS-7	N15^0 04’ 29.5	E76^0 34’11.8’’
8	LBS-8	N15^0 04’ 09.4	E76^0 34’ 31.4’’
9	LBS-9	N15^0 04’ 11.1	E76^0 34’ 35.0’’
10	LBS-10	N15^0 03’ 50.8	E76^0 34’ 54.3’’

The Ground Control Points (GCP) points are cement structures made at those points as there are no permanent points nearby lease area. These are shown in Surface Plan and photographs of boundary pillars and GCP are enclosed.

Table –2.2: Ground control points (GCP) (Datum WGS-1984)

GCP No.	Co-ordinates		Distance from LBS-6	Level MSL
	Northing	Easting		
1	N15^0 04’ 06.1’’	E76^0 33’ 44.2’’	431m	844
2	N15^0 03’ 58.2’’	E76^0 33’ 42.9’’	805m	650
3	N15^0 03’ 51.1’’	E76^0 33’ 52.9’’	502m	655

The photos of Boundary pillars, GCP, and mine are enclosed in **Annexure XIV**

c) Location Map:

A general location map is attached as **Plate-I(a)** on administrative map and precise map showing lease area and access routes with area marked on a Survey of India topo-sheet of 1:50,000 scale as **Plate I(b)**. CEC sketch of the area is enclosed as **Plate-I(c).**

3.0 DETAILS OF APPROVED MINING PLAN

3.1) Date and reference of earlier approved Mining Plan

Not applicable as this is first Mining Plan after Issue of LOI to JSW Steel Limited.

3.2 Details of last modifications if any (for the previous approved period) of approved MP/SOM, indicating date of approval, reason for modification

Not applicable as this is first Mining Plan after Issuance of LOI to JSW Steel Limited.

3.3) Review of earlier approved proposal in respect of excavation exploration, reclamation etc.

Not applicable as this is first Mining Plan after Issuance of LOI to JSW Steel Limited.

3.4) Status of compliance of violations pointed out by IBM

Not applicable as this is first Mining Plan after Issue of LOI to JSW Steel Limited.

3.5) Indicate and give details of any suspension/closure/prohibitory order issued by any Government agency under any rule or Court of law:

Not applicable as this is first Mining Plan after Issue of LOI to JSW Steel Limited.

3.6) In case the MP/SOM is submitted under rules 9 and 10 of the MCDR 88 or under rule 17(3) of the MCR' 2016 for approval of modification, specify reason and justification for modification under these rules.

Not applicable.

PART – A

1.0 GEOLOGY AND EXPLORATION

a) Description of the topography, drainage pattern, vegetation, climate, and rainfall data of the mining lease area.

(i) Topography

The Lease area of **Devadari Iron ore mine (V.S. Lad & Sons, ML No. 2290)** is covered in Survey of India topo-sheet no.57A/12 and bound by Longitudes 76º34'04" to 76º34'54" and Latitudes 15º03'40" to 15º04'30". The mine lease area has the strike extension of about 1550 m length along the NNW-SSE within the wide area of about 580 m. The maximum and minimum elevation is 970 m. & 825m. above MSL respectively. The mine lease area is gentle slope, and the area has Sub-dendritic pattern of drainage. The lease area is surrounded by forest lands. Majority of the land with-in the buffer-zone consists of hilly tract with ultimate spurs and valleys.

(ii) Drainage Pattern

There are no rivers or perennial water courses in the mine lease area. However, the area is traversed by numerous seasonal water courses which are usually active during monsoon season and draining into the nearby water bodies (Hulikunte tank). Naturally, no rain water accumulates in the lease area. The rain water flows from hill slopes and it does not accumulate till it reaches the lower valleys. Hence, the drainage pattern is sub-dendritic in nature and is typical of the hilly area.

A total of 13 *nalas* are originating from the lease area. Out of the total, 2 are originating from SW side near the cliff and joining to the *Hulikunte* tank and 4 from western slope adjacent to the ML, 5 from SE side and 2 from eastern side adjacent to the ML outside towards NE and finally draining to *Narihalla* stream.

In the Plan Period, the lowest working proposed is 810 m above MSL which is about 240 m above the ground water table. In the Conceptual period, mine working is expected to reach 802m above MSL, which is 232 m above water table at the end of the life of the mine. Therefore, there is no chance of encountering underground water source in this mining activity.

(iii) Vegetation

Even though the mining lease area is within the forest, The nearly 80% of the lease area is already broken due to the previous mining activity and remaining 20% of area is covered by only small bushes, shrubs and trees are seen in the low level (Unbroken area) of the lease area. The density of forest is only 0.4 Ha. The impact on forest due to proposed mining is very minimal and the vegetation around the area is mixed open jungle of neither commercial nor medicinal value.

(iv) Climate

The Sandur Schist Belt area of Ballari district experience dry semi-arid climate with mean annual rainfall varying from 40cm to 80cm. The monsoon begins in June first week and continues up to September and winter from the month of October to January is somewhat pleasant however, extreme summer continues from the month of February to May.

(v) Rainfall Data

The annual rainfall in Sandur varies from 40cm to 80cm. The rainfall is mostly (60.22%) confined to the period from June to September. During south west monsoon (October to November) 22.21% of the annual rainfall is received, and another 17.57% of rainfall occurs as sporadic in other months of the year.

b) Brief description of Regional Geology with Reference to Location of lease

The lease area is located in Devadari block of Sandur schist belt forming part of the Ballari-Hospet group of iron/manganese ore deposits. This schist belt is the smallest of the three basins and covers an area of just 960 sq. km. Structurally, it is highly disturbed and squeezed out of shape by an intrusion of younger granites. Shelf facies as in the other basins is confined to the western margin. Well-developed mafic magmatism and strong development of manganiferous greywacke, phyllite and numerous bands of banded hematite quartzites (BHQ) characterize the basin. The basin is known for its rich accumulation of both iron and manganese ore. Basement cover relations are concealed because of intense deformation and intrusions by younger granite.

This lens-shaped Schist belt is about 60km long, with a maximum width of 28 km in the central part. Four formations have been distinguished in this basin: (Yeshwantnagar, Deogiri,

Donimalai and Nandihalli). The Yeshwantnagar formation is largely composed of volcanic flows; the Deogiri formation by manganiferous greywacke argillite and the Donimalai formation by extensive development of banded haematite chert and jasper. The topmost Nandihalli formation is made up of metabasalts with intercalation of greywacke and argillites. Lateritization has played an important role in the concentration of manganese and iron deposits in the profile, resulting in rich accumulation of manganese/iron ore for which this schist belt is well known.

Table-1.1: The stratigraphic succession of Sandur Schist belt

Nandihalli formation	Metabasalt, metagabbro, acid volcanics and intercalated bands of greywacke-argillite, etc.
Donimalai formation	Banded ferruginous or pyrite ferrous chert (with its various metamorphic equivalents), metabasalt/ amphibolite, metagabbro, andesitic tuff, acid volcanic, conglomerate, meta-greywacke and metapelites, (garnet-mica schist, andalusite schist, cordierite-garnet gneiss, etc.)
Deogiri formation	a. Manganiferous greywacke-argillite, with some bands of banded ferruginous chert and thin dolomitic limestone. b. Metabasalt and rare acid tuff. c. Arenites, dolomitic limestone and phyllite.
Yeshwantnagar formation	Metabasalt/amphibolite with meta-pyroxenite, metagabbro and thin intercalated bands of quartzite and quartz-mica schist.
Peninsular gneiss: (banded granodiorite/tonalite gneiss)	

(Source: Stratigraphy and Structure of the Sandur Schist Belt, Karnataka, Abhinaba Roy and SK Biswas in Journal of Geological Society of India, Vol. 24. Jan. 1983)

The manganese ore deposits are mainly concentrated along the western part of the Sandur schist belt and restricted to Lower Deogiri formations. The important deposits are found in the Kammathuru, Yeshwantnagar and Ramdurg areas. The chief ores are wad and psilomelane and usually they occur as a mixture of wad and psilomelane. The better grades of ores are found in the Kumaraswamy area. Lateritization has played an important role in the concentration of manganese and iron deposits in the profile, giving rise to rich accumulation of manganese and iron ore for which this schist belt is well known *(Source: Geology of*

Karnataka-BP Radhakrishna & R Vaidyanathan).

c) Geology of the lease area:

The mineralized zones of M/s V.S. Lad and Sons Mining Lease Area (ML No. 2290) shows distinct lensoidal type of ore body which exhibit folding nature. The ore lens attains, at times, good persistency. However, clay as an intrusive body does cut across the ore body. Principal ore minerals are haematite, magnetite, goethite and limonite. In the entire deposit, the high grade ore is almost free from lateritization and the laterite capping area is very less (2-3%), whereas the blue dust area ranges about 5%. However, the blue dust mostly contains more haematite concentration, therefore, good quantity of hematitic ore could be easily available from the blue dust.

The shape of an ore body on the cross section line has been obtained by interpretation and correlation of the borehole data. The possibility of an ore body being in the nature of ore folded sedimentary bed, behaving as a stratigraphic unit was considered. The alternative hypothesis of an ore body, being a leached and replaced portion of some pre-existing rock, in this case the BHQ, appeared to be more realistic and adopted for determination of the ore bottom configuration. The shape of the waste consisting essentially of ferruginous shale, at times, BHQ has been ascertained by joining the upper limit of the ore zone with iron content of more than 45% in adjacent boreholes.

The general sequence of rock formations found in the lease area is as given below,

- Soil Cover/ Float Ore
- Banded Hematite Quartzite (BHQ)
- Iron Ore Formation
- Shale/ Phyllites

Soil Cover/ Float Ore

Since the mine has been in operation for several decades before falling into ‘C’ category, hence area is already considered as broken up. There is no likelihood of generation of topsoil. However, if, some quantity is generated during the mining operations from lease area, at the same time it will be used for afforestation purpose.

Banded Heamatite Quartzite's (BHQ)

The Banded Haematite Quartzite's is exposed in the area of ML block in the form of discontinuous bands at places along the hill slopes. The BHQ exposed in patches over the iron ore formation, is banded in nature and following the trend of the iron ore formation with dip of 55˚ to 68˚ towards East. The BHQ in the area is considered as waste due to low Fe content and exhibit, fine grained, cherry red in color and has metallic luster. Use of BHQ will be explored as per quality and quantity required by JSW steel plant from this mine.

Iron Ore Formation

The iron formation/deposit of this mine lease area is part of Devadari Range and it is known for its good quality. There are three major Iron ore bands passing through the lease area. One band is on Southern side of the pit, with dimension 720mx70m (Length x Width). Second ore band is situated in the middle of the pit with dimension 350mx20m (Length x Width). Third band is situated on the western side of the pit with dimension 750mx20m (Length x Width). The iron ore deposit occurs in the area, in the form of reef, with BHQ, Phyllite. The dip varies between 55˚ to 68˚, towards East.

The iron ore formation occurs in the form of reef having reddish brown in colour and hard metallic luster. Ore in the form of lumps and fines having average ratio of 30: 70 is observed at many places. The quality of iron ore is good with the grade varies ranging from 45% to + 65% Fe content. Considering the above mentioned orebody dimensions and also the exploratory drilling carried out by M/s MECL, the total mineralized area established so far is 81.50 Ha.

Shale/ Ferruginous Clay

Shale /Ferruginous Clay are exposed as wall rocks at places and also exposed within the iron ore formation, as intercalated waste. It is light yellow to light pinkish red in color.

d) Details of Exploration Agency

Name of Exploration agency	**M/s Mineral Exploration Corporation Limited**
Address	Dr. Babasaheb Ambedkar Bhawan, Highland Drive Road, Seminary Hills, Nagpur, Maharashtra 440006
E-mail id	headband@mecl.gov.in
Phone No.	0712 251 0310

e) Details of prospecting/exploration already carried out

i) Number of pits and trenches indicating dimensions, spacing etc along and across the strike/foliation with reference to geological plan.

Exploration of the lease area was carried out by M/s MECL. No pitting or trenching was carried out by M/s MECL. As it was a working mine earlier, most of the orebody has been exposed, wherein pits were already available

ii) Number of boreholes indicating type (Core/RC/DTH), dia., spacing, inclination, Collar level, depth etc with standard borehole logs duly marking on geological plan/sections.

M/s MECL has drilled 10 nos. of Core drill holes (322.50m) and 38 nos. of RC drill holes with a depth of 1918 meters during 2014. These Boreholes are marked in Geological Plan and the respective borehole logs are enclosed as **Annexure- X.**

Table 1.2: Details of boreholes drilled

BH no.	LATITUDE			LONGITUDE			Collar Level	Depth (m)
	D	M	S	D	M	S	R. L.	
MVMR-1	15	3	41.51	76	34	46.37	868.466	45.00
MVMR-2	15	3	54.61	76	34	43.65	911.636	70.00
MVMR-3	15	3	48.53	76	34	46.87	876.228	50.00
MVMR-4	15	3	50.47	76	34	42.32	924.166	30.00
MVMR-5	15	3	44.73	76	34	45.34	893.360	60.00
MVMR-6	15	3	49.01	76	34	39.57	922.504	60.00

MVMR-7	15	3	46.14	76	34	48.86	848.406	25.00
MVMR-8	15	3	57.55	76	34	41.77	918.359	22.00
MVMR-9	15	3	56.03	76	34	38.94	939.762	40.00
MVMR-10	15	4	3.07	76	34	38.75	901.825	40.00
MVMR-11	15	3	51.53	76	34	38.27	937.504	40.00
MVMR-12	15	3	47.92	76	34	43.45	922.920	60.00
MVMR-13	15	3	52.62	76	34	48.94	844.968	40.00
MVMR-14	15	4	5.94	76	34	37.69	905.369	35.00
MVMR-15	15	4	6.89	76	34	32.85	909.702	40.00
MVMR-16	15	4	0.26	76	34	33.02	942.459	36.00
MVMR-17	15	4	2.86	76	34	17.58	909.523	60.00
MVMR-18	15	4	14.85	76	34	12.55	920.126	45.00
MVMR-19	15	4	24.93	76	34	10.35	890.237	43.00
MVMR-20	15	4	23.72	76	34	7.56	882.016	35.00
MVMR-21	15	4	8.94	76	34	15.53	919.055	60.00
MVMR-22	15	4	5.19	76	34	21.00	926.841	60.00
MVMR-23	15	4	10.90	76	34	18.96	905.178	60.00
MVMR-24	15	4	13.72	76	34	17.48	910.448	50.00
MVMR-25	15	4	8.48	76	34	20.69	896.993	60.00
MVMR-26	15	4	6.40	76	34	17.35	927.128	70.00
MVMR-27	15	4	15.84	76	34	21.30	887.025	50.00
MVMR-28	15	4	19.49	76	34	13.98	921.565	50.00
MVMR-29	15	4	13.90	76	34	24.46	882.974	50.00
MVMR-30	15	4	17.46	76	34	15.63	920.927	40.00
MVMR-31	15	4	11.72	76	34	25.91	884.019	70.00
MVMR-32	15	4	21.30	76	34	17.68	896.895	36.00
MVMR-33	15	4	1.82	76	34	24.35	944.135	70.00
MVMR-34	15	3	56.63	76	34	26.96	923.512	70.00
MVMR-35	15	3	59.55	76	34	25.16	945.387	70.00
MVMR-36	15	4	5.84	76	34	29.44	913.986	70.00
MVMR-37	15	4	2.95	76	34	31.31	930.241	60.00
MVMR-38	15	3	58.24	76	34	36.97	935.269	46.00
MVM-39	15	4	0.02	76	34	40.81	901.448	53.00

MVM-40	15	3	49.94	76	34	49.18	847.024	27.50
MVM-41	15	3	56.09	76	34	32.78	950.642	30.00
MVM-42	15	4	1.28	76	34	19.34	937.537	42.00
MVM-43	15	4	7.38	76	34	25.06	874.292	30.00
MVM-44	15	3	42.77	76	34	50.41	828.748	10.00
MVM-45	15	4	12.29	76	34	14.56	936.357	30.00
MVM-46	15	4	22.09	76	34	11.67	910.771	37.00
MVM-47	15	4	17.91	76	34	18.94	889.429	31.00
MVM-48	15	3	53.51	76	34	40.51	923.255	32.00
TOTAL								**2240.5**

iii) Details of samples analysis indicating type of sample (surface/subsurface from pits/trenches/borehole, etc.):

Total 2182 nos. of Samples of ore and waste from the boreholes were analyzed. Analytical Results of litho-logs and chemical analysis of Borehole samples are enclosed in **Annexure X.** and NABL certificate of Accreditation of MECL laboratory is enclosed as **Annexure XVIII**

iv) Expenditure incurred in various prospecting operations:

Entire prospecting operation of the lease area has been carried out by M/s MECL. The actual expenses incurred by the Government of Karnataka on mine exploration, preparation of Provisional R&R Plans, survey, construction of pillars and DGPS survey, amounts to **INR 3,80,37,482 (Indian Rupees Three crore eighty lakhs thirty-seven thousand four hundred and eighty-two).**

f) Surface Plan

The Surface Plan has been prepared on a scale of 1:2000 R.F with contour interval of 5m and is enclosed as **Plate No. II(a).**

g) Geological Plan

The Geological Plan has been prepared on a scale of 1:2000 R.F, incorporating already carried out and proposed exploration data, mineralized zone, lithologs, and structural features and is enclosed as **Plate No. II(b).**

h) Geological Section

Based on the Geological Plan, geological Cross Sections has been drawn at an interval of 100 m on a scale of 1:2000 R.F. and enclosed as **Plate No. II(c)**.

i) Future exploration program:

Most of the area is exposed and MECL has carried out exploration. However, the MECL has estimated reserves under G1, G2 & G3 category. Therefore to know the variation in the grade and recovery, ascertain the extent and depth and also for converting G3 category to G1 category lessee proposes to drill about 32 vertical core/RC boreholes of about 50 m depth to establish the G1 category and to identify the small ore bands lying within the lease area. The proposed exploration program will commence from second year of the plan period. Besides five boreholes (namely PBH-5, 6, 20, 21, 28) have also been proposed in BHQ to check the grade for its suitability/blending. The Proposed position of the boreholes are marked in the Geological Plan **(Plate No. II(b).**

Table-1.3 (a) Future Exploration Programme

Year	No. of Boreholes (Core/RC/DTH)	Grid Interval	Total Meterage	No. of Pits, Dimensions and Volume	No. of Trenches, Dimensions and Volume	Remarks
I	-	-	-	-	-	
II	10	100 m	500 m	-	-	Confirmation of Ore reserves, to ascertain the extent and depth of mineralization,
III	11	100 m	550 m	-	-	
IV	11	100 m	650 m	-	-	
V	-	-	-	-	-	
Total	**32**		**1600 m**	**-**	**-**	

Table 1.3 (b) Location of Proposed boreholes

Proposed Year	PBH	Sections	Northing	Easting
			(WGS-1984)	
II	1	S2-S2’	669912.3027	1665922.911
	2	S4-S4’	669780.8681	1665994.092
	3	S6-S6’	669779.9225	1666096.118
	4	S7-S7’	669733.0511	1666168.795
	5	S8-S8’	669486.9245	1666146.535
	6	S9-S9’	669439.596	1666220.144
	7	S10-S10’	669496.3816	1666383.772
	8	S10-S10’	669580.7614	1666434.014
	9	S11-S11’	669441.6042	1666472.827
	10	S11-S11’	669496.5919	1666506.285
III	11	S13-S13’	669313.7018	1666551.871
	12	S14-S14’	669094.3439	1666498.537
	13	S14-S14’	669267.3522	1666603.996
	14	S14-S14’	669191.4365	1666616.126
	15	S15-S15’	669082.4273	1666610.335
	16	S16-S16’	669026.7367	1666682.087
	17	S17-S17’	668991.7874	1666774.363
	18	S19-S19’	668895.683	1666956.719
	19	S21-S21’	668685.8842	1667145.154
	20	S20-S20’	668668.3488	1667017.57
	21	S20-S20’	668717.0638	1666969.542
IV	22	S21-S21’	668580.2936	1667009.749
	23	S20-S20’	668617.4945	1666923.512
	24	S19-S19’	668675.435	1666822.766
	25	S18-S18’	668731.181	1666738.392
	26	S17-S17’	668769.2606	1666639.077
	27	S16-S16’	668755.0907	1666516.866

	28	S15-S15’	668901.4036	1666544.22
	29	S15-S15’	668819.8167	1666450.58
	30	S14-S14’	668896.7473	1666378.58
	31	S13-S13’	668922.9374	1666314.121
	32	S12-S12’	668960.0186	1666264.446

j) Mineral Reserves/Resources as per UNFC with respect to the threshold value notified by IBM

(i) Mineralisation

All the materials 31 analysing more than 45% and above have been considered as ore. The ore exhibits wide variations of physical properties ranging from compact, hard and massive ore to soft, granular, unconsolidated sandy blue dust or reddish brown powdery ore.

However, categorization/classification of ore based on quantitative data such as hard, soft, laminated, powdery etc., have been possible based on mine data (size range or granulometry). It is based on physical properties like colour, presence or absence of weakness, cohesiveness of the grains etc. Thus, lithological classification helped in revealing a stratigraphical picture of the relative preponderance of different ore types.

The iron ore in nature is not homogeneous, but consists of a mixture of many ore types. Hence, practical approach of demarcating the ore zones based on predominant nature of the lithology/ore substantiated with analytical data have been applied.

(ii) Types of Ores

Various types of iron ores are derived from haematite viz. massive ore, laminated ore and blue dust.

Type of Ore	Characteristic Features
Lateritic	Porous and cavernous in nature
Laminated	Closely spaced laminae, which give rise to biscuity ores.
Blue dust (-)10 mesh	Ore constituting of haematite and martite
Massive (haematitic)	No planar structure

The blue dust consists of 10-15% of (-) 100 mesh size fractions and above 80% of (-)100 to (-)325 mesh size.

Besides the float ore gets accumulated along the slope and foot hills which are purer in iron content. In Ballari-Hospet region also the float ore occurs with >64% Fe. The gangue materials are of shale pieces, banded haematite quartzite, dolerite and clay. If lateritisation is extensive, the alumina to silica ratio will be high.

Type of Ore	**Fe%**
Massive ore(Haematitic)	67.69
Compact laminated ore	67
Powdery ore	65
Laminated ore	65

(iii) Grade Classification

The exploration efforts in 70's were mainly for lumpy ores; fines were not given economic importance. Similarly, exploration will also be required to categorize the ore reserves/ resources based on end user's grade classifications. At threshold cut-off of 45% Fe as stipulated by IBM and at 45% Fe cut-off, the mineralized zones within the lease hold area have been delineated and presented in the Table-1.4.

Table-1.4: Detail of Iron Ore Zone Intersected in the Boreholes (At 45% Fe Cut-off)

Borehole Number	**Intersection (m)**		**Diff (m)**	**True Thick-ness (m)**	**G r a d e (%)**			**Rice Ratio Fe/SiO_2 + Al_2O_3**	**Fe/ Al_2O_3**	**Fe/ SiO_2**
	From	**To**			**SiO_2**	**Fe**	**Al_2O_3**			
MVMR-1	25.00	34.00	9.00	8.46	11.90	48.70	10.79	2.15	4.51	4.09
MVMR-3	0.00	45.00	45.00	42.30	8.55	58.86	4.14	4.64	14.22	6.88
MVMR-4	0.00	14.00	14.00	13.16	6.90	62.62	2.58	6.61	24.27	9.08
MVMR-5	0.00	1.00	1.00	0.94	8.73	51.52	6.60	3.36	7.81	5.90
MVMR-5	17.00	19.00	2.00	1.88	13.20	50.19	10.71	2.10	4.69	3.80
MVMR-6	0.00	1.00	1.00	0.94	11.26	50.53	9.69	2.41	5.21	4.49
MVMR-6	21.00	23.00	2.00	1.88	14.65	47.74	12.49	1.76	3.82	3.26
MVMR-6	27.00	36.00	9.00	8.46	15.08	46.49	13.48	1.63	3.45	3.08
MVMR-7	0.00	14.00	14.00	13.16	13.23	53.62	5.75	2.83	9.33	4.05
MVMR-8	0.00	6.00	6.00	5.64	10.78	58.00	3.27	4.13	17.74	5.38
MVMR-10	0.00	10.00	10.00	9.40	11.64	60.39	0.74	4.88	81.61	5.19
MVMR-11	0.00	8.00	8.00	7.52	8.33	62.37	1.79	6.16	34.84	7.49
MVMR-12	16.00	17.00	1.00	0.94	16.16	45.50	16.47	1.39	2.76	2.82

MVMR-13	0.00	3.00	3.00	2.82	31.60	45.97	1.88	1.37	24.45	1.45
MVMR-13	9.00	10.00	1.00	0.94	25.74	50.66	1.78	1.84	28.46	1.97
MVMR-13	14.00	30.00	16.00	15.04	29.81	47.21	1.40	1.51	33.72	1.58
MVMR-13	35.00	36.00	1.00	0.94	28.93	48.15	1.53	1.58	31.47	1.66
MVMR-15	0.00	6.00	6.00	5.64	31.23	46.39	0.68	1.45	68.22	1.49
MVMR-16	31.00	32.00	1.00	0.94	32.76	45.51	1.53	1.33	29.75	1.39
MVMR-17	24.00	35.00	11.00	10.34	30.07	45.28	4.17	1.32	10.86	1.51
MVMR-17	42.00	45.00	3.00	2.82	31.22	46.97	0.86	1.46	54.62	1.50
MVMR-18	0.00	8.00	8.00	7.52	9.89	56.78	6.75	3.41	8.41	5.74
MVMR-18	27.00	30.00	3.00	2.82	30.79	45.73	2.80	1.36	16.33	1.49
MVMR-18	32.00	34.00	2.00	1.88	30.32	46.19	2.94	1.39	15.71	1.52
MVMR-19	9.00	43.00	34.00	31.96	11.91	58.77	2.64	4.04	22.26	4.93
MVMR-20	0.00	11.00	11.00	10.34	7.58	61.14	1.55	6.70	39.45	8.07
MVMR-21	6.00	9.00	3.00	2.82	9.90	57.30	5.27	3.78	10.87	5.79
MVMR-23	0.00	4.00	4.00	3.76	6.95	60.41	6.05	4.65	9.99	8.69
MVMR-25	0.00	41.00	41.00	38.54	4.11	64.51	2.07	10.44	31.16	15.70
MVMR-27	2.00	3.00	1.00	0.94	18.97	51.28	1.01	2.57	50.77	2.70
MVMR-27	40.00	41.00	1.00	0.94	32.41	45.64	1.53	1.34	29.83	1.41
MVMR-28	0.00	38.00	38.00	35.72	28.69	46.38	3.29	1.45	14.10	1.62
MVMR-29	0.00	42.00	42.00	39.48	28.12	47.82	2.18	1.58	21.94	1.70
MVMR-30	0.00	6.00	6.00	5.64	19.82	50.58	4.89	2.05	10.34	2.55
MVMR-32	0.00	1.00	1.00	0.94	24.44	46.73	7.13	1.48	6.55	1.91
MVMR-32	4.00	5.00	1.00	0.94	14.06	50.53	9.43	2.15	5.36	3.59
MVMR-32	17.00	25.00	8.00	7.52	25.60	45.72	6.09	1.44	7.51	1.79
MVMR-32	33.00	36.00	3.00	2.82	23.65	48.57	3.23	1.81	15.04	2.05
MVMR-34	0.00	3.00	3.00	2.82	12.68	52.59	6.53	2.74	8.05	4.15
MVMR-36	0.00	46.00	46.00	43.24	6.35	63.29	2.10	7.49	30.14	9.97
MVMR-37	0.00	8.00	8.00	7.52	29.51	47.15	1.24	1.53	38.02	1.60
MVMR-37	14.00	16.00	2.00	1.88	24.91	49.98	2.30	1.84	21.73	2.01
MVMR-37	55.00	56.00	1.00	0.94	34.06	45.23	0.77	1.30	58.74	1.33
MVMR-38	0.00	24.00	24.00	22.56	6.41	63.37	2.27	7.30	27.92	9.89
MVM-39	0.00	49.00	49.00	46.07	2.45	65.83	2.25	14.01	29.26	26.87
MVM-40	0.00	27.50	27.50	25.85	11.85	59.89	1.80	4.39	33.27	5.05
MVM-41	1.00	27.50	26.50	24.91	3.95	63.45	2.54	9.78	24.98	16.06
MVM-42	25.50	42.00	16.50	15.51	19.82	45.66	10.67	1.50	4.28	2.30
MVM-44	0.00	2.00	2.00	1.88	12.32	57.47	4.96	3.33	11.59	4.66
MVM-44	8.00	9.00	1.00	0.94	20.24	53.90	2.18	2.40	24.72	2.66
MVM-45	0.00	28.75	28.75	27.03	16.25	52.55	6.75	2.28	7.79	3.23
MVM-47	0.00	18.50	18.50	17.39	11.66	59.73	2.22	4.30	26.91	5.12
MVM-48	0.00	28.50	28.50	26.79	9.91	59.78	1.47	5.25	40.67	6.03

(iv) Mineralisation Factor

Mineralogy of an iron deposit has a great influence in the ore treatment characteristics and economics. Magnetite is recoverable by relatively simple economical magnetic separation while haematite, goethite, siderite require expensive roasting or flotation processes. Although when the grains are coarse, haematite ore may get treated with low cost. Mineralisation factor is the ratio of net ore bearing area to gross area. It is referred as the co-

efficient of impurities. The mineralization factor for M/s V.S. Lad and Sons Mining Lease Area (ML No. 2290) is 4.067

(v) Physical Characteristics of Ore

The ore are lateritic ore, massive ± laminated, soft laminated, blue dust, limonitic ore, powdery, and siliceous ore.

Principal ore minerals are haematite + magnetite, goethite and limonite.

(vi) Chemical Characteristics of the Iron Ore

In the entire deposit, the high grade ore is almost free from laterisation and the laterite area is very less (2-3%), whereas the blue dust area ranges about 5%. However, the blue dust mostly contains more haematite, therefore, good quantity of haematitic ore could be easily available from the blue dust. The haematitic ore persists even beyond the level of exploration as could be visualize from the geological cross sections (S2 – S2' to S21 – S21'), over the strike length of 1891m.

Silica to Alumina ratio ranges between 0.15 and 0.91 with the average of 0.35 indicating low level of lateritisation; whereas the Iron to Alumina ratio for the M/s V.S. Lad and Sons Mining Lease Area (ML No. 2290) is 0.081. The ore in general is rich in iron [>55%Fe], but they also contain 1-7.99% Al_2O_3 and the ore deposits normally have Al_2O_3: Fe ratio around 0.01 – 0.29 average being 0.08.

(vii) Estimation of Reserves / Resources and Grade

After delineating the limit of non-ore (45%) and boundaries of different litho-units, the geometry of the ore body have been demarcated and the sectional area has been computed by the software using AutoCAD. Thus, the volume has been calculated by multiplying the sectional area with sectional influence.

Ore resource tonnage has been estimated by multiplying the volume with the tonnage factor of specific gravity of 3.50. The sum has been considered as geological in-situ resources.

At the back drop of iron ore extraction from the lease hold area of M/s V.S. Lad and Sons Mining Lease Area (ML No. 2290), over an average strike length of 1981.00m, 525.00m

wide and up to the average vertical true depth of 38.69m, allow us to presume that the iron ore zone has wide consistent continuity. Moreover, iron ore has been extracted from Kumaraswamy range not only by NMDC but also by SMIORE since Independence. However, Dalmia International, also extracted the ore from NEB range since Independence only for export. Therefore, UNFC code pertains to economical, feasibility and geological axis of (111) (121) & (122) have been assigned. The estimates of reserves and resources at 45% Fe cut off are given in Table -1.6.

It reveals that the lease area has the extension of about 1981.00m length along the N60°E-S60°W with an average wide area of 525.00m. A total 28.618 m.t. of net reserves with average grade of 56.69% Fe, 13.31% SiO_2 and 3.40% Al_2O_3 have been estimated.
A summary of the category wise Geological reserve estimated for this mine is given in table below:

Table-1.6: Geological Reserves

Category	**UNFC**	**Geological Reserves (tonnes)**
Proved	111	18336716
Probable	121/122	8352917
Inferred	333	1929120
	Total	**28,618,753**
	Average Fe %	**56.69%**
Source: Table-5, Page No. 27-29 of MECL Report		

k) (i) Detailed calculation of reserves /resources by Cross section method

As detailed exploration has been carried out by MECL, the details of estimation of reserves /resources are based on their report. Resources have been estimated by geological cross section method. In order to delineate the ore and non-ore zones, the grade or threshold value of 45% Fe has been adopted, thus non-ore above and below ore zones has been demarcated. At threshold cutoff of 45% Fe as stipulated by IBM, the mineralized zone was demarcated within the lease hold area and the respective ore reserves are estimated.

A total of 21 geological cross sections serially numbered S1 – S1' to S21 – S21' from northeast to southwest (along N60°E – S60°W) direction have been prepared based on the

interpretation of subsurface borehole qualitative data along with surface geological data which is perpendicular to general strike of the ore body.

50.0m on either side of the iron ore intersection of the borehole has been placed under (111), the next 50.0m under (121) category of UNFC. Correction factor of 1.10 for thickness of iron ore in strike direction has been applied. Similarly, a correction factor of 0.848 has been applied to get the true thickness.

Area explored under different level of exploration has been marked on the geological plan **(Plate No. II(b).**

As detailed exploration has been carried out by M/s MECL, following data is furnished based on M/s MECL report. Section Wise, Borehole Wise, as well as UNFC Category wise reserves are furnished in table 1.7.

Detailed calculation of Mineable ore reserves/resources section-wise

TABLE-1.7: SECTION-WISE, BOREHOLE-WISE, CATEGORY-WISE MINEABLE ORE RESERVES ESTIMATED BY CROSS SECTION METHOD

Section Number	Borehole Number	Intersection (m)		Diff (m)	True Width (m)	Average sectional Influence (m)	Area (Sq.m) (111)	Area (Sq.m) (121)	Area (Sq.m) (333)	Bulk Density	Reserves (Tonnes) (111)	Reserves (Tonnes) (121)	Reserves (Tonnes) (333)	Total Reserve and Resources	Grade		
		From	To												Fe%	SiO2%	Al2O3%
S1-S1'	MVMR-1	25	34	9	8.46	103.3	0	1522.9583	292.9249	3.0	0	471964.777	90777.42651	562742.2037	48.7	11.9	10.79
	MVMR-44	0	2	2	1.88	103.3	0	287.6888		3.0	0	89154.7591	0	89154.75912	57.47	12.32	4.96
	Sub-Total :										0	**561119.536**	**90777.42651**	**651896.9628**	**49.9**	**11.96**	**9.99**
S2-S2'	MVMR-5	17	19	2	1.88	64.6	222.1034	149.9203		3.0	43043.6389	29054.5541	0	72098.19306	50.19	13.2	10.71
	MVMR-7	0	14	14	13.16	64.6	1302.3264	131.1443		3.0	252390.856	25415.7653	0	277806.6217	53.62	13.23	5.75
	Sub-Total :										**295434.495**	**54470.3195**	**0**	**349904.8147**	**52.91**	**13.22**	**6.77**
S3-S3'	MVMR-3	0	45	45	42.3	38.49	3250.695	2341.3815	6679.7746	3.0	375357.752	270359.322	771313.5731	1417030.647	58.86	8.55	4.14
	Projection Influence					46.6	710.117			3.0	99274.3566	0	0	99274.3566	58.86	8.55	4.14
	MVM-40	0	27.5	27.5	25.85	38.49	2344.2451	194.5739		3.0	270689.982	22467.4482	0	293157.4299	59.89	11.85	1.8
	Sub-Total :									3.0	**745322.09**	**292826.77**	**771313.5731**	**1809462.433**	**59.03**	**9.08**	**3.76**
S5-S5'	MVMR-13	0	3	3	2.82	66.6	450.8423	833.4901	1600.7577	3.0	90078.2915	166531.322	319831.3885	576441.002	45.97	31.6	1.88
		14	30	16	15.04	66.6	1576.7367	1135.0266	630.8296	3.0	315031.993	226778.315	126039.7541	667850.0614	47.21	29.81	1.4
	Sub-Total :										**405110.284**	**393309.637**	**445871.1425**	**1244291.063**	**46.63**	**30.65**	**1.62**
S6-S6'	MVMR-6	21	23	2	1.88	97.65	201.334	10.7791		3.0	58980.7953	3157.73735	0	62138.53265	47.74	14.65	12.49
		27	36	9	8.46	97.65	903.1695	315.7819		3.0	264583.505	92508.3076	0	357091.8126	46.49	15.08	13.48
	MVMR-4	0	14	14	13.16	97.65	1160.2267	121.0259		3.0	339888.412	35454.5374	0	375342.9492	62.62	6.9	2.58
	Sub-Total :										**663452.712**	**131120.582**	**0**	**794573.2944**	**54.21**	**11.18**	**8.25**
S7-S7'	MVMR-11	0	8	8	7.52	98.2	1077.5821			3.0	317455.687	0	0	317455.6867	62.37	8.33	1.79
	Projection Influence			0		54.4	1554.9883			3.0	253774.091	0	0	253774.0906	62.37	8.33	1.79
	MVMR-48	0	28.5	28.5	26.79	98.2	2811.0233			3.0	828127.464	0	0	828127.4642	59.78	9.91	1.47
	Sub-Total :									3.0	**1399357.24**	**0**	**0**	**1399357.241**	**60.84**	**9.27**	**1.6**

Section Number	Borehole Number	Intersection (m)		Diff (m)	True Width (m)	Average sectional Influence (m)	Area (Sq.m) (111)	Area (Sq.m) (121)	Area (Sq.m) (333)	Bulk Density	Reserves (Tonnes) (111)	Reserves (Tonnes) (121)	Reserves (Tonnes) (333)	Total Reserve and Resources	Grade		
		From	To												Fe%	SiO2%	Al2O3%
S8-S8'	MVMR-8	0	6	6	5.64	95.95	375.8976			3.0	108202.124	0	0	108202.1242	58	10.78	3.27
	Sub-Total :										**108202.124**	**0**	**0**	**108202.1242**	**58**	**10.78**	**3.27**
S9-S9'	MVM-41	0	28.5	28.5	26.79	107.44	0	4781.2875	904.1298	3.0	0	1541104.59	291419.1171	1832523.704	60.46	4.37	2.83
	MVMR-38	0	24	24	22.56	107.44	0	3995.464		3.0	0	1287817.96	0	1287817.956	63.37	6.41	2.27
	MVM-39	0	49	49	46.07	107.44	0	7883.251		3.0	0	2540929.46	0	2540929.462	65.83	2.45	2.25
	Sub-Total :										**0**	**5369852.01**	**291419.1171**	**5661271.123**	**63.53**	**3.97**	**2.44**
S10-S10'	MVMR-34	0	3	3	2.82	88.44	159.6338	147.5029		3.0	42354.0398	39135.4694	0	81489.50924	52.59	12.68	6.53
	MVMR-10	0	10	10	9.4	88.44	1114.2717	367.798		3.0	295638.567	97584.1654	0	393222.7328	60.39	11.64	0.74
	Sub-Total :										**337992.607**	**136719.635**	**0**	**474712.242**	**59.05**	**11.82**	**1.73**
S11-S11'	MVMR-37	0	8	8	7.52	67	845.5953	362.159		3.0	169964.655	72793.959	0	242758.6143	47.15	29.51	1.24
		14	16	2	1.88	67	205.5261	172.5731		3.0	41310.7461	34687.1931	0	75997.9392	49.98	24.91	2.3
	Sub-Total :										**211275.401**	**107481.152**	**0**	**318756.5535**	**47.82**	**28.41**	**1.49**
S12-S12'	MVMR-36	0	46	46	43.24	65.2	4174.2535	2007.6033		3.0	816483.985	392687.205	0	1209171.19	63.29	6.35	2.1
	MVMR-15	0	6	6	5.64	65.2	385.1942	224.2556	276.84	3.0	75343.9855	43864.3954	54149.904	173358.2849	46.39	31.23	0.68
	Sub-Total :										**891827.97**	**436551.601**	**54149.904**	**1382529.475**	**61.29**	**9.29**	**1.93**
S13-S13'	MVM-42	25.5	42	16.5	15.51	90.1	1655.1314	941.4472		3.0	447382.017	254473.178	0	701855.1956	45.66	19.82	10.67
	Sub-Total :										**447382.017**	**254473.178**	**0**	**701855.1956**	**45.66**	**19.82**	**10.67**
S14-S14'	MVMR-17	24	35	11	10.34	100.9	0	1300.80		3.0	0	393752.16	0	393752.16	45.28	30.07	4.17
		42	45	3	2.82	100.9	0	438.57		3.0	0	132755.139	0	132755.139	46.97	31.22	0.86
	Sub-Total :										**0**	**526507.299**	**0**	**526507.299**	**45.71**	**30.36**	**3.34**

Section Number	Borehole Number	Intersection (m)		Diff (m)	True Width (m)	Average sectional Influence (m)	Area (Sq.m) (111)	Area (Sq.m) (121)	Area (Sq.m) (333)	Bulk Density	Reserves (Tonnes) (111)	Reserves (Tonnes) (121)	Reserves (Tonnes) (333)	Total Reserve and Resources	Grade		
		From	To												Fe%	SiO2%	Al2O3%
S15-S15'	MVMR-25	0	41	41	38.54	93.8	3968.6	1623.053		3.0	1116764.04	456727.114	0	1573491.154	64.51	4.11	2.07
	Sub-Total :										**1116764.04**	**456727.114**	**0**	**1573491.154**	**64.51**	**4.11**	**2.07**
S16-S16'	MVMR-21	6	9	3	2.82	101	0	282.55		3.0	0	85612.65	0	85612.65	57.3	9.9	5.27
	MVMR-23	0	4	4	3.76	101	0	348.0013		3.0	0	105444.394	0	105444.3939	60.41	6.95	6.05
	MVMR-29	0	42	42	39.48	101	0	4676.3		3.0	0	1416918.9	0	1416918.9	47.82	28.12	2.18
	Sub-Total :										**0**	**1607975.94**	**0**	**1607975.944**	**49.15**	**25.76**	**2.6**
S17-S17'	MVM-45	0	25.75	25.75	27.03	103.4	0	3164.4		3.0	0	981596.88	0	981596.88	52.55	16.25	6.75
	Sub-Total :										**0**	**981596.88**	**0**	**981596.88**	**52.55**	**16.25**	**6.75**
S18-S18'	MVMR-30	0	6	6	5.64	103	0	691.772		3.0	0	213757.548	0	213757.548	50.58	19.82	4.89
	MVMR-18	0	8	8	7.52	103	0	552.39		3.0	0	170688.51	0	170688.51	56.78	9.89	6.75
		27	30	3	2.82	103	0	353.06		3.0	0	109095.54	0	109095.54	45.73	30.79	2.8
		32	34	2	1.88	103	0	251.4		3.0	0	77682.6	0	77682.6	46.19	30.32	2.94
	MVM-47	0	18.5	18.5	17.39	103	0	1790		3.0	0	553110	0	553110	59.73	11.66	2.22
	Sub-Total :										**0**	**1124334.2**	**0**	**1124334.198**	**55.24**	**16.1**	**3.52**
S19-S19'	MVMR-28	0	38	38	35.72	95.2	3070.3424	1902.867		3.0	876889.789	543458.815	0	1420348.605	46.38	28.69	3.29
	MVMR-32	17	25	8	7.52	95.2	711.6135	218.553		3.0	203236.816	62418.7368	0	265655.5524	45.72	25.6	6.09
		33	36	3	2.82	95.2	245.264	45.4438		3.0	70047.3984	12978.7493	0	83026.14768	48.57	23.65	3.23
	Sub-Total :										**1150174**	**618856.301**	**0**	**1769030.305**	**46.38**	**28.02**	**3.69**
S21-S21'	MVMR-19	9	43	34	31.96	89.25	4181.6435	2475.71		3.0	1119635.05	662871.353	0	1782506.4	58.77	11.91	2.64
	MVMR-20	0	11	11	10.34	89.25	1001.322			3.0	268103.966	0	0	268103.9655	61.14	7.58	1.55
	Sub-Total :										**1387739.01**	**662871.353**	**0**	**2050610.365**	**59.08**	**11.35**	**2.5**
	Total										**9160034**	**13716793.5**	**1653531.163**	**24530358.67**	**56.69**	**13.31**	**3.4**
											NET RESOURCES :			**23303841**	**56.69**	**13.31**	**3.4**

(ii) Detailed calculation of reserves /resources by Slice plan method

Levels	GEOLOGICAL IRON ORE RESOURCES					
	Area	Influ	Volume	Recovery	TF	Quantity
	sqm.	Mtr	CuMtr	95%		tons
810	2178	8	17424	16553	3.5	57934.8
818	7102	8	56816	53975	3.5	188913.2
826	12734	8	101872	96778	3.5	338724.4
834	27755	8	222040	210938	3.5	738283
842	38562	8	308496	293071	3.5	1025749.2
850	47762	8	382096	362991	3.5	1270469.2
858	64771	8	518168	492260	3.5	1722908.6
866	97044	8	776352	737534	3.5	2581370.4
874	117476	8	939804	892814	3.5	3124849.409
882	99579	8	796634	756803	3.5	2648809.178
890	80687	8	645497	613222	3.5	2146277.621
898	92431	8	739451	702478	3.5	2458673.95
906	80907	8	647254	614892	3.5	2152120.391
914	102299	8	818393	777474	3.5	2721157.8
922	70226	8	561808	533718	3.5	1868011.398
930	67528	8	540223	513212	3.5	1796242.951
938	25220	8	201760	191672	3.5	670852
946	20502	8	164016	155815	3.5	545353.2
TOTAL						28056700.7

Levels	MINEABLE IRON ORE RESERVES					
	Area	Influ	Volume	Recovery	TF	Quantity
	sqm.	Mtr	CuMtr	95%		tons
810	2178	8	17424	16553	3.0	49658.4
818	7102	8	56816	53975	3.0	161925.6
826	12734	8	101872	96778	3.0	290335.2
834	27755	8	222040	210938	3.0	632814
842	38562	8	308496	293071	3.0	879213.6
850	47762	8	382096	362991	3.0	1088973.6
858	64771	8	518168	492260	3.0	1476778.8
866	97044	8	776352	737534	3.0	2212603.2
874	117476	8	939804	892814	3.0	2678442.351
882	99579	8	796634	756803	3.0	2270407.867
890	80687	8	645497	613222	3.0	1839666.532
898	92431	8	739451	702478	3.0	2107434.814
906	80907	8	647254	614892	3.0	1844674.62
914	102299	8	818393	777474	3.0	2332420.971
922	70226	8	561808	533718	3.0	1601152.627
930	67528	8	540223	513212	3.0	1539636.815
938	25220	8	201760	191672	3.0	575016
946	20502	8	164016	155815	3.0	467445.6
TOTAL						24048600.6

These reserves estimated by slice plan method are compared with geological reserves and Mineable Reserve estimated by cross sectional method as below:

Table: Comparison of reserves/resources in tonnes

	Reserves/ Resources	**Slice Plan Method**	**Cross Sectional Method**	**Variation**
Iron Ore +45% Fe	Geological resources	***28056700***	***28,618,753***	1.96%
	Mineable Reserve	***24048600***	***23,303,841***	3.19%

From the above it is evident that the mineable reserves estimated by cross section method is lower than that of by slice plan method and the variance is also within the limits.

Bench wise slice plans are enclosed as **Plate no VIII(a) to VIII(r)** (**Slice 946, 938, 930.…810).**

l) Mineral Resources:

Following parameters have been considered by MECL for estimating the Geological reserves/resources:

(i) Bulk density of 3.5 t/m^3

(ii) Cut-off grade of 45% Fe.

(iii) Call factor of 10% reduction and correction factor of 1.10 and 0.848 based on the true thickness of the ore body obtained during drilling.

(iv) Demarcation of the ore body has been done based on the exploration data and the respective cross sections were prepared accordingly.

(v) 50 m on either side of the iron ore intersection of the boreholes has been placed under 111 and the next 50 m under 121 of UNFC.

(vi) 7.50 m Buffer zone (safety zone) area has been considered.

Details of section wise geological reserves as per MECL is given in **Annexure XI**, A summary of same is given below:

Category	**UNFC**	**Reserves/Resources (tonnes)**	**Average Grade**
Proved	111	18,336,716	56.69 %
Probable	121/122	8,352,917	
Inferred	333	1,929,120	
Total		**28,618,753**	

However mineable reserves have not been estimated by MECL. Taking into account physical characteristics and grade of the ore, a bulk density of 3 t/m^3 and 95% of the ore recovery has been considered for estimating the mineable reserves. The same parameters have also been considered in the approved R&R plan. Following are the details of the reserves estimated:

Category	**UNFC**	**Reserves/Resources (tonnes)**	**Average Grade**
Proved	111	8,702,032	56.69 %
Probable	121/122	13,030,954	
Inferred	333	1,570,855	
Total		**23,303,841**	

Inferred resources are less than 50% of proved plus probable reserves, they can be considered as reserves only. Hence the mineable reserves would be 23,303,841 tonnes or say 23.30 million tonnes which may be considered as reserves.

Table – 1.8: Total resources in tonnes as on 01.01.2017

Level of Exploration	Iron Ore(tonnes)	Average Grade
G1 - Detailed Exploration	18,336,716	56.69 %
G2 - General Exploration	8,352,917	
G3 – Prospecting	1,929,120	
G4- Reconnaissance	--	

ESTIMATION OF RESERVES / RESOURCES AND GRADE

After delineating the limit of non-ore zone (45%) and boundaries of different litho-units, the geometry of the ore body have been demarcated and the sectional area has been computed by using AutoCAD software. Thus, the volume has been calculated by multiplying the sectional area with sectional influence.

Ore resource tonnage has been estimated by multiplying the volume with the tonnage factor of bulk density of 3.50. The sum has been considered as geological in-situ resources.

At the back drop of iron ore extraction from the leasehold area of Devadari Iron Ore Mine, (ML No. 2290), over an average strike length of 1981.00m, 525.00m wide and up to an average thickness (depth) of 38.69m, allows us to presume that the iron ore zone has wide consistent continuity. Moreover, iron ore has been extracted from Kumaraswamy range not only by NMDC but also by SMIORE since Independence. However, Dalmia International, also extracting the ore from NEB range since Independence only for export. Therefore, UNFC code pertains to economical, feasibility and geological axis of (111) (121) and (121) have been assigned. The estimates of reserves and resources at 45% Fe cut off are given in Table-1.4.

It reveals that the lease area has an extension of about 1981.00m length along N60°E-S60°W direction with an average wide area of 525.00m. A total 28.618 m.t. of net-reserves estimated with an average grade of 56.69% Fe, 13.31% SiO_2 and 3.40% Al_2O_3.

RICE RATIO

Fe : SiO_2 + Al_2O_3ratio is 3.752 for the entire lease hold area [S1-S1' to S21-S21']. The Al_2O_3: SiO_2 ratio is 0.351 and Al_2O_3 : Fe is 0.081 from the weight percent recovery of iron, if entire ore material be fully utilized.

Table-1.9: Resources and Reserves in tonnes

Classification	*UNFC Code*	*Iron Ore (tonnes)*	*Average Grade*
A. Total Mineral Reserve			*56.69% Fe*
1.Proved Mineral Reserve	*111*	*18,336,716*	
2.Probable Mineral Reserve	*121&122*	*8,352,917*	
B. Total Remaining Resources			
1.Feasibility Mineral Resource	*211*		
2.Prefeasibility Mineral Resource	*221 and 222*		
3.Measured Mineral Resource	*331*		
4.Indicated Mineral Resource	*332*		
5.Inferred Mineral Resource	*333*	*1,929,120*	
6.Reconnaissance Mineral Resource	*334*		
Total Reserve + Resources		***28,618,753***	

Note: *It may not be possible to quantify grade wise reserves, as normally there is considerable variation in size and grade distribution within the ore zone, which results into variable recovery factor and bulk density. Thus, tonnages arrived are tentative.*

2.0 MINING

A. Open Cast Mining

a) Brief description of the existing as well as proposed method for excavation with all design parameters indicating on plans /sections

i) Existing Method of Excavation

The mining operations were earlier carried out by open cast, fully mechanized mining method using HEMM. Only one pit has been worked at NW-SE direction spreading all along the length of the lease area. Only a small portion of mine pit was encroached towards east (EP-1) and north (EP-2). The ML area is divided into three mining blocks *i.e.*, A, B and C, which were worked on both slopes of the hill all along the strike length of the ML. The mine pit was worked in unsystematic/haphazard manner by selective mining leaving leaner grade and hard strata of ore/non mineralized portion in between. The benches were worked in uneven manner and no regular or systematic benches were formed. The total number of 3-8 benches were worked in the mining pits and an overall pit slope angle is about 45 degrees. The total strike length of the mine working is about 1200m and its width is ranging from 320m to 550m. The average height of the benches is varying between 4-12m and width 8m with slope of 60 degrees. Top most RL is 966m while ultimate pit depth would be 802m.

ii) Proposed Method for Excavation

Fully mechanized open cast method of mining by drilling and blasting and deployment of HEMM equipments like hydraulic excavators, wheel loaders and dumpers, will be undertaken. For this plan period, benches which were worked unsystematically and haphazardly need to be corrected at the beginning, to achieve optimum exploitation of the mineral deposit, the mine will be developed by top slicing, making benches with a height and width of 8m each and keeping the necessary berm width. It is proposed to develop elongated bench faces in 4th and 5th year depending on the face profile, feasible stripping ratio. The slope of faces will be maintained as 80^0-85^0 to horizontal and the direction of advancement will be towards northern side of the proposed working area. These aspects have been depicted on the production & development plans. The ROM excavated will be processed in the mobile crushing and screening plants to obtain the final product and the waste generated will be dumped in the designated places.

The finished products, i.e. lump ore and fine ore will be loaded into tippers and will be stacked at the ore stockyard. As this mine will be used for captive purpose only, entire quantity of finished product from stockyards will be dispatched to JSW Steel Plant by rail and/or road. In future pipe conveyor may also be used after carrying out necessary feasibility studies.

The total Mining lease area will be covered by two major pit having the dimension given below:

Pit Number	Dimension LXWX D	Top RL	Bottom RL	No. of benches
1	850 X 220 X 60	960	902	8
2	650X110X35	950	910	5

b) Year-wise tentative Excavation in Cubic Meters indicating development, ROM, pit wise

(i) Insitu Tentative Excavation:

As per the Plans and Section **(Plate no. III(a) to III(e) & III(f)** drawn for the designed parameters, the year wise tentative excavation both in Cum. and tonnage is given below:

Table 2.1 Proposed year wise tentative Excavation in Cum

Year	Pit No.	Total tentative Excavation (m^3)	Top oil (m^3)	OB/SB/IB (m^3)	ROM (m^3)		Total Mineral Reject (m^3)	ROM/ waste Ratio
					Ore (m^3)	Intercalated Waste (m^3)		
I	I	1431626	-	1043293	388333	-	-	1:2.69
II	I	900669	-	512336	388333	-	-	1:1.31
III	I	865620	-	477287	388333	-	-	1:1.23
IV	I	961289	-	572956	388333	-	-	1:1.48
V	I	1306796	-	918463	388333	-	-	1:2.37
Total		**5466000**	**-**	**3524335**	**1941665**	**-**	**-**	

Table 2.2 Proposed year wise tentative Excavation in Tonnes

Year	Pit No.	Total tentative Excavation (tonnes)	Top Soil (tonnes)	OB/SB/IB (tonnes)	ROM (tonnes)		Total Mineral Reject (tonnes)	ROM/ waste Ratio
					Ore (tonnes)	Intercalated Waste (Tonnes)		
I	I	3251586	-	2086586	1165000	-	-	1:1.79
II	I	2189671	-	1024671	1165000	-	-	1:0.88
III	I	2119573	-	954573	1165000	-	-	1:0.82
IV	I	2310911	-	1145911	1165000	-	-	1:0.98
V	I	3001926	-	1836926	1165000	-	-	1:1.58
Total		**12873667**	-	**7048667**	**5825000**	**-**	**-**	

As the entire ROM (up to threshold value of +45% Fe) is consumed by the JSW steel plant, no mineral rejects are generated.

a) First year development & production

From the maps prepared for development and production **Plate No. III(a) & its Section Plate no. III(f)**, the benches are proposed to be formed between 914 and 866 m. Above MSL with 6 benches of width and height of 8 m each. For 1st year the total area Proposed for backfilling is 3.34 Ha The average ore to waste ratio works out to be 1:2.69 (in cum) and 1:1.79 (in tonnes). The total saleable ore amounts to 1165000 tonnes, while, the total waste of 2086586 tonnes likely to be generated will be stocked in the dump yard designated for the purpose.

b) Second year development & production

From the maps prepared for development and production **Plate No. III(b)& its Section Plate No III(f**), the benches are proposed to be formed between 906 and 842 m. Above MSL with 9 benches of width and height of 8 m each. For 2nd year the total area Proposed for backfilling is 4.67 Ha The average ore to waste ratio works out to be 1:1.31 (in cum) and 1:0.88 in tonnes. The total saleable ore amounts to 1165000 tonnes, while, the total waste of 1024671 tonnes likely to be generated will be stocked in the dump yard designated for the purpose.

c) Third year development & production

From the maps prepared for development and production **Plate No. III(c) & its Section Plate No.III(f)**, the benches are proposed to be formed between 962 and 842 m. Above MSL with 15 benches of width and height of 8 m each. For 3rd year the total area Proposed for dumping is 5.57 Ha The average ore to waste ratio works out to be 1:1.23 (in cum) and 1:0.82 in tonnes. The total saleable ore amounts to 1165000 tonnes, while, the total waste of 954573 tonnes likely to be generated will be stocked in the dump yard designated for the purpose.

d) Fourth year development & production

From the maps prepared for development and production **Plate No. III(d) & its Section Plate No.III(f)**, The benches are proposed to be formed between 962 and 826 m. Above MSL with 18 benches of width and height of 8 m each. For 4th year the total area Proposed for backfilling is 6.50 Ha The average ore to waste ratio works out to be 1:1.48 (in cum) and 1:0.98 in tonnes. The total saleable ore amounts to 1165000 tonnes, while, the total waste of 1145911 tonnes likely to be generated will be stocked in the dump yard designated for the purpose.

e) Fifth year development & production

From the maps prepared for development and production **Plate No. III(d) & its Section Plate No.III(f)**, the benches are proposed to be formed between 962 and 810 m. Above MSL with 20 benches of width and height of 8 m each. For 5th year the total area Proposed for backfilling is 6.52 Ha and temporary dump is 3 Ha. The average ore to waste ratio works out to be 1:2.37 (in cum) and 1:1.58 in tonnes. The total saleable ore amounts to 1165000 tonnes, while, the total waste of 1836926 tonnes likely to be generated will be stocked in the dump yard designated for the purpose.

Year-wise opening and closing balance of mineable reserves is mentioned in **table 2.3**

Table 2.3 Tentative opening and closing balance of mineable reserves for plan period

Year	Opening balance (Tonnes)	Tentative Year wise Production (Tonnes)	Closing Balance (Tonnes)
I	23,303,841	1165000	22138841
II	22138841	1165000	20973841
III	20973841	1165000	19808841
IV	19808841	1165000	18643841
V	18643841	1165000	17478841

First Year

PRODUCTION AND DEVELOPMENT PLAN - 1 YEAR

SECTION 2 - 2'

Level	Sectional influence	Proved (G - 1)			Intercalated waste @ 2 b.d with 5% ore	WASTE			TOTAL WASTE
		Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.		Sectional area	Volume	Quantity @ 2 b.d	
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
1882	66.6	15	969	2,762	97	517	33,298	66,796	66,893
+871	66.6	197	12,725	36,270	1,273	731	47,223	94,745	95,718
+886	66.6	160	10,335	29,458	1,034	662	42,119	84,258	85,292
Total				68,489	2,403			245,800	247,883

SECTION 3 - 3'

Level	Sectional influence	Proved (G - 1)			Intercalated waste @ 2 b.d with 5% ore	WASTE			TOTAL WASTE
		Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.		Sectional area	Volume	Quantity @ 2 b.d	
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+914	46.6	0	-	-	-	477	22,228	44,456	44,456
+906	46.6	0	-	-	-	1095	51,027	102,054	102,054
1898	46.6	249	11,503	33,070	1,160	1106	51,540	103,079	104,240
+890	46.6	801	37,327	106,381	3,733	763	35,556	71,112	74,844
+882	46.6	1405	65,478	186,598	6,547	407	18,966	37,932	44,480
+874	46.6	2102	97,953	279,167	9,795	103	4,800	9,600	19,395
+866	46.6	2305	107,413	306,127	10,741	0	-	-	10,741
Total				911,342	31,977			368,253	400,210

SECTION 4 - 4'

Level	Sectional influence	Proved (G - 1)			Intercalated waste @ 2 b.d with 5% ore	WASTE			TOTAL WASTE
		Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.		Sectional area	Volume	Quantity @ 2 b.d	
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
1914	38.5	0	-	-	-	1025	39,463	78,925	78,925
+906	38.5	0				1084	41,734	83,468	83,468
+898	38.5	0	-	-	-	1102	42,427	84,854	84,854
+890	38.5	0	-	-	-	1284	49,434	98,868	98,868
+882	38.5	0	-	-	-	1312	50,512	101,024	101,024
1874	38.5	0	-	-	-	1428	54,978	109,956	109,956
+866	38.5	0	-	-	-	1528	58,828	117,656	117,656
Total				-	-			674,751	674,751

SECTION 5 - 5'

Level	Sectional influence	Proved (G - 1)			Intercalated waste @ 2 b.d with 5% ore	WASTE			TOTAL WASTE
		Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.		Sectional area	Volume	Quantity @ 2 b.d	
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+922	66.6	0	-	-	-	166	13,989	21,978	21,978
+914	66.6	0	-	-	-	859	57,209	114,419	114,419
+906	66.6	0	-	-	-	924	61,538	123,077	123,077
+898	66.6	0				806	53,671	119,347	119,347
+890	66.6	185	12,321	35,113	1,232	986	65,668	131,335	132,567
+882	66.6	351	23,377	66,623	2,338	899	57,875	115,751	118,088
+874	66.6	440	29,304	83,516	2,930	986	65,668	131,335	134,266
Total				185,255	6,500			757,242	763,742

TOTAL ORE IN MT	1.165
Total Ore	1165086
Total waste	2086586
Ore to waste Ratio	1 : 1.79

Second Year

PRODUCTION AND DEVELOPMENT PLAN - II YEAR

SECTION 2 - 2'

Level	Sectional influence	Proved (G - 1)			Intercalated waste @ 2 b.d with 5% rec	WASTE			TOTAL WASTE
		Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.		Sectional area	Volume	Quantity @ 2 b.d	
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+858	54.6	0				729	47093	94187	94187
+850	54.6	59	4,457	12,704	446	859	55491	110983	111429
+842	54.6	575	37,145	1,05,863	3,715	536	34626	69251	72966
Total				1,18,567	4,160			274421	278581

SECTION 3 - 3'

Level	Sectional influence	Proved (G - 1)			Intercalated waste @ 2 b.d with 5% rec	WASTE			TOTAL WASTE
		Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.		Sectional area	Volume	Quantity @ 2 b.d	
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+858	46.6	2014	93,852	2,67,479	9,385	0	0	0	9385
+850	46.6	1725	80,385	2,29,097	8,039	54	2516	5033	13071
+842	46.6	1615	75,259	2,14,488	7,526	377	17568	35135	42662
Total				7,11,065	24,950			40169	65119

SECTION 4 - 4'

Level	Sectional influence	Proved (G - 1)			Intercalated waste @ 2 b.d with 5% rec	WASTE			TOTAL WASTE
		Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.		Sectional area	Volume	Quantity @ 2 b.d	
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+858	38.5	0	-	-	-	1108	42658	85316	85316
+850	38.5	0	-	-	-	1259	48472	96943	96943
+842	38.5	0	-	-	-	1328	51128	102256	102256
Total				-	-			284515	284515

SECTION 5 - 5'

Level	Sectional influence	Proved (G - 1)			Intercalated waste @ 2 b.d with 5% rec	WASTE			TOTAL WASTE
		Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.		Sectional area	Volume	Quantity @ 2 b.d	
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+866	56.6	609	40,559	1,15,594	4,056	921	61339	122677	126733
+858	56.6	701	46,687	1,33,057	4,669	939	62537	125075	129743
+850	56.6	458	30,503	86,933	3,050	1028	68465	136930	139980
Total				3,35,584	11,775			384682	396456

TOTAL ORE IN MT	1.165
Total Ore	1165216
Total waste	1024671
Ore to waste Ratio	1 : 0.88

Third Year:

PRODUCTION AND DEVELOPMENT PLAN - III YEAR

SECTION 6 - 6'									
Level	Sectional influence	Proved (G - 1)			Intercalated waste @ 2 h.d with 5% rec	WASTE			TOTAL WASTE
		Sectional area	Volume	Quantity @ 3 h.d with 95% Rec.		Sectional area	Volume	Quantity @ 2 h.d	
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+930	97.65	0	-	-	-	0	-	-	-
+922	97.65	155	15,136	43,137	1,514	188	18,358	36,715	38,230
+914	97.65	727	70,992	2,02,325	7,099	468	45,700	91,400	98,500
+906	97.65	350	34,178	97,406	3,418	1094	1,06,829	2,13,658	2,17,076
Total				3,42,869	12,030			3,41,775	3,53,805

SECTION 7 - 7'									
Section Number	Sectional influence	Proved (G - 1)			Intercalated waste @ 2 h.d with 5% rec	WASTE			TOTAL WASTE
		Sectional area	Volume	Quantity @ 3 h.d with 95% Rec.		Sectional area	Volume	Quantity @ 2 h.d	
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+946	98.2	0	-	-	-	20	1,964	3,928	3,928
+938	98.2	0	-	-	-	291	28,576	57,152	57,152
+930	98.2	849	84,372	2,37,610	8,437	139	13,680	27,360	35,637
+922	98.2	547	54,224	1,51,690	5,422	814	79,935	1,59,870	1,65,192
+914	98.2	752	73,846	2,10,462	7,385	819	80,426	1,60,852	1,68,236
+906	98.2	795	78,069	2,22,497	7,807	829	81,408	1,62,815	1,70,623
Total				8,22,258	28,851			5,71,917	6,00,768

TOTAL ORE IN MT	1.165
Total Ore	1165127
Total waste	954573
Ore to waste Ratio	1 : 0.82

Fourth Year:

PRODUCTION AND DEVELOPMENT PLAN - IV YEAR

SECTION 1 - 1'

Section Number	Sectional Influence	Proved (G - 1)			Intercalated waste @ 2 b.d with 5% rec	WASTE			TOTAL WASTE
		Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.		Sectional area	Volume	Quantity @ 2 b.d	
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+858	103.3	0	-	-	-	128	13,222	26,445	26,445
+850	103.3	0	-	-	-	458	47,311	94,623	94,623
+842	103.3	675	69,728	1,98,723	6,973	774	79,954	1,59,908	1,66,881
+834	103.3	965	99,685	2,84,101	9,968	420	43,386	86,772	96,740
+826	103.3	350	36,155	1,03,042	3,616	641	66,215	1,32,431	1,36,046
Total				**5,85,866**	**20,557**			**5,00,179**	**5,20,735**

SECTION 2 - 2'

Section Number	Sectional Influence	Proved (G - 1)			Intercalated waste @ 2 b.d with 5% rec	WASTE			TOTAL WASTE
		Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.		Sectional area	Volume	Quantity @ 2 b.d	
m	m	m2	m3	Tonnes	Tonnes	m2	m2	Tonnes	Tonnes
+834	64.6	840	54,264	1,54,652	5,426	650	41,990	83,980	89,406
+826	64.6	150	9,690	27,617	969	769	49,677	99,355	1,00,324
Total				**1,82,269**	**6,395**			**1,83,335**	**1,89,730**

SECTION 3 - 3'

Section Number	Sectional influence	Proved (G - 1)			Intercalated waste @ 2 b.d with 5% rec	WASTE			TOTAL WASTE
		Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.		Sectional area	Volume	Quantity @ 2 b.d	
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+834	46.6	1320	61,512	1,75,309	6,151	352	16,403	32,806	38,958
+826	46.6	950	44,270	1,26,170	4,427	536	24,978	49,955	54,382
Total				**3,01,479**	**10,578**			**82,762**	**93,340**

SECTION 4 - 4'

Section Number	Sectional influence	Proved (G - 1)			Intercalated waste @ 2 b.d with 5% rec	WASTE			TOTAL WASTE
		Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.		Sectional area	Volume	Quantity @ 2 b.d	
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+834	38.5	0	-	-	-	1598	61,523	1,23,046	1,23,046
+826	38.5	0	-	-	-	1663	64,026	1,28,051	1,28,051
Total				-	-			**2,51,097**	**2,51,097**

SECTION 5 - 5'

Section Number	Sectional influence	Proved (G - 1)			Intercalated waste @ 2 b.d with 5% rec	WASTE			TOTAL WASTE
		Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.		Sectional area	Volume	Quantity @ 2 b.d	
m	m	m2	m3	Tonnes	Tonnes	m2	m2	Tonnes	Tonnes
+842	66.6	505	33,633	95,854	2,363	658	43,823	87,646	91,009
Total				**95,854**	**2,363**			**87,646**	**91,009**

TOTAL ORE IN MT	**1.165**
Total Ore	**1165468**
Total waste	**1145911**
Ore to waste Ratio	**1 : 0.98**

Fifth Year:

PRODUCTION AND DEVELOPMENT PLAN - V YEAR

SECTION 3 - 3'

Section Number	Sectional Influence	Proved (G - 1) Sectional area	Proved (G - 1) Volume	Proved (G - 1) Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	WASTE Volume	WASTE Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+818	46.6	510	23,766	67,733	2,377	429	19,991	39,983	42,359
+810	46.6	165	7,689	21,914	769	438	20,411	40,822	41,591
Total				**89,647**	**3,146**			**80,804**	**83,950**

SECTION 4 - 4'

Section Number	Sectional Influence	Proved (G - 1) Sectional area	Proved (G - 1) Volume	Proved (G - 1) Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	WASTE Volume	WASTE Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+818	38.5	0				1258	48,433	96,866	96,866
+810	38.5	0				1041	40,079	80,157	80,157
Total				-	-			**1,77,023**	**1,77,023**

SECTION 5 - 5'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Proved (G - 1) Volume	Proved (G - 1) Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	WASTE Volume	WASTE Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+842	66.6	730	48,618	1,38,261	4,862	789	50,549	1,01,099	1,05,961
+834	66.6	670	44,622	1,27,173	4,462	1003	66,800	1,33,600	1,38,062
+826	66.6	755	50,283	1,43,307	5,028	1028	68,465	1,36,930	1,41,958
+818	66.6	451	30,037	85,604	3,004	643	42,824	85,648	88,651
+810	66.6	85	5,661	16,134	566	659	43,889	87,779	88,345
Total				**5,10,779**	**17,922**			**5,45,054**	**5,62,976**

SECTION 6 - 6'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Proved (G - 1) Volume	Proved (G - 1) Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	WASTE Volume	WASTE Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+898	97.65	260	25,389	72,359	2,539	1125	1,09,856	2,19,713	2,22,251
+890	97.65	730	71,285	2,03,161	7,128	968	94,525	1,89,050	1,96,179
+882	97.65	380	37,107	1,05,755	3,711	1325	1,29,386	2,58,773	2,62,483
Total				**3,81,274**	**13,378**			**6,67,535**	**6,80,913**

SECTION 7 - 7'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Proved (G - 1) Volume	Proved (G - 1) Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	WASTE Volume	WASTE Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+898	98.2	655	64,321	1,83,315	6,432	1658	1,62,816	3,25,631	3,32,063
Total				**1,83,315**	**6,432**			**3,25,631**	**3,32,063**

TOTAL ORE IN MT	**1.165**
Total Ore	**11,65,015**
Total waste	**18,36,926**
Ore to waste Ratio	**1 : 1.57**

Table – 2.4: Summary of production program

Year	Ore in Million tonnes	Waste in Million tonnes	Ore to waste ratio
First	1.165	2.08	1 : 1.79
Second	1.165	1.02	1 : 0.88
Third	1.165	0.95	1 : 0.82
Fourth	1.165	1.14	1 : 0.98
Fifth	1.165	1.83	1 : 1.57

II) Dump re-handling: (for the purpose of recovery of mineral):

In order to advance the benches certain portion of the ID-1 is required to be re-handled. The year wise proposed dump re-handling quantities for scientific advancement of benches is given the table below and the waste material so recovered would be backfilled in the designated place as proposed.

Dump ID	Year	Year wise Handling		Estimated Recovery of Saleable material (Cum)	Reject*	
		Cum	Tonnes		Cum	Tonnes
ID-1	First	18,000	36,000	-	18,000	36,000
	Second	1,300	2,600	-	1,300	2,600
	Third	8,900	17,800	-	8,900	17,800
	Fourth	-	-	-	-	-
	Fifth	-	-	-	-	-
	total	**28,200**	**56,400**	-	**28,200**	**56,400**

*In case the quality of the material is found to be useable by blending the same would be consumed and records will be maintained accordingly.

c) Individual year wise Production & Development Plans and sections:

Year wise Production and Development plans and sections are enclosed in 1:2000 scale. **(Plate IIIa, IIIb, IIIc, IIId &IIIe)**

Also combined production and development sections are enclosed in 1:2000 scale **(Plate IIIf)**

d) Salient features of the proposed method of working:

Open cast fully mechanized (category 'A') method of mining will be adopted to mine the iron ore deposit keeping in mind the quality, cost, safety and conservation of mineral.

Bench height will be 8m and width will be more than 8 m. The overall pit slope angle will be 45^0 max from the horizontal and individual bench slope will maintained at $80^{0.}$ Deep hole drilling and blasting techniques will be adopted to fragment the ore/waste formation. ROM will be fed to mobile crushing and screening plants to produce usable ore fractions. All waste material will be dumped systematically in the area earmarked.

Ore dispatch will be done by road to siding and JSW steel plant through trucks of 10/16/21 tons capacity. Loading will be carried out systematically and care will be taken to prevent spillage and dust generation. All loaded trucks will be covered by tarpaulins and water sprinkling will be ensured all along the haul roads and benches to avoid generation of dust during haulage. Other activities like water supply for domestic use, water sprinkling and afforestation will be done by water tankers.

(i) Drilling & Blasting:

Drilling and blasting will be carried out in hard formations. Drilling will be carried out with the help of hydraulic top hammer drills of 100 mm diameter. Blast parameter like Spacing, Burden, Depth of holes, explosive charge, stemming etc. will be decided as per the strata conditions. In general, for hard rock, spacing and Burden of 3 X 2.5 mts and depth of 8 mts will be followed. Controlled blasting with diagonal pattern firing will be in practice which is much safe, fragmentation is good and throw is within control. Sequential blasting, is done by using delay detonator or NONEL system of initiation which reduces vibration and flyrock has been proposed to be continued during the plan period. Rock breaker will be deployed to avoid secondary blasting. Scientific and safe blasting, as mentioned above, will be practiced for getting optimum blast results and minimization of hazards while preventive measures like marking of danger zone, arrangement of warning signals by siren etc. shall be adopted. Blasting shelters will be provided within the blasting danger zone.

Type of Explosives to be used

The most common type of explosive available readily e.g. Slurry/Emulsion cartridge explosives (83 mm)/ ammonium nitrate, fuel oil mixture (ANFO) will be used in the mines. Ammonium nitrate will be mixed with fuel oil (diesel) in a proportion of 94:6 prior to blasting at site.

(ii) Handling of Ore/Waste

In-situ Ore/Waste and Blasted Ore/Waste will be excavated by 1.6 Cum Bucket excavators and shifted by 20 T dumpers to the mobile Crushing and Screening plant for processing. The waste is mainly consisting of shale and BHQ. The waste generated will be backfilled in worked out area in the central portion of the lease as per R&R Plan and the Ore will be fed either directly to the screen or to the crushers depending on the type of ore. In the mobile Crushing & Screening unit two fraction of products will be segregated, undersize below 10mm which is treated as fines and 10 to 40 mm, is treated as calibrated lump ore.

In soft zone ore will be excavated by excavator/loader and loaded into 21 tonnes tippers and transported to screening plant. The oversize product will be transported to the mobile crushing unit for crushing. The fines and C-ore are stocked separately and based on the plant demand the Iron Ore products will be dispatched.

Finished products will be dispatched to the JSW Steel Plant, as the entire production is being consumed by the plant itself, where further beneficiation and upgradation of ore will be carried out inside the plant.

As per the requirement of the steel plant it is proposed to transport the ROM directly to the plant for further blending. Alternatively, ROM could also be sent to the stockyard located outside the lease area for processing and further transportation to the steel plant by prevailing system of transportation.

(iii) Production & Development Plan

Based on the availability of Mineral reserves, dump capacity and volume of traffic, annual production of 1.165 million tonnes PA. is considered as the feasible production level based on the capacity of reserves which is approved by CEC.

In the entire mine production and development benches in the waste and ore zone are oriented and worked along the strike of the ore body. The present position of working /pit layout dumps are shown in surface plan **(Plate no. II(a)** and Geological Plan **(Plate no. II(b)** and It is proposed to work in the sections from S1-S1’ to S7-S7’ during the plan period. The benches will be properly developed for a height of 8m & width of at least 8m.

The year wise benches proposed to be worked both in ore and overburden are shown in P&D plans and Cross Sections **(Plate No.III(a) to III(e)& Plate No.III(f)** for the plan period.

e) The layout of mine workings, pit road layout, layout of faces and sites for disposal of overburden/waste along with ground preparation prior to disposal of waste, reject etc.

Bench height will be 8m and width will be more than 8m. The overall pit slope angle will be 45^0 max from the horizontal. Approach road to workings will from western portion of lease area. The excavation of ore and waste will be done by excavators and hauled by 20 ton dumpers. Slope of the faces will be maintained at 80^0 degrees. Benches will be advancing towards southwest from northeast, including the benches would be laid along with the strike of the deposit. Drilling and blasting techniques will be used to break the hard ore/waste formation.

ROM will be fed to mobile crushing and screening plant to produce useable fractions. Haulage roads will be maintained with a gentle gradient of not more than 1:16 (except short ramps). The haul road will be maintained with prescribed width and gradient (except short ramp) and care will be taken to ensure all the safety measures in place. The approach road from active mining area to backfilling/dump yard will be maintained with more than 8 mts width and ramp with the gradient of 1:16.

During the first five years, it is proposed to produce 1.165 million tonnes of iron ore per annum at a stripping ratio of 1:1.79 (Maximum) about 7.04 million tonnes of waste is required to be handled during the first five year plan period.

The waste mainly consist of shale/Phylite and BHQ. The waste generated will be backfilled in worked out area in the central portion and also proposed temporary dump in the lease area as per R & R plan. The area demarcated for the back filling in this plan period is 6.52 Ha and 3.00 Ha for Temporary dump. Which is sufficient as it can hold 7.27 Million tonnes and the expected waste generation of about 7.04 Million tonnes in this plan period. Temporary dumping as well as back filling will be continued in the conceptual period also. Details of extent, co-ordinates and levels of working etc., are given below:

Table- 2.5: Year wise working details

Year	Area In Ha	No. of Benches	Level in mRL	Location Co-ordinates	
				Northing	Easting
First	6.75	6	906 to 866	1665733-166072	669537-669871
Second	9.06	9	906 to 842	1665728-1666089	669513-669898
Third	14.64	15	962 to 842	1665726--1666219	669414-669900
Fourth	17.48	18	962 to 826	1665654-1666219	669414-669933
Fifth	19.43	20	962 to 810	1665665-1666218	669414-669947

Table -2.6: Year wise quantity of Waste to be generated

Year	Topsoil		Waste		Mineral rejects		
	Reuse / Spreading	Storage	Backfilling	Temporary dump	Blending	Storage	Beneficiation
First	-	-	2086586	-	-	-	-
Second	-	-	1024671	-	-	-	-
Third	-	-	954573	-	-	-	-
Fourth	-	-	1145911	-	-	-	-
Fifth	-	-	144500	1692426	-	-	-

**** Before commencement of backfilling within the designated area, the traces of ore present will be removed completely within three months of first year plan period itself.***

f) Conceptual Mining plan

The mineable reserves estimated are 23.30 million tons and with the proposed production of 1.165 MTPA, the life of mine will be 20 years. Conceptual mine planning has been made considering the life of the mine. The life of mine will be enhanced depending upon the result of the exploration carried out during conceptual plan periods. The various R & R measures which is approved by ICFRE like Dump and encroached area management, Surface water management, Green belt Development, afforestation and Environmental monitoring (which are detailed in Table 2.8 and 2.9) are provided with a specific timeline which already detailed in Table 2.10, and we are committed to implement the recommendation on ground with prescribed timelines.

Conceptual Plan is enclosed in **Plate- VI.**

i) Excavation: In this lease about 81.15 ha area is mineralized. Considering the current exploration data and geology, pit layout is designed. The mining will be carried out in the already opened pits in this plan period and in the conceptual stage. The final pit limit is designed based on the ultimate pit slope and ultimate pit limit.

Table-2.6: UPL Parameters

Area (ha)	Pit Dimension			
	Length (m)	Width (m)	Depth (m)	Slope
81.15	1914	424	100	45^{o}

The ultimate pit limit is demarcated on the Geological Plan and Cross Sections are enclosed as **Plate II(b**) and **Plates II(c)** respectively. Location of proposed workings are shown in the year wise layout plans, **Plate III(a) to III(e).**

ii) Recovery of ROM: The recovery of ore from the reef ore zone is considered as 95% for production planning. The entire ROM (+45% Fe) has been proposed to be consumed by the JSW steel plant.

iii) Disposal of Waste: The waste mainly consist of shale/Phylite and BHQ. The waste generated will be backfilled in worked out area in the central portion and also proposed temporary dump in the lease area as per R & R plan. The area demarcated for the back filling in this plan period is 6.52 Ha and 3.00 Ha for Temporary dump. Which is sufficient as it can hold 7.27 Million tonnes and the expected waste generation of about 7.04 Million tonnes in this plan period. Temporary dumping as well as Backfilling will be continued in the conceptual period also. There is no mineral reject generation during plan period as all the +45% Fe material produced will be sent to JSW Steel plant.

iv) Backfilling of voids: Backfilling of mined out areas are proposed for waste dumping which is detailed in previous section.

v) Reclamation and Rehabilitation

For protection of the mining area and to prevent further degradation of land and stabilization of dumps, the measures that are proposed in the R&R plan will be carried out. The details of the same are given below:

The successful Reclamation and Rehabilitation plan for the mine will primarily depend on following considerations:

1. Rehabilitation and Reclamation of Encroached Areas.
2. Loose OB dumps and their stabilization
3. Mining pits, their back filling and stabilization
4. Nala/Stream courses and their stabilization
5. Development of vegetation on non-mineralized areas
6. Safety zone and Greenbelt Development
7. Avenue plantation all along mine haul roads

Reclamation and Rehabilitation Measures

The measures contemplated under the R and R plan are broadly categorized under the following heads:

1. R and R measures for areas considered under encroachment.
2. Stabilization of Dumps
3. Surface Water Management
4. Afforestation/ Plantation
5. Green Belt Development

R&R Measures for Area under encroachment

An area of **21.17 ha** has been identified by the CEC as encroachment under categories such as mining pit, over burden dumps and others in the ML area and it will be reclaimed and rehabilitated by afforesting with suitable vegetation as well as implementing engineering measures.

Table 2.7: Particulars of area under encroachment are given below:

Particulars	Area (ha)
Mine pit	0.23
Over Burden Dumps	15.94
Others	5.00
Total	**21.17**

Measures for the management of OB dumps (Dump Management Plan)

In order to stabilize waste dumps, toe wall at its toe and catch water drains (garland drains) and Silt Traps (ST) will be constructed as per design. Dumping will be carried out by adopting retreating method starting from bottom and reaching to the top by creating terraces of 10 m height and 6-8 m width. Berms will be provided at the toe of each terrace to avoid water flow over the dump slopes. Wherever necessary, garland drains will be provided and connected to the vertical drains and finally to the check dams followed by Silt Settling Tanks (SSTs). Inactive dumps will be vegetated with suitable plantation immediately after the terraces are made and the active dumps will be protected from erosion by planting with suitable grass/legumes. All the plantation activities will preferably be taken up during monsoon seasons to enjoy the benefit of rainwater for the same. Geo-textile/coir mat may be opted for the permanent dumps which have adverse conditions like steep slopes, poor soil fertility, and instability of soil and lack of moisture.

Besides, encroached dumps there are inactive dump left unprotected in the lease area. Therefore, as per R&R plan prepared by ICFRE, suitable protective measures are proposed for the same to reduce the further erosion of waste material.

i) Existing Waste/ Over Burden Dumps

A total of 3 waste dumps are observed in the ML area. Out of the total, one is located completely outside the ML at north (EID-2) another one is located completely within the ML on the working pit at western side (ID-2) and the other one is located within and partially encroached outside the lease area towards SW side (ID-1/EID-1).

- **ID-1/EID-1:** This dump is located at the western part and is partially encroached outside the lease area near to corner pillar No-3. The dump has a total height of 178m and slope angle of 45-60^{o}. The top and bottom of it is varied between 836m and 658m respectively. The dump is having two terraces at different heights. The dump has formed two tails because of severe sliding of its OB materials from both sides of the cliff into the *nala* downside which is draining into the *Hulikunte* tank located nearly 1.0km away from the lease area at NW side. The tail thus formed has encroached into forest area outside the lease boundary.
- **ID-2:** As against the CEC observations, this dump is an extension of the dump ID-1/EID-1. It is located within the ML area at NW side above the top two benches of the mine pit. The top and bottom RL of the dump varies from 958m to 940m respectively. On north of the dump, there are two small working pits lying side by side. The haulage road leading to the northern part of the lease area is made through the dump surface. No bio-engineering measures are observed. However, two terraces have been made at the SW side and are planted sparsely with *Eucalyptus* sp.
- **EID-2:** This dump is located completely outside the lease area at its northern tip. The top and bottom RL of the dump varies from 889 to 736m respectively. The slope angle of it varies from 60-70^{o}. The dump is severely eroded into the forest and *nala* due to lack any significant bio-engineering measures.

ii) Engineering measures for the waste dumps (as per R&R plan prepared by ICFRE)

Toe Wall: One RR stone masonry cement sand mortar toe wall of a length of about 600 m together with 4 RR dry stone masonry toe walls of length varying from 160-220 m are proposed for the EID-1 in the ML area. Apart from this, one each RR dry toe walls are also proposed for the EID-2. On the body of the cement sand mortar toe walls, weep holes

should be provided at 1x1m grid points for facilitating seepage of water. Altogether, 6TWsare proposed for the management of waste dumps in the ML area.

Garland Drains (Catch Water Drains): The GDs are proposed 1-2 m below the toe wall to collect the discharging runoff water at the toe of dump and to carry it safely to SST tanks followed by natural water courses. It should have 2.0 m top width, 1.0 m bottom width and 1.0 m depth. A total of 6 GDs are proposed for the management of waste dumps in the ML.

Geo-textile/ Coir mat: As the waste dumps are too large and are located on a sloppy terrain, there is an ample chance of further deteriorating the condition of the dump. Hence, it is proposed to protect the dump from further erosion by employing geo-textile/coir matting over an area of approximately 4.0 ha.

Log Wood Check Dam (LWCD): This structure is proposed to be constructed in narrow gullies having a width of about 3-6 m. Wooden logs of sprouting species such as *Lannea coromandelica, Bombax ceiba, Erythrina suberosa, E. indica, Ficus benghalensis,* etc., needs be inserted up to a depth of about 30 cm on the dump terrace in series at distance of about 30 cm from centre to centre. Boulders of 40 cm size and above may be hand packed between risers and logs up to 1.0 m depth. A total number of **70 LWCDs** are proposed for gullies in EID and ID in the lease area.

Brush Wood Check Dam (BWCD): It is proposed for narrow gullies of about 1-3 m wide and is suitable for the areas where boulders are not available. It is essentially like logwood check dam and in this, brush wood such as branches, twigs, climbers, etc., are used instead of wooden logs. Altogether, **280 BWCDs** are proposed for gullies in EID and ID in the lease area.

Loose Boulder Check Dam (LBCD)-(Random Rubble dry stone masonry): The LBCDs are proposed for gullies having a width of about 5-10 m and their bed slope less than 10%. A total number of **55 LBCDs** are proposed for gullies in EIDs and IDs in the area.

Table-2.8: Proposed engineering measures for management of waste dumps (ML No. 2290)									
Location	**Items**	**Particulars of works**	**No**	**Dimension in m**				**Qty.**	**Unit**
				Length	**Width**		**Height**		
					Top	**Bottom**			
EID-1	TW-1: Toe Wall at the toe of the dump	Foundation in hard soil mixed with boulders including hard rock	1.0	850.00	2.00		0.60	1020.00	cum
		Plain cement concrete (1:4:8) in foundation	1.0	850.00	1.70		0.15	216.75	cum
		RR Stone masonry cement sand mortar (1:6)	1.0	850.00	1.00	2.00	3.00	3825.00	cum
	GD-1	Garland drain below the toe wall	1.0	870.00	2.00	1.00	1.00	1305.00	cum
	TW-2: Toe wall at the toe of waste dump	Foundation in hard soil mixed with boulders including hard rock	1.0	160.00	2.00		0.60	192.00	cum
		Plain cement concrete (1:4:8) in foundation	1.0	160.00	1.70		0.15	40.80	cum
		RR Stone masonry Dry	1.0	160.00	1.00	3.00	2.00	640.00	cum
	GD-2	Garland drain below the toe wall	1.0	170.00	2.00	1.00	1.00	255.00	cum
	TW-3: Toe wall at the toe of waste dump	Foundation in hard soil mixed with boulders including hard rock	1.0	180.00	2.00		0.60	216.00	cum
		Plain cement concrete (1:4:8) in foundation	1.0	180.00	1.70		0.15	45.90	cum
		RR Stone masonry Dry	1.0	180.00	1.00	3.00	2.00	720.00	cum
	GD-3	Garland drain below the toe wall	1.0	190.00	2.00	1.00	1.00	285.00	cum
	TW-4: Toe wall at the toe of waste	Foundation in hard soil mixed with boulders including hard rock	1.0	200.00	2.00		0.60	240.00	cum

	dump	Plain cement concrete (1:4:8) in foundation	1.0	200.00	1.70		0.15	51.00	cum
		RR Stone masonry Dry	1.0	200.00	1.00	3.00	2.00	800.00	cum
	GD-4	Garland drain below the toe wall	1.0	210.00	2.00	1.00	1.00	315.00	cum
	TW-5: Toe wall at the toe of waste dump	Foundation in hard soil mixed with boulders including hard rock	1.0	220.00	2.00		0.60	264.00	cum
		Plain cement concrete (1:4:8) in foundation	1.0	220.00	1.70		0.15	56.10	cum
		RR Stone masonry Dry	1.0	220.00	1.00	3.00	2.00	880.00	cum
	GD-5	Garland drain below the toe wall	1.0	230.00	2.00	1.00	1.00	345.00	cum
	Geotextile	Manual terracing followed by Geotextile/coir matting and plantation may be done on high steep sliding part of the OB dump	--	--	--	--	--	3.00	ha
EID-2	TW-6: Toe wall at the toe of waste dump	Foundation in hard soil mixed with boulders including hard rock	1.0	160.00	2.00		0.60	192.00	cum
		Plain cement concrete (1:4:8) in foundation	1.0	160.00	1.70		0.15	40.80	cum
		RR Stone masonry Dry	1.0	160.00	1.00	3.00	2.00	640.00	cum
	GD-6	Garland drain below the toe wall	1.0	180.00	2.00	1.00	1.00	270.00	cum
APPROACH ROAD	CATCH DRAIN (CD)	DRAIN ALONG THE ROAD	1.00	4200.00	1.50	1.00	1.00	5250.00	cum

TD	TW-7: Toe wall at the toe of waste dump	Foundation in hard soil mixed with boulders including hard rock	1.0	360.00	2.00		0.60	432.00	cum
		Plain cement concrete (1:4:8) in foundation	1.0	360.00	1.70		0.15	91.80	cum
		RR Stone masonry Dry	1.0	360.00	1.00	3.00	2.00	1440.00	cum

	GD-7	Garland drain below the toe wall	1.0	363.00	2.00	1.00	1.00	544.50	cum
BACKFILLING	TW-8: Toe wall at the toe of Backfilling	Foundation in hard soil mixed with boulders including hard rock	1.0	266.00	2.00		0.60	319.20	cum
		Plain cement concrete (1:4:8) in foundation	1.0	266.00	1.70		0.15	67.83	cum
		RR Stone masonry Dry	1.0	266.00	1.00	3.00	2.00	1064.00	cum
	GD-8	Garland drain below the toe wall	1.0	272.00	2.00	1.00	1.00	408.00	cum
EIDs & IDs	Brush Wood Check Dam (BWCD)	BWCD	100.0	2.00	-	1.50	1.00	200.00	m
		BWCD	80.0	3.00	-	1.50	1.00	240.00	m
		BWCD	60.0	4.00	-	1.50	1.00	240.00	m
		BWCD	40.0	5.00	-	1.50	1.00	200.00	m
	Log Wood Check Dam (LWCD)	LWCD	30.0	4.00	-	2.00	1.00	120.00	m
		LWCD	20.0	5.00	-	2.00	1.00	100.00	m
		LWCD	10.0	6.00	-	2.00	1.00	60.00	m
		LWCD	10.0	7.00	-	2.00	1.00	70.00	m
	Loose Boulder Check Dam (LBCD)-small	LBCD	20.0	4.00	1.00	3.00	2.00	320.00	cum
		LBCD	15.0	5.00	2.00	3.00	2.00	375.00	cum
		LBCD	10.0	6.00	2.00	4.00	2.00	360.00	cum
		LBCD	10.0	8.00	2.00	4.00	2.00	480.00	cum

iii) Surface Water Management: The proposed engineering measures for the surface water management of the ML area are given below:

Loose Boulder Check Dam (LBCD): (Random Rubble dry stone masonry): The LCDs are proposed for gullies having a width of about 5-10 m and their bed slope less than 10%. A total number of **42 LBDs** of a length varying from 5 to 18 m are proposed for the *nalas* in the lease area.

Gabion (Wire crate) Check Dam (GCD): This structure is usually proposed for gullies having a bed slope of more than 10% and a high discharge rate. Gabion check dams are very useful in the areas where sediment load is very high and are very cost effective for the reclamation of mine areas and wastelands. Altogether, **27 GCDs** of a length varying from 8 to 25 m are proposed for the *nalas* within and outside the ML area.

Silt Trap (ST): This is useful/ essential to prevent sediment and silt from entering into area outside the ML through the surface water runoff. A total number of **3 STs** of a dimension of 10x5x2 are proposed for the *nalas* in the ML area.

Stone Masonry Check Dam (SMCD) - cement sand mortar (1:6): This is usually considered as a key structure at the end of all the gully control structures like LBCD, GCD, etc. A total number of **9 SMCDs** of a length varying from 13 to 30 m are proposed for the *nalas* in the lease area.

Silt Settling Tank (SST): This is particularly important for the water channels having a high discharge loaded with heavy sediments. The water in these natural courses should be allowed to flow out only after treatment through the silt settling tanks. A total number of **3 SSTs** of a dimension of 2**0x10x3** are proposed for the *nalas* in the ML area.

Rain Water Harvesting Pit (RWHP): The function of the RWHP is to recharge ground water by harvesting runoff. This structure should have a length and width of 10.0 m each at the top and 5.0 m each at the bottom and a height of 2.0 m. It should be filled with sand over of 20 cm thick and 20cm thick cover of gravel of a size 20 mm. A total of **20 WHPs** are proposed in the *nalas* in the lease area.

Design details of proposed bio-engineering measures are enclosed in **Annexure - XIII**

Table 2.9 Proposed bio-engineering measures for surface water management (ML No. 2290)								
Nala name	Items	No.	Dimension in m				Qty	Units
			Length	Width		Height		
				Top	Bottom			
N-1	LBCD-1	1.0	5.00	1.00	2.00	1.00	7.50	Cum
	LBCD-2	1.0	8.00	1.00	2.00	1.50	18.00	Cum
	LBCD-3	1.0	6.00	1.00	2.00	1.00	9.00	Cum
	LBCD-4	1.0	9.00	1.00	2.00	1.50	20.25	Cum
	LBCD-5	1.0	6.00	1.00	2.00	1.00	9.00	Cum
	LBCD-6	1.0	10.00	1.00	2.00	1.50	22.50	Cum
	GCD-1	1.0	15.00	1.00	2.00	2.00	45.00	Cum
	GCD-2	1.0	12.00	1.00	2.00	3.00	54.00	Cum
	GCD-3	1.0	16.00	1.00	3.00	3.00	96.00	Cum
	GCD-4	1.0	25.00	1.00	3.00	3.00	150.00	Cum
	RWHP-1	1.0	10.00	10.00	5*5	3.00	1.00	No.
	RWHP-2	1.0	10.00	10.00	5*5	3.00	1.00	No.
	RWHP-3	1.0	10.00	10.00	5*5	3.00	1.00	No.
	SMCD-1	1.0	13.00	1.00	2.00	2.00	13.00	m
	SMCD-2	1.0	30.00	1.00	2.00	3.00	30.00	m
	SST-1	1.0	20.00	10.00	-	3.00	1.00	No.
N-2	LBCD-7	1.0	5.00	1.00	2.00	1.00	7.50	Cum
	LBCD-8	1.0	6.00	1.00	2.00	1.00	9.00	Cum
	LBCD-9	1.0	10.00	1.00	2.00	1.50	22.50	Cum
	GCD-5	1.0	8.00	1.00	2.00	2.00	24.00	Cum
	GCD-6	1.0	15.00	1.00	3.00	3.00	90.00	Cum
	GCD-7	1.0	20.00	1.00	3.00	3.00	120.00	Cum
	GCD-8	1.0	25.00	1.00	3.00	3.00	150.00	Cum
	RWHP-4	1.0	10.00	10.00	5*5	3.00	1.00	No.
N-3	LBCD-10	1.0	10.00	1.00	2.00	1.50	22.50	Cum
	LBCD-11	1.0	15.00	1.00	2.00	1.50	33.75	Cum
	GCD-9	1.0	16.00	1.00	3.00	3.00	96.00	Cum
	GCD-10	1.0	20.00	1.00	3.00	3.00	120.00	Cum
	GCD-11	1.0	25.00	1.00	3.00	3.00	150.00	Cum
	RWHP-5	1.0	10.00	10.00	5*5	3.00	1.00	No.

	RWHP-6	1.0	10.00	10.00	5*5	3.00	1.00	No.
	ST-1	1.0	10.00	5.00	--	2.00	1.00	No.
	SMCD-3	1.0	30.00	1.00	2.00	2.00	30.00	m
N-4	LBCD-12	1.0	6.00	1.00	2.00	1.00	9.00	Cum
	LBCD-13	1.0	8.00	1.00	2.00	1.50	18.00	Cum
	GCD-12	1.0	12.00	1.00	2.00	3.00	54.00	Cum
	GCD-13	1.0	15.00	1.00	3.00	3.00	90.00	Cum
	RWHP-7	1.0	10.00	10.00	5*5	3.00	1.00	No.
	ST-2	1.0	10.00	5.00	--	2.00	1.00	No.
N-5	LBCD-14	1.0	10.00	1.00	2.00	1.50	22.50	Cum
	LBCD-15	1.0	12.00	1.00	2.00	1.50	27.00	Cum
	GCD-14	1.0	15.00	1.00	3.00	3.00	90.00	Cum
	GCD-15	1.0	20.00	1.00	3.00	3.00	120.00	Cum
	RWHP-8	1.0	10.00	10.00	5*5	3.00	1.00	No.
	ST-3	1.0	10.00	5.00	--	2.00	1.00	No.
	SMCD-4	1.0	30.00	1.00	2.00	2.00	30.00	m
N-6	LBCD-16	1.0	6.00	1.00	2.00	1.00	9.00	Cum
	LBCD-17	1.0	8.00	1.00	2.00	1.50	18.00	Cum
	GCD-16	1.0	10.00	1.00	2.00	3.00	45.00	Cum
	RWHP-9	1.0	10.00	10.00	5*5	3.00	1.00	No.
	SMCD-5	1.0	13.00	1.00	2.00	2.00	13.00	m
N-7	LBCD-18	1.0	5.00	1.00	2.00	1.00	7.50	Cum
	LBCD-19	1.0	8.00	1.00	2.00	1.50	18.00	Cum
	LBCD-20	1.0	12.00	1.00	2.00	1.50	27.00	Cum
	LBCD-21	1.0	15.00	1.00	2.00	1.50	33.75	Cum
	LBCD-22	1.0	18.00	1.00	3.00	2.00	72.00	Cum
	LBCD-23	1.0	10.00	1.00	2.00	1.50	22.50	Cum
	LBCD-24	1.0	12.00	1.00	2.00	1.50	27.00	Cum
	LBCD-25	1.0	10.00	1.00	2.00	1.50	22.50	Cum
	GCD-17	1.0	20.00	1.00	3.00	3.00	120.00	Cum
	GCD-18	1.0	25.00	1.00	3.00	3.00	150.00	Cum
	GCD-19	1.0	15.00	1.00	3.00	3.00	90.00	Cum
	RWHP-10	1.0	10.00	10.00	5*5	3.00	1.00	No.
	RWHP-11	1.0	10.00	10.00	5*5	3.00	1.00	No.
	SST-2	1.0	20.00	10.0	-	3.00	1.00	No.

				0				
	SMCD-6	1.0	23.00	1.00	2.00	3.00	23.00	m
N-8	LBCD-26	1.0	8.00	1.00	2.00	1.50	18.00	Cum
	LBCD-27	1.0	10.00	1.00	2.00	1.50	22.50	Cum
	LBCD-28	1.0	10.00	1.00	2.00	1.50	22.50	Cum
	LBCD-29	1.0	8.00	1.00	2.00	1.50	18.00	Cum
	LBCD-30	1.0	10.00	1.00	2.00	1.50	22.50	Cum
	LBCD-31	1.0	15.00	1.00	2.00	1.50	33.75	Cum
	LBCD-32	1.0	8.00	1.00	2.00	1.50	18.00	Cum
	LBCD-33	1.0	10.00	1.00	2.00	1.50	22.50	Cum
	GCD-20	1.0	15.00	1.00	3.00	3.00	90.00	Cum
	GCD-21	1.0	20.00	1.00	3.00	3.00	120.00	Cum
	RWHP-12	1.0	10.00	10.00	5*5	3.00	1.00	No.
	RWHP-13	1.0	10.00	10.00	5*5	3.00	1.00	No.
	RWHP-14	1.0	10.00	10.00	5*5	3.00	1.00	No.
	SMCD-7	1.0	23.00	1.00	2.00	2.00	23.00	m
	SMCD-8	1.0	30.00	1.00	2.00	3.00	30.00	m
	SST-3	1.0	20.00	10.00	-	3.00	1.00	No.
N-9	LBCD-34	1.0	8.00	1.00	2.00	1.50	18.00	Cum
	LBCD-35	1.0	10.00	1.00	2.00	1.50	22.50	Cum
	GCD-22	1.0	15.00	1.00	3.00	3.00	90.00	Cum
	GCD-23	1.0	20.00	1.00	3.00	3.00	120.00	Cum
	RWHP-15	1.0	10.00	10.00	5*5	3.00	1.00	No.
N-10	LBCD-36	1.0	8.00	1.00	2.00	1.50	18.00	Cum
	LBCD-37	1.0	10.00	1.00	2.00	1.50	22.50	Cum
	GCD-24	1.0	15.00	1.00	3.00	3.00	90.00	Cum
	RWHP-16	1.0	10.00	10.00	5*5	3.00	1.00	No.
	RWHP-17	1.0	10.00	10.00	5*5	3.00	1.00	No.
N-11	LBCD-38	1.0	6.00	1.00	2.00	1.50	13.50	Cum
	LBCD-39	1.0	8.00	1.00	2.00	1.50	18.00	Cum
	LBCD-40	1.0	8.00	1.00	2.00	1.50	18.00	Cum
	GCD-25	1.0	10.00	1.00	2.00	3.00	45.00	Cum
	GCD-26	1.0	10.00	1.00	2.00	3.00	45.00	Cum
	RWHP-18	1.0	10.00	10.0	5*5	3.00	1.00	No.

				0				
	RWHP-19	1.0	10.00	10.00	5*5	3.00	1.00	No.
	SMCD-9	1.0	13.00	1.00	2.00	2.00	13.00	m
	SST-4	1.0	20.00	10.00	-	3.00	1.00	No.
N-12	LBCD-41	1.0	6.00	1.00	2.00	1.50	13.50	Cum
	LBCD-42	1.0	8.00	1.00	2.00	1.50	18.00	Cum
	GCD-27	1.0	15.00	1.00	3.00	3.00	90.00	Cum
	RWHP-20	1.0	10.00	10.00	5*5	3.00	1.00	No.

Afforestation:

After excluding the area finally classified under green belt (3.59 ha), the area to be afforested in lease area at the conceptual stage of the mine has been worked out to be 96.95 ha (i.e., 100.54 – 3.59). The afforestation covering 1000 trees and 2500 shrubs per ha, inclusive of maintenance for five year has been worked out as per the norms of State Forest Department, Karnataka.

Work of afforestation will be carried out in close connection with the State Forest Department, Karnataka, utilizing local people and the periodical monitoring will also be carried out, in co-ordination with state agencies.

Afforestation will be made through:

- Propagules (seeds, tubers, corms, bulbs, rhizomes and roots) stored in theTop soil and sowing seed;
- Planting nursery-raised seedlings
- By seed dibbling
- Silt accumulated in silt settling tanks/check dams etc. can be removed and could be used after mixing with FYM and sand in the ratio 2:1:1. This mixture could be used for plantation.

Table-2.10: Implementation Schedule of Mitigation / Engineering Measures

Type	Particulars of work	Years		
		1	2	3
Dump & Encroached area Management				
EID/ID	Toe wall at the toe of waste dump	√		
	Garland drain	√		
Encroached area as per CEC	Afforestation	√	√	√
Surface water management				
Gully plugs	Loose Boulder check dam (dump)	√	√	√
	Logwood (dump)	√	√	√
	Brushwood (dump)	√	√	√
Check dams	Gabion/Wire crate check dam	√		
	Rain water harvesting pit	√		
	Silt trap	√		
	Stone masonry check dam	√		
	Loose Boulder check dam	√		
Greenbelt development		√	√	√
Afforestation		√	√	√
Environmental monitoring & watch –ward		√	√	√

Table- 2.11: Indicative cost summary of above R&R measures

Sl.No.	Item of work	Rs. in Lakhs
1.	Cost of rehabilitation for encroachment area (afforestation)	36.84
2.	Cost of engineering structures for waste dumps	111.51
3.	Cost of engineering structures for Surface water management	87.57
4.	Cost of afforestation of the total area at the conceptual stage	168.69
5.	Cost of afforestation of area under greenbelt	9.23
Grand Total		**413.84 ***

**Excluding the cost of SMP, BMP, Monitoring, etc.*

Greenbelt development plan

In order to minimize the impact of mining on environmental components outside the mine lease area, greenbelt zone of 7.5m width will be established in safety zone inside mine lease area. The establishment of Green belt will help wildlife movement, and also human health. The greenbelt will act as a barrier to trap the suspended dust particles and also suppresses air pollutants. As per ICFRE R&R plan, it is proposed to create a green belt with tall seedlings (>1 m height) of fast growing species to hasten the process of greening the area. Green belt available in the safety zone of this mine has been partly planted, without altering the natural green belt.

Indicative cost of developing Green belt is given in the table below:

Sl. No.	Mine Lease No.	Area of Greenbelt (Ha)	Rate/Ha (in lakhs)	Total Amount (in lakhs)
1	ML-2290	3.59	2.57	9.23

The proposed cost is only indicative and the work pertaining to various engineering and biological measures may vary subject to Scheduled rates of Karnataka State. The final dimensions of the engineering structures may be modified depending on the suitability of the local field conditions.

Plans & Sections

All the Reclamation & rehabilitation measures, listed above are shown on Land use plan at the end of ensuing plan period **(Plate no. IV)** & Environment plan **(Plate no. V).**

g) Extent of Mechanization

As proposed above, fully mechanized method of working will be adopted for this mine. For the plan period, production of Iron ore of 1.165 MTPA has been planned. This envisages handling of 2.13 million tonnes (maximum during the plan period) of waste per year.

In order to achieve the target production, the different mining activities is being proposed during the daylight hours only. The effective working hours will be 9(nine) and that is used only to calculate the mining machineries fleet. Operation will be spread over in two shifts and care has been taken to deploy the manpower only for eight hours including recess, by virtue

of the head count planning. The recovery of ore involves removal of over–burden/side burden removal and processing of ROM. By adopting, a combination of Drilling, Excavation, Hauling, Crushing & Screening, Loading and Transporting machinery will be used. Further ancillary machinery like water sprinklers, road graders, dozers, weighing machine etc., will also be deployed. The following are the list of machinery being deployed in the mine.

(1) Drilling Equipment

Type	Nos.	Dia. of hole (mm)	Motive power	H.P.
Self-propelled Hydraulic Drill with Top Hammer	2	102-115	Diesel	-

(2) Loading Equipment

Type	Nos.	Bucket capacity Cum	Motive power	H.P.
Pay Loader	3	2.8	Diesel	260
Front end loader	2	1.2	Diesel	96
Excavator	8+2	1.4-1.6	Diesel	200
Excavator-cum-rock breaker	1	0.9-1.1	Diesel	150

(3) Haulage and Transport Equipment

(a) Haulage within the Mining Leasehold

Type	Nos.	Body capacity Cum	Motive power	H.P.
Tippers/Dumpers	30	16-18	Diesel Engine	250-280

(b) Transport from Mine Head to the Destination

The transportation of Iron ore from mine head to JSW Steel plant will be carried out through tipper/trucks by road. 30% of the trucks are owned by company rest 70% of the trucks will be hired on a contractual basis. Above listed machineries in the mine are in good condition and as and when machine break-down, such machine will be repaired on site by the department engineers.

(4) Details of Auxiliary Operations and Related Machineries

Details of Machineries deployed for auxiliary operations are as follows:

Type	Nos.	capacity	Unit	Motive power	H.P.
Dozer	1	-	-	Diesel	183
Road Grader	1			Diesel	145
Mobile Crushing plant	1	200	TPH	-	
Screening Unit	2	250-300	TPH		
Weigh Bridge	4	60	T	-	-
Water Tanker	6+2	10,000	Ltrs.	-	180
Mobile Tower Lights	2	4	KVA	-	-
D.G Sets	2	100	KVA	-	25
Bus	1	40 Seater			
Jeeps	3	5 Seater			
Diesel Tankers	1	8 KL			180
Explosive Van	1	-			
Maintenance van	1				
Ambulance	1				

Calculations:

a) Drilling Equipment

In the plan period, the maximum quantity to be handled is 1.165 million tonnes of Ore and waste 2.13 (maximum out of five years) million tonnes, total handling will be approximately 3.29 MTPA. 60% of the total quantity will require drilling and blasting.

Assumptions. Bulk Density : 3T/CuM Mine will operate during daylight hours only, therefore effective working hours will be-9 Hours.		
Drilling		
Specification of drill machine		
Diameter of drill	**:**	102 mm
Maximum operating pressure	**:**	250 bar
Drilling parameters		
Hole Diameter (D)	**:**	102 mm
Height of the bench	**:**	8 m
Length of the blast hole	**:**	8.8 m (including sub grade drilling)
Burden (B)	**:**	2.5 m
Spacing (S)	**:**	3 m
Volume of earth to be broken/loosen per hole	**:**	B x S x H = 2.5 x 3 x 8 = 60 CuM

Meterage of drilling per drill for primary blasting in ore/waste zone		
Maximum volume of material to be excavated (in any year of plan period)	**:**	10,99,567 Cum
Volume of material which requires drilling and blasting, as per the nature of the deposit is around 60% of the total excavation (as those are hard and massive in nature)	**:**	6,59,740 Cum
Number of holes to be drilled/year	**:**	6,59,740 ÷ 60 = 10,996 numbers
Number of holes to be drilled per day considering 300 work days in a year	**:**	10,996 ÷ 300 = 36.65 or 37 numbers
Total meterage of drilling/day (length of blast hole = 8.8m including sub grade-drilling)	**:**	37×8.8 = 325.6 m
Requirement of drills		
Avg. Drilling rate	**:**	30 m / hr
Effective drilling meterage in a day by single drilling machine (effective working hrs = 9 hrs)	**:**	30 x 9 =270
Number of drills required	**:**	325.6÷270 = 1.205
Considering Availability as 90% and Utilisation 90% No. Of Drill Required		1.48 say-2

No. of Drills required to meet the drilling requirements taking into consideration availability, utilization and the operator efficiency is **Two**.

b) Excavation

Specification of excavators		
Bucket capacity (C)	:	1.4 Cum
Bucket fill factor (F)	:	0.8
Time cycle pass at 90^{O} swing (T)	:	45 sec
Swell factor (S)	:	0.8
Production efficiency factor (e)	:	0.8
Job management factor (f)	:	0.9
Time Scheduling		
Working days per year	:	300 days
Effective working hours per day(day light only)	:	09
Seconds in hour	:	3600 sec
Output /1.4 CuM excavator/annum	:	[C x F x S x f x 3600 x 9 x 300] ÷ T = [1.4 x 0.8 x 0.8 x 0.8 x 0.9 x 3600 x 9 x 300] ÷ 45 = 1,39,345.92 in 9 hour
No. of Excavators Required		
Maximum excavation in any year of plan period	:	10,99,567 Cum
Requirement of excavator	:	10,99,567 ÷ 1,39,345.92 = 7.89
By Considering availability as 90% and utilisation as 90% Requirement of Excavator is		9.74 or say 10

No. of Excavators required to meet the excavation taking into consideration availability, utilization and the operator efficiency is **ten***.

**Another two excavator of smaller capacity will be added to the existing fleet for feeding the mobile Crushing and Screening plant.*

c) Transportation

Wastes (OB/SB/IB) shall also be encountered during the proposed period of mining in the process of extracting ROM. Calculation for no. of dumper required for transportation of ROM and waste material to their respective sites is based on 2 km hauling distance (lead) from the quarries within the leasehold area.

Loading time

Capacity of the dumper (20 tons)	:	6.67 CuM loose materials
Rate of production of 1.4 CuM excavator per day	:	1,39,345 CuM ÷ 300 = 464.48 or 465 CuM
Number of passes required for one Dumper attached to 1.4 CuM excavator	:	Dumper capacity ÷ [C x F x S] = 6.67 ÷ [1.4 x 0.8 x 0.8] = 7.45 or 8 passes
Hauling time for waste dump yard and ore stack yard	:	Average haul length to be covered by the loaded Dumper (2 km) ÷ Average speed of the Dumper (20 km h) (Loaded and empty) = 6 min
Return time	:	6 min
Dumper cycle time (waste dump yard and ore stack yard) = Loading time + hauling time + unloading time + return time + spotting time and waiting time	:	6 + 6 + 2 + 6 + 3 = 23 min
Effective working hours per Dumper per day	:	9 hrs
Number of trips per Dumper per day	:	(9 x 60) ÷ 23 = 23.47 or 23 trips
Volume per day per Dumper	:	23 x 6.67 = 153.41 CuM
Dumper requirement (attached to 1.4 CuM excavator)	:	465 ÷ 153.41 = 3.03 or 3 numbers
8(Eight) 1.4 CuM excavators shall require	:	8 x 3 = **24** Dumpers of 20 tonne
Considering availability as 90% and utilisation as 90%, No. of dumpers required is	:	29.62 or say 30 Nos.

No. of Tippers required to meet the excavation requirement taking into consideration availability, utilization and the operator efficiency is **Thirty.**

Calculations:

DRILLING AND BLASTING

a) Drilling

The actual requirement of drilling and blasting is 60% of the total excavation. As per the Monthly Production Plan, the designated drilling area will be leveled with help of Dozer and loaders. Blast design parameters are fixed depending on the type of strata. The drill plan will be prepared prior to the systematic drilling. Drilling will be carried out with the help of DTH drills.

b) Blasting

Broad blasting parameters like charge per hole, blasting pattern, charge per delay and maximum number of holes blasted in a round, manner and sequence of firing, etc. are discussed below:

Bulk Density (In-situ)	3.0 t/cum
Spacing	3.0 m
Burden	2.5 m
Average Depth	8.8m (including sub grade drilling)
Powder Factor	7 t/kg

Maximum volume of material to be excavated (in any year of plan period)	**:**	10,99,567 Cum
Volume of material require drilling and blasting, as per the nature of the deposit is around 60% of the total excavation as those are hard and massive in nature)	**:**	6,59,740 Cum
Total Tonnage by Drilling & Blasting	**:**	6,59,740x3=19,79,220 Tonne
Total Tonnage by Drilling & Blasting/Month	**:**	19,79,220/12=1,64,935 Tonne
Powder Factor	**:**	7 T/Kg

Total Explosive Required/Month	:	1,64,935/7=23,562 Kg
Base Charge Required@20%	:	4,712 Kg i.e 4.71 Tonne
Column Charge(ANFO) @ 80%	:	18,849 Kg i.e. 18.84Tonne
Nonel(Shock Tubes) Required in meter @14 Mtrs./Hole in a month	:	916x14=12,828 Mtrs.
Blasting Frequency /week	:	3
Total Blast/Month	:	4x3=12
Ordinary Detonator Required@4/Blast	:	12x4=48 Nos.
Safety Fuse in Meter@1.25 Mtrs /OD	:	48x1.25=60 Mtrs.

Type of Explosives to be used

Slurry/ Emulsion Cartridge explosives (83 mm)/ Prills of ammonium nitrate (with diesel as fuel in the ratio of 94:6) is proposed to be used to load the blast hole as primer and Column charge.

Storage of Explosives

It is proposed to procure explosives and services from licensed vendors, till the time JSW steel Limited obtains requisite permission for storage, transport and use of Explosive.

M/s JSW Steel Limited has been awarded multiple mines following the auction process, (further expected to get some more mines in future auction process), which are located in vicinity to each other. In order to maximize the utilization of resources Centralized/ individual magazine is being planned. Necessary permissions regarding the establishment of magazine and ammonium nitrate storage will be taken. Till the time necessary permissions are obtained, services of authorised vendors will be taken.

3.0 MINE DRAINAGE

a) Minimum and maximum depth of water table based on observations from nearby wells and water bodies:

The water table near the mine vary from 30m to 50m bgl that is about 570 to 550 MSL as per the bore wells drilled nearby as general ground level is about 600 MSL.

b) Maximum and minimum depth of workings:

The mining activity will be concentrated on the elevated portions of the hill range. The RL of general ground level is 600 MSL and the minimum depth of workings will be at 975 mRL and maximum depth will be around 747 mRL.

c) Quantity and quality of water likely to be encountered, the pumping arrangements and places where the mine water is finally proposed to be discharged:

There is no chance of encountering groundwater during mining as the lowest level in mining will be sufficiently higher than general ground level. The monsoon water gets drained off through the natural valleys.

d) Regional and local drainage pattern, indicating annual rainfall, catchments area, and likely quantity of rainwater to flow through the lease area, arrangement for arresting solid wash off etc.

There are no rivers or perennial water courses in the mine lease area. However, the area is traversed by numerous seasonal water courses which are usually active during monsoon season and draining into the nearby water bodies (Hulikunte tank). Usually, no rain water accumulates in the lease area. The rain water flows from hill slopes and it does not accumulate till it reaches the lower valleys. Hence, the drainage pattern is sub-dendritic in nature and is typical of the hilly area.

4.0 STACKING OF MINERAL REJECT /SUB GRADE MATERIAL AND DISPOSAL OF WASTE

a) Nature and quantity of topsoil, overburden / waste and Mineral Reject to be disposed off:

Topsoil: The mining area has been broken-up and was worked on the higher elevation. Area where iron ore excavation is proposed contains no topsoil.

Overburden/Waste and Mineral Rejects: The waste rock consists of shale and BHQ.

Shale: This is mainly friable material with light yellowish to red in color having fine grains.

BHQ: It is hard and compact layered rock formation with color ranging from grey to black.

Table -4.1: Year wise quantity of Waste to be generated

Year	Topsoil		Waste		Mineral rejects		
	Reuse / Spreading	Storage	Backfilling	Temporary dump	Blending	Storage	Beneficiation
First	-	-	2086586	-	-	-	-
Second	-	-	1024671	-	-	-	-
Third	-	-	954573	-	-	-	-
Fourth	-	-	1145911	-	-	-	-
Fifth	-	-	144500	1692426	-	-	-

Details of existing sub grade stacks present in the lease area are given below:

Table 4.2 Existing Subgrade Stacks

Stack No.	Location	Extent in Ha.	Height in m
SG-1	S-15 to S-16	0.06	4.0
SG-2	S-17 to S-18	0.338	5.0
SG-3	S-17 to S-18	0.021	1.0
SG-4	S-18 to S-19	0.032	2.0
SG-5	S-18 to S-19	0.060	2.0
SG-6	S-19 to S-20	0.013	1.0
SG-7	S-17 to S-19	1.163	13.0

b) Dumping area:

The BHQ/shale waste material will be disposed off in the area earmarked for backfilling in the central portion of the lease area as well as temporary dump. Ore left over, if any, will be extracted before backfilling is started. Apart from it there are two existing waste dump present in the lease area, the details are given below:

Table 4.3: Existing Waste Dumps

Waste Dump No.	Location	Extent in Ha.	Height in m
ID-1	S-1 to S-11	15.84	16.0
ID-2	S-11 to S-14	4.92	14.0

c) Manner of disposal of waste, configuration and sequence of year wise build-up of dumps along with the proposals for protective measures

The waste material generated during the course of mining will be handled separately and transported to the proposed backfilling area and temporary dump, in the portions of worked out pits between sections D1 – D6. Year wise backfilling and temporary dump details are given below:

Table-4.4: Year wise backfilling proposals

Year	Area (Ha)	No. of stages	Level in mRL	Location Co-ordinates	
				Northing	Easting
First	3.34	3	970 - 940	1666132-1666343	669122-669334
Second	4.67	3	970 - 940	1666123-1666385	669115-669329
Third	5.57	2	970 -950	1666125-1666435	669102-669326
Fourth	6.50	3	970 - 940	1666127-1666438	669085-669326
Fifth	6.52	3	970 - 940	1666127-1666438	669085-669326
	3.00*	3	940-910	1666822-1667035	668703-668892

*3.00 Ha is proposed for temporary dump.

No sub-grade generation is proposed in this plan period.

Table 4.5: Proposed engineering measures for backfilling and temporary dump									
Location	Items	Particulars of works	No	Dimension in m				Qty.	Unit
				Length	Width		Height		
					Top	Bottom			
TD	TW-7: Toe wall at the toe of waste dump	Foundation in hard soil mixed with boulders including hard rock	1.0	360.00	2.00		0.60	432.00	cum
		Plain cement concrete (1:4:8) in foundation	1.0	360.00	1.70		0.15	91.80	cum
		RR Stone mansonry Dry	1.0	360.00	1.00	3.00	2.00	1440.00	cum
	GD-7	Garland drain below the toe wall	1.0	363.00	2.00	1.00	1.00	544.50	cum
BACKFILLING	TW-8: Toe wall at the toe of Backfilling	Foundation in hard soil mixed with boulders including hard rock	1.0	266.00	2.00		0.60	319.20	cum
		Plain cement concrete (1:4:8) in foundation	1.0	266.00	1.70		0.15	67.83	cum
		RR Stone mansonry Dry	1.0	266.00	1.00	3.00	2.00	1064.00	cum
	GD-8	Garland drain below the toe wall	1.0	272.00	2.00	1.00	1.00	408.00	cum

5.0 USE OF MINERAL AND MINERAL REJECT

a) Requirement of end-use industry:

Since this mine is a captive mine to JSW Steel Limited., entire production will be utilized in the JSW Steel Plant.

Name of the Firm Company	Chemical Specification	Physical Specification
M/s JSW Steel Limited.	+45% Fe	Lumps 10-40 mm
	+45% Fe	Fines 0-10 mm

b) Requirement of intermediate industries involved in up gradation of mineral before its end-use:

Since this mine is captive, entire production will be utilized in the JSW Steel Plant. Hence no intermediate industries are involved in upgradation of mineral.

c) Detail requirements for other industries, captive consumption, export, associated industrial use etc.

i) Entire quantity of Iron ore mined (as captive) from this mine will be utilized in JSW steel plant.

Name of the Firm Company	Chemical Specification	Physical Specification
M/s JSW Steel Limited.	+45% Fe	Lumps 10-40 mm
	+45% Fe	Fines 0-10 mm

ii) As per the requirement of the steel plant there is also a proposal to transport the RoM directly to the steel plant as ore beneficiation Unit is already existing and is operational in the plant. Alternately, RoM could also be sent through stockyard by appropriate prevailing system of transportation.

d**) Precise physical and chemical specification stipulated by buyers**

Presently the material produced will be transported to M/s JSW Steel Plant for its own captive use, so there are no stipulated buyer.

e) Details of processes adopted to upgrade the ROM to suit the user requirements:

ROM produced will be sent for dry processing (Crushing / screening) to generate +10-40mm calibrated lumpy Iron ore and -10mm fines Iron ore by Crushing / screening plant. Since all +45% Fe grade Iron ore will be used in the steel plant, and hence there will be no specific blending of different grade of ore.

6.0 PROCESSING OF ROM AND MINERAL REJECT

a) Nature of processing / beneficiation of ROM or Mineral Reject, indicating size and grade of feed material and concentrate (finished marketable product), recovery etc. Processing of Mineral Reject

No beneficiation of ROM or mineral reject will be carried out in the lease area during the plan period. However, sorting and sizing will be carried out by mobile crushing and screening of the ore to the required physical specification. The crusher will process the mineral to different sizes of 0-10 (fines) and 10-40mm (c-ore), which will be stacked separately outside the lease area.

Processed ore stacked separately will be transported to JSW Steel Plant, as entire production of Iron ore mined from this mine will be consumed by the plant for its captive uses.

Tentative location of C & S and Processed stock are given below

C & S Plant unit (Mobile/Fixed) and Stock yard	Location Co-ordinates	
	Northing	Easting
I	1667000-1667075	668600-668671
II	1666451-1666531	669280-669352

Location of crushing and screening plant is shown in **Plate no III(a) to III(e).**

b) Material balance chart with a flow sheet or schematic diagram of the processing procedure

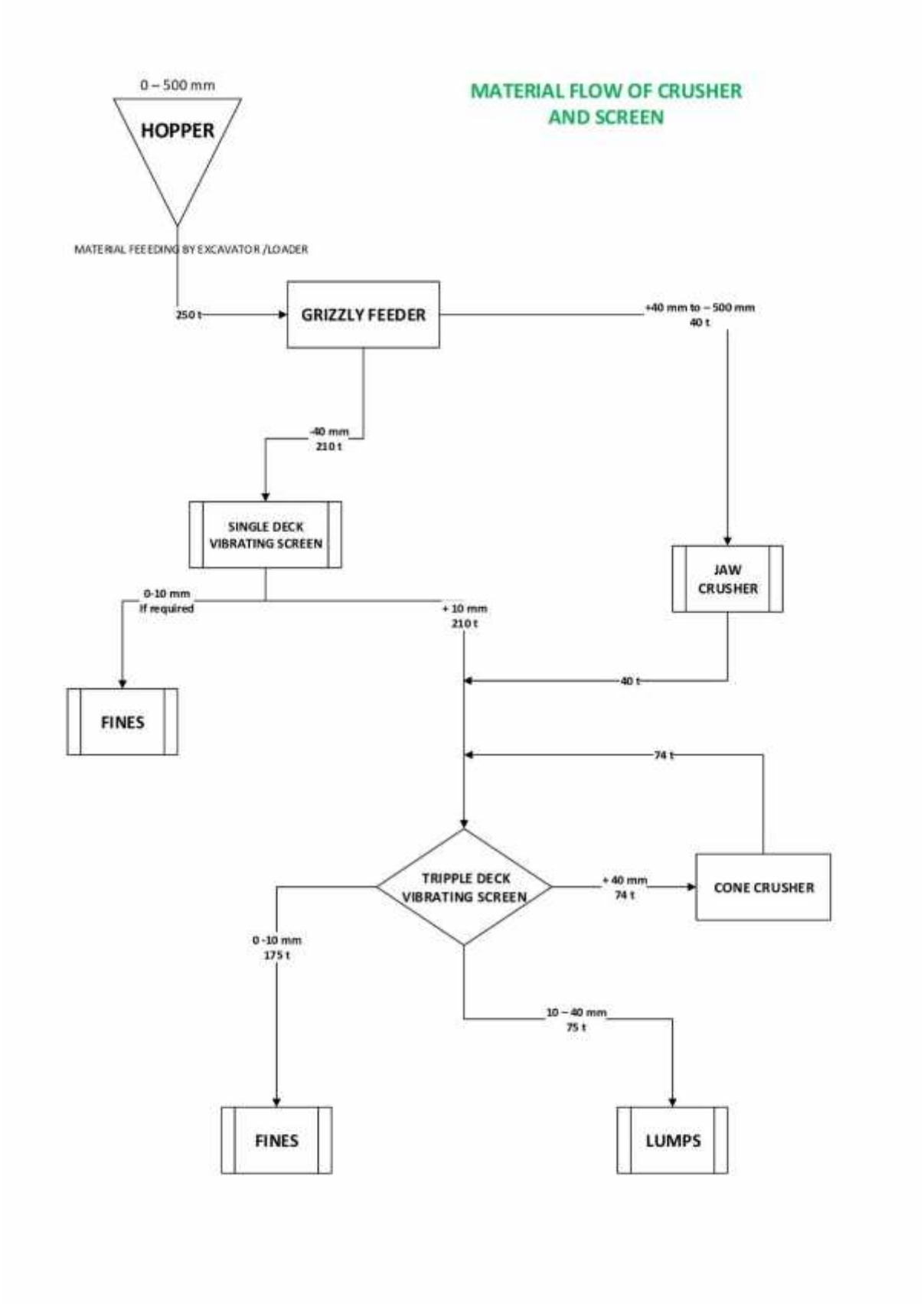
i) A mobile crushing plant of 200/250 tonnes/hour and screening unit of 250-300 tonnes/hour capacity will be established in the mine, to process the ROM upto 500 mm sizes. The crusher

will process the mineral to different sizes of 0-10 (fines) and 10-40mm (c-ore), which will be stacked separately at the designated stock yard outside the lease area for further transportation to JSW Steel plant.

ii) As per the requirement of the steel plant, we also propose to transport the ROM directly to the steel plant as Ore Crushing and Screening with Beneficiation Unit is already established in the plant. Alternatively, ROM may also be sent through intermediate stockyard by appropriate prevailing system of transportation.

Table -6.1: Likely material balance in percentage

Description	Rate in percentage
Feed (+10 mm ROM)	100%
Cal. Ore (+10 to -40 mm)	30%
Fines (-10mm)	70%


MATERIAL FLOW OF CRUSHER AND SCREEN
0 – 500 mm
HOPPER
MATERIAL FEEDING BY EXCAVATOR /LOADER
250 t
GRIZZLY FEEDER
+40 mm to – 500 mm
40 t
-40 mm
210 t
SINGLE DECK VIBRATING SCREEN
JAW CRUSHER
0-10 mm
If required
+ 10 mm
210 t
FINES
40 t
74 t
TRIPPLE DECK VIBRATING SCREEN
+ 40 mm
74 t
CONE CRUSHER
0 -10 mm
175 t
10 – 40 mm
75 t
FINES
LUMPS

c) The disposal method for tailings or reject from the process Plant.

Not applicable.

d) Quantity and quality of tailings/reject proposed to be disposed, size and capacity of tailing pond, toxic effect of such tailings, if any, with process adopted to neutralize any such effect before their disposal and dealing of excess water from the tailings dam.

Not applicable.

e) Quality and type of chemicals to be stored on site/plant.

Not applicable.

f) Quantity and type of chemicals to be stored on site/plant.

Not applicable.

g) Water usage of the mine, disposal of waste water

Approximately 610 Cum is daily water requirement for dust suppression, afforestation purpose, canteen and other general requirements, for this mine. Water will be drawn from company bore wells dug in nearby mining areas.

Crushing & Screening process does not have any water requirement as C&S units will be fitted with dust suction system.

7.0 OTHERS

a) Site services:

All major and capital repairs including maintenance and servicing of all mining equipment and machinery will be carried out at the mine workshop and central workshop. The workshop is provided with all essential facilities under following sections:

i. Heavy vehicles section
ii. Medium and light vehicles section
iii. Auto-Electrical section
iv. Welding and blacksmith section
v. Machinery and lathe section

All activities of the workshop are carried out under the supervision and control of qualified Mechanical and Electrical engineers with the help of experienced mechanics and electricians. An independent store for all essential spare parts will also be maintained at the mine workshop.

Power Supply

As mentioned earlier the requirement of the electric power will be tapped from the HT line passing near to the lease area by means of a suitable transformer. Till the time power is made available, DG set will be used. HEMM will be fueled by HSD. Most of the HEMM, C&S plants will be operated by HSD till power supply is provided.

Water Supply

The requirement of water supply, both for drinking and mine will be drawn from the company bore wells dug in nearby mining area.

Office

Since the mine working area spread is more, makeshift office in portable cabins have been proposed with necessity amenities.

Canteen:

A small canteen has been proposed near the mine office to cater the needs of persons employed in mine and ancillary activities.

Dispensary:

A dispensary/ cum-clinic is maintained at Toranagallu Office, where from all basic medical needs of workers and staff can be fully met. The company has undertaken various health camps and also strengthened the existing primary health centers located in the surrounding villages. And first aid room/stations will be provided with prescribed appliances.

b) Employment potential:

Vice president, Mines (JSW Steel Limited) heads the central mine organization followed by senior mining professionals (GM, DGM) and Mines Manager holding 1st class Certificate of competency. This mine will provide employment to 158 people and also generates indirect employment to around 200 people. Most of the work force employed by the lessee will be for mine supervision.

Table -7.1: Category wise employment

Category: Mine Official (Highly skilled)

Designation	No. of Persons
Mines Manager	1
Asst. Mines Manager	2
Mining Engineer	1
Environment Engineer	1
Geologist	1
Mechanical Engineer	1
Electrical Engineer	1
Mine Surveyor	1
Mining Foreman	4
Mining Mate cum Blaster	2
Welfare officer	1
IT officer	1
Total	**17**

Category: Skilled

Designation	No. of Persons
HEMM operator	90
Maintenance Dept. Staff	6
Office Staff	5
Total	**101**

Category: Semi-skilled

Designation	No. of Persons
Helpers	12
Drivers	8
Total	**20**

Category: Unskilled

Designation	No. of Persons
Workmen	20
Total	**20**

8.0 PROGRESSIVE MINE CLOSURE PLAN UNDER RULE 23 OF MCDR 1988

8.1 Environment Base line information:

This mine is recently reallocated to JSW Steel Limited., through an E-Auction process, conducted in accordance with the Mineral (Auction) Rules, 2015. The transfer of statutory clearances is under process. This has restricted our access to the core as well as buffer zones of mining lease. After the commencement of mining operations, a detailed EIA/EMP will be carried out.

The Mining lease area for Iron ore will be worked by opencast fully mechanized method. Deep-hole drilling and blasting operations are envisaged for production of the ore and removal of waste. This is estimated to be about 60% of the total handling and resorted only if hard rock formation is encountered during mining operations. It is a known fact that any mining activity will alter the existing ecology. The following chapter discuss in detail the effects of mining on the existing environment and the proposed measures to mitigate the same.

8.1.1 Existing land use pattern:

Table-8.1: Existing land use pattern

Particulars of Land use	Area(ha)
Area under Mining	64.78
Inactive Dump	14.28
Roads	0.70
Infrastructure	0.30
stockyard	1.50
Greenbelt/ Safety zone area	3.59
Unbroken area	15.39
Total	**100.54**

8.1.2 Water regime:

There are no rivers or perennial water courses in the mine lease area. However, the area is traversed by numerous seasonal water courses which are usually active during monsoon season and draining into the nearby water bodies (Hulikunte tank). Usually, no rain water

accumulates in the lease area. The rain water flows from hill slopes and it does not accumulate till it reaches the lower valleys. Hence, the drainage pattern is sub-dendritic in nature and is typical of the hilly area. A total of 13 *nalas* are originating from the lease area. Out of the total, 2 are originating from SW side near the cliff and joining to the *Hulikunte* tank and 4 from western slope adjacent to the ML, 5 from SE side and 2 from eastern side adjacent to the ML outside towards NE and finally draining to *Narihalla* stream.

8.1.3 Quality of air And Ambient noise level:

Ambient Air Quality: Since the existing mine is not in operation since 2011, we do not envisage any change in the ambient air quality from the baseline environmental parameters. As the mine is not in operation, ambient air quality for both the core zone (mining lease area) and buffer zone (within 10 km from the boundary of mining lease) is expected to be within the prescribed standards.

However, once the mining becomes operational, regular monitoring of air quality for the core and buffer zone will be undertaken. Air quality will be closely monitored, data collected will be analysed to understand the quality of air. In case, the air quality does not meet the norms for certain parameters, adequate measures will be taken to contain the air quality parameters well within the prescribed limits.

Noise Levels: Since the existing mine is not in operation since 2011, change in the ambient noise levels is not envisaged.

However, once the mining becomes operational, regular monitoring of noise levels for the core and buffer zone will be undertaken. Data collected will be analysed to understand the sources for excessive noise levels. In case, the noise levels do not meet the norms for certain parameters, adequate measures will be taken to contain the noise level parameters well within the prescribed limits.

8.1.4 Flora & Fauna

a) Flora:The vegetation occurring in the area belongs to Southern tropical dry deciduous forests. The dominant tree species found in the area are:

Table-8.2: Flora Species

S.No	Local Name	Botanical Name
1	Khair	Acacia catechu
2	Pachali	Dalbergia Paniculata
3	Rose wood	Dalbergia latifolia
4	Hudi	Stereospermum chelonoides
5	Maradi	Buchanania lanzan
6	Channaagi	Lagerstroemia parviflora
7	Dindal	Anogeissus latifolia
8	Honne	Pterocarpus marsupium
9	Beete	Dalbergia latifolia
10	Somi	Soymida febrifuga
11	După	Boswellia Serrata
12	Mashiwala	Chloroxylon swietenia
13	Maddi	Morinda tinctoria
14	Nobela	Limonia acidissima
15	Bela	Feronia elephantum
16	Bikke	Gardenia gummifera
17	Kakke	Cassia fistula
18	Boravi	Ixora arborea
19	Tega	Tectona grandis
20	Jagalaganti	Diospyros Montana

b) Fauna: In the buffer zone area, a total of 36 vertebrates and 20 invertebrates were recorded. Out of this, 26 were mammals, 7 were reptiles, 2 were amphibians and 20 were arthropods.

Antelope, spotted deer, Sambhar, Red and black mouth monkey, pig, Rabbit, Cow, Buffalo, Mouse, Porcupine and Horse observed belong to mammals.

House Lizard, Garden lizard, Krait, Cobra, Viper, Python and chameleon were among the reptiles observed. Frog and Todd were the amphibians found in the region.

Millipede, Centipede, Cockroach, Ant, Honey Bee, House fly, Red ant, Silver Fish, Earthworm, Cricket and grasshopper observed fall under the category, arthropods.

Major avifauna observed in the region include Nilkanth, Crow, Pigeon, Batair, Koel, Teetar, Owl, Kite, peacock, Parrot, Bulbul, Whistling teal, Vultures, Maina, Egred, Brahmany Kite, Shikra, Buzzard, Blue jay and Shrike.

8.1.5 Climatic conditions:

The study area forms a part of the region dominated by tropical climate with hot summer days moderately cool winters and moderate monsoon. The maximum & minimum temperatures with in core zone area were observed to be 41^0C and20^0C, respectively and the relative humidity varied between 30% & 80%.

8.1.6 Human Settlements

No human settlements within the lease area. However, within 10 km radius from mine lease area there are 16 villages and the demographic profile of the villages are given below:

Sl. No.	Village	Total Population
1	Lakshmipura	1316
2	Somalapur	300
3	Yeswanthanagar	5157
4	Daulatpur	2178
5	Krishnanagar	4160
6	Muraripur	1138
7	Taranagar	5377
8	Bhujanganagar	4672
9	Ranjitpur	874
10	Vittalnagar	833
11	Deogiri	3224
12	Shro.Gangalapur	460
13	Griplur	1
14	Ubbalagundi	1280
15	Gangalapur	672
16	Donimalai Township	6554
	TOTAL	**38196**

8.1.7 Public buildings, places of worship and monuments

There are no public buildings, natural parks, places of worship & monument within the core zone or within the vicinity of the mine area.

8.1.8 Any sanctuary located near leasehold

There is no sanctuary located near the lease area.

Environmental Plan is enclosed in 1:5000 **(Plate V)**

8.2 Impact Assessment:

i) Land area indicating the area likely to be degraded due to quarrying, dumping, roads, workshop, processing plant, tailing pond/dam, township etc.

The mining pits are present in the lease area serving as production benches. The major impacts observed include soil erosion, loss of topsoil, creation of pits and deforestation and possibility of adding silt load in the natural nallah nearby the lease area.

ii) Air quality:

The semi-arid climatic condition of the area coupled with mining activities on the top of the hills through open-cast, contributes to air pollution. The dust is observed to be the predominant air pollutant when the mining is in operation.

iii) Water quality:

The major impact on water pollution is due to erosion of waste dump and sub-grade dump, oil and grease, contamination of water bodies due to discharge of mine water/effluent and sedimentation of the seasonal nallahs flowing nearby.

Iv) Noise levels:

Noise pollution by mining activities is mainly because of excavation, handling and transportation of ore and overburden and operation of processing equipment.

v) Vibration levels (due to blasting):

As deep hole drilling and blasting would be conducted, certain impact on ground vibration is likely to be caused. However, well designed blasting pattern, use of shock tube initiation system, use of M.S. delay detonators, will be used to minimise the ground vibration levels. Hence there is no major impact due to blasting.

vi) Water regime:

There is no seepage water and there is no water table in the vicinity as the lowest level in mining will be well above the ground level. Monsoon water gets drained through seasonal nallahs and joins nearby tank.

The mining operations are conducted at hill top which is at much higher level than ground water level. Mining activities will not intersect the groundwater as the groundwater table.

vii) Acid mine drainage:

Not applicable as no acidic material is present in the mining area.

viii) Surface subsidence:

Not applicable as it is opencast mining in a stable area.

ix) Socio-economics:

The mining will bring positive effect by way of generation of employment and business opportunities to local people. Apart from this, lessee will undertake CSR activities focusing on measures to improve education, health, literacy of the people of surrounding villages.

x) Historical monuments etc.

There are no public buildings, places of worship or monuments are located near the lease area.

Mitigative measures:

Air: It is proposed to deploy Water tankers with automated sprinkling system to suppress dust by regular water spraying on all the roads used for haulage and around mobile Crushing & Screening Plant. Plantation will be carried out as green belt all along the lease boundary which will act as windbreaks.

Water: For protection of the mining area and for arresting solid wash-off the surface water management measures will be implemented as proposed in the R&R report.

Noise: The management plan for controlling noise pollution are by providing noise insulation/padding in plants and machinery wherever practicable, limiting of speed of haulage vehicles/tippers, proper maintenance of noise generating parts of the machine, provision of earmuffs to workers.

Regular monitoring of all the environmental parameters will be undertaken as per CCOM circular, Location of monitoring stations has been marked on Environment plan **(Plate V).**

8.3 Progressive reclamation Plan:

8.3.1. Mined-Out Land:

The existing land use pattern is as follows:

No. 8.3 EXISTING LAND USE PATTERN

Sl. No.	Particulars	Land use Plan at the end of Plan period (Area in Ha)
1.	Area under Mining	64.78
2.	Dumping	14.28
3.	Mineral stock	1.50
4.	Roads	0.70
5.	GreenBelt/ Safety zone	3.59
6.	Infrastructure	0.30
7.	Virgin Area/ Unbroken Area	15.39
Total		**100.54**

The proposed land use pattern is as follows:

No. 8.4 PROPOSED LAND USE PATTERN

Sl. No.	Particulars	Land use Plan at the end of Plan period (Area in Ha)
1.	Area under Mining	57.76
2.	Dumping	23.77
3.	Roads	0.70
4.	GreenBelt/ Safety zone	3.59
5.	Infrastructure	0.50
6.	Crushing & Screening, Weigh Bridge with stockyard	2.50
7.	Virgin Area/ Unbroken Area	11.72
Total		**100.54**

Mining activity is yet to start in this area. The proposed area to be worked during the plan period is shown in the year-wise production and development plans. Mining in this plan period is proposed in the existing benches of earlier mined out area. Part of the mined out pits will be backfilled by the waste.

Hence reclamation by afforestation of encroached area, Active dumps and green belt development along the lease boundary will be carried out.

The environmental protective works such as afforestation, avenue plantation, settling tank, geo-textile matting, green belt development, dump management, check dam, retaining wall will be taken up in the mine effectively as per the ICFRE - R & R Plan.

Year-wise afforestation programme is furnished below and same has been marked on year-wise Production and Development plans **(Plate No. III(a) to III(e).**

Year	Type	Quantity	Location
I	Agave roots Saplings	18,000 Nos.	Greenbelt development & area under encroachment
II	Agave roots Saplings	18,000 Nos.	Greenbelt development & area under encroachment
III	Agave roots Saplings	18,000 Nos.	Greenbelt development & area under encroachment
IV	Agave roots Saplings	18,000 Nos.	Greenbelt development & area under encroachment
V	Agave roots Saplings	18,000 Nos.	Greenbelt development & area under encroachment

8.3.2 Topsoil Management:

Since the mine has been operation for several years before falling into 'C' category, entire area is already broken up. As per proposed mining programme over next five years, there is no likelihood of generation of topsoil. The soil is also not conducive for agricultural purpose. However if, some quantity is generated from cavities the same will be stacked and used for afforestation purpose.

8.3.3 Tailings Dam Management:

Not required as no tailing dam is present or proposed.

8.3.4 Acid mine drainage, if any and its mitigative measures:

Not applicable as no acidic material is present in the mining area.

8.3.5 Surface subsidence mitigation measures:

Not applicable as the proposal is for opencast mining in a stable area.

Table-8.4: Summary of year wise proposal for item No. 8.3

Items	Details	Year-wise Proposed measures					Remarks
		Ist	IInd	IIIrd	IVth	Vth	
Dump Management	Area afforested in (Ha)	-	-	-	-	-	All the proposed dumps will remain active during plan period.
	No. of saplings planted	-	-	-	-	-	N.A.
	Cumulative no. of plants planted	-	-	-	-	-	N.A.
	Cost including watch and ward care during the year	-	-	-	-	-	N.A.
Management of worked out benches	Area available for rehabilitation (Ha)	-	-	-	-	-	Mining operations yet to resume. No worked out abandoned benches. Rehabilitation not proposed.
	Afforestation done	-	-	-	-	-	N.A.
	No. of saplings planted in the year	-	-	-	-	-	N.A.
	Cumulative no. of plants	-	-	-	-	-	N.A.
	Cost including watch & care	-	-	-	-	-	N.A.
R&R by backfilling	Void available for backfilling (L x W x D)	207 x182x30	259x240x30	297x236x20	335x245x30	335x252x30	-
	Void Filled by waste/ tailing (Area in Ha.)	3.34	4.67	5.57	6.50	6.52	N.A.
	Afforestation on the backfilled area	-	-	-	-	-	N.A.

	Rehabilitation by making water reservoir	-	-	-	-	-	N.A.
Rehabilitation of waste land within lease	Area available (Ha)	-	-	-	-	-	-
	Area rehabilitated	-	-	-	-	-	Afforestation work will be taken up simultaneously with mining operation.
	Method of rehabilitation	-	-	-	-	-	Local species, as suggested by ICFRE will be planted to restore the natural flora.
Others	Area for Greenbelt Development (Ha)	0.72	0.72	0.72	0.72	0.71	Greenbelt development in the 7.5 m safety zone all along the mine boundary
	Afforestation for area under encroachment (Ha)	4.24	4.24	4.24	4.24	4.21	-

*It is fresh auctioned block mine operation are not yet be resumed

To prevent further degradation of land and stabilization of dumps, engineering measures i.e. toe walls, garland drains etc. are proposed inside the lease area. The details are given below:

8.4 Disaster Management and Risk Assessment:

The aim of disaster management is to identify potential dangers associated with the mining operations. An important element of mitigation is emergency planning i.e., recognizing that accidents are Possible, assessing the consequences of such possible accidents and deciding on

the emergency procedures, in advance, both on-site and off-site, that would need to be implemented in the event of an emergency, systematically and without delays and confusion.

The risk and disasters that could be foreseen in opencast mines may arise from:

i. Failure of external overburden dumps
ii. Failure of mine bench slopes
iii. Fly-rock from blasting operations
iv. Chemical spills
v. Fire in the bulk fuel storage or forest fire
vi. Plying of trucks and other vehicles on public roads

Maintenance of proper bench geometry, observing safety precautions for transport, proper storage, safe handling and use of explosives and fuel etc., good maintenance of roads and transport units, fire prevention measures, good dump management, shall go a long way in preventing accidents/disasters. No chemicals are used in mining operations or beneficiation process. Hence, there is no risk involved due to chemical spills.

Mining will be carried-out strictly as per MMR 1961 and all other rules and regulations. Project proponent is having mobile communication system for quick passing of information if need arises. Proper training will also be given to the work persons periodically, as per DGMS rules.

The management is committed to identify possible causes for the potential disasters and draw a code of emergency measures and procedures to deal with such disasters, which is otherwise also advised by DGMS through their periodic circulars.

Safety and Security

Around the ultimate pit limit, a fencing will be constructed as per the norms prescribed by the DGMS, to fence off the entry of stray animals and persons to the mine area. Where such effective blocking is not possible, watch & ward Posts will be established. Periodical inspection of all such arrangements will be carried out. The visitors will be allowed to enter the mine area only with permission.

Risk Management

In case of any emergency, evacuation of affected people will be undertaken immediately. Injured person(s) will be shifted to the hospital by departmental ambulance to Sanjeevani Hospital and Government. Hospital located at 25 km. & 5 Km. from mine head respectively. Using cellphone service, monitoring of relief services will be carried out.

No high-risk accidents are anticipated, as the project is an open cast mining operation in a stable area free from land subsidence, earthquake etc. However, in case of any eventuality, the designated Mines Manager will be managing of the situation. He will be having communication facility and a Jeep at his disposal which will help in evacuating persons involved in any accidents.

Details of the Person to be contacted in case of emergency situation:

Name: Sri MV Sundra Raja,

Mines Manager

Cell: 9480694327

Nearest Hospital (102), Fire station (101) and Police Station (08395-260249) are in Sandur which is about 9 km away from the mine.

8.5 Care and maintenance during temporary discontinuance:

An emergency plan to deal with the situation of temporary discontinuance or incomplete programme due to Court order/due to statutory requirements or any other unforeseen circumstances will be drawn by the technical & managerial personnel to suit the specific situation of this mine.

This will be reviewed & modified to suit the varying conditions. This would involve preventing access to dangerous places, pits and preventing accidental fall into the pit of animals & men. Safety measures, such as firefighting equipment, switchgear etc., will be placed at readily accessible locations.

The following measures will be implemented:

(i) Proper and adequate security at the entrance/exit to the mine to prevent entry of unauthorized person.

(ii) Top edges of the quarry will be fenced off.

(iii) Entrance to the toe of dumps will be blocked.

(iv) Special security and fire preventing measures will be taken at dangerous places/explosive magazine etc.,

(v) All the above will be examined by mines manager once in a week to ensure that they are in order.

8.6 Financial Assurance:

Details of land use proposed for mining and allied activities regarding calculation of Financial Assurance as per COM's Circular no. 4, 2006 are given below.

Sl. No.	Particulars	Area put on use at start of MP (Ha)	Additional requirement during plan period (Ha)	Total Area (Ha) A+B=C	Area considered as fully reclaimed and rehabilitated (Ha)	Net area considered for calculation (Ha) C-D=E
		A	**B**	**C**	**D**	**E**
1	Area under mining	64.78	2.50	67.28-6.52-3.0 =57.76*	-	57.76
2	Storage for topsoil	-	-	-	-	-
3	Waste dump site	14.25	6.52(BF)+3.0(TD)=9.52	23.77	-	23.77
4	Mineral storage	1.50	0.50	2.00	-	2.00
5	Infrastructure-Workshop, Admin. Building etc	0.30	0.20	0.50	-	0.50
6	Roads	0.70	-	0.70		0.70
7	Railways	-	-	-		-
8	Tailing pond	-	-	--		--
9	Effluent treatment plant	-	-	-		-
10	Mineral separation plant	-	-	-		-
11	Township area	-	-	-		-
12	Green belt/Afforestation	3.59	-	3.59		3.59
12A	Engineering meausers(retention wall, Garland drain,)	--	0.20	0.20	-	0.20
13	Others -*Un used*	15.42	-	12.02		-
	Grand Total	**100.54**	**12.92**	**100.54**		**88.52**

**6.52 of mining area will be used under Backfilling and 3.00 Ha for temporary dumping (as per R & R plan).*

Financial area assurance plan is enclosed in 1:2000 **(Plate VII)**

B P Pandey

Qualified Person