MINING PLAN

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

For

"RAMA IRON ORE MINE"

(Rama Rao Paol, ML No.2621)

Village- Ramgad

Taluka- Sandur, District- Ballari, State- Karnataka

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

Type of Land- Ramgad Reserved Forest

Lease Area: 33.80 Ha.

Of

M/s. JSW STEEL LTD.

Prepared by

B.P. Pandey

B.TECH. (Mining)

Qualified Person

1. MINE DESCRIPTION

Introductory note

Rama Iron Ore Mine, ML No. 2621, located in Ramgad village, Sandur Taluka, Ballari District, over an extent of 33.80 Ha area of Forest Land of Ramgad range 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. 2621, previously held by M/s Rama Rao Paol has a total encroachment area of 28.12 Ha (entirely under others category). 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 had directed the Government of Karnataka to submit the Reclamation and Rehabilitation Plan(s) for the districts of Bellary, Tumkur and Chitradurga within three months. Subsequently, the Government of Karnataka vide letter dated 29th September, 2011 has assigned the work 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 that the details of mineral reserves to be available based on the exploration data undertaken by the State Govt. Accordingly the Govt. of Karnataka has provided 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 Bellary, Chitradurga and Tumkur Districts of Karnataka State.

M/s. MECL has conducted Exploration in the Mining Lease area of Rama Iron Ore Mine, ML No. 2621, by Geological mapping, core drilling and RC drilling etc. The reserves have been estimated

by MECL. Total mineable reserves of 25.67 Million tonnes have been estimated based on the exploration data.

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/12/2621/2016-17 **(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 1.28 MTPA, 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 25th March 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 1.28 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**	**1.28**
2.	Dump Capacity	1.31
3.	Road Capacity	0.94
4.	EC Capacity	0.50

The indicative cost estimate for the implementation of engineering and biological measures for reclamation and rehabilitation plan is 116.72 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

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 ACCESSABILITY

a) Lease Details (Existing Mine)

Name of the mine	**Rama Iron Ore Mine** **(Rama Rao Paol, ML No. 2621)**
Lat/long of any boundary point	LBS -1 Latitude - 15° 07' 37.1" Longitude - 76° 27' 56.0" There are 8 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
Ramgad reserved Forest	33.80	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	33.80 ha
District & State	Ballari Dist, Karnataka State
Taluka	Sandur
Village	Ramgad
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-west of the lease area at around 1.0 km. Nearest

	Railway Siding is Ramgad Railway siding at about 10 kms from lease area. 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/8 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.	CORNER PILLAR No.	Map Datum – WGS 84	
		Latitude	Longitude
1	LBS – 1	N 15º 07’37.1”	E 76º 27’56.0”
2	LBS – 2	N 15º 07’33.0”	E 76º 27’59.4”
3	LBS – 3	N 15º 07’31.4”	E 76º 27’59.9”
4	LBS – 4	N 15º 07’29.6”	E 76º 28’01.3”
5	LBS – 5	N 15º 07’27.6”	E 76º 27’58.7”
6	LBS – 6	N 15º 07’03.0”	E 76º 28’11.8”
7	LBS – 7	N 15º 07’08.1”	E 76º 28’21.0”
8	LBS – 8	N 15º 07’41.2”	E 76º 28’02.7”

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 in **Annexure XIV**.

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

GCP No.	Co-ordinates		Distance & Direction from LBS-6
	Northing	Easting	
1	N15^0 07’ 26.1’’	E76^0 28’ 46.0’’	924.15m Towards NE
2	N15^0 07’ 22.0’’	E76^0 28’ 48.9’’	895.28m Towards NE
3	N15^0 07’ 22.6’’	E76^0 28’ 60.6’’	981.48m Towards NE

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 Rama Iron Ore Mine, ML No. 2621 is covered in Survey of India Topo-sheet No. 57 A/8 and bound by Longitudes 76º27'56" to 76º28'21" and Latitudes 15º07'03" to 15º07'41.2".

Buffer zone- the buffer zone area characteristically comprises of valleys and altitude varying between 600 to 1023 m above MSL, surrounded by rugged hills, marked by discrete, NW-SE trending ridges, separated by flat or gently sloping land. The area has got sub-dendritic pattern of drainage. The terrain is hilly with alternate valleys. The hill contain erosion resistant rocks like banded hematite quartzite (BHQ), banded hematite jasper (BHJ), granite, argillites etc. some steep escarpments are encountered in these hill ranges.

Core zone- the mining lease area forms part of fairly high range of hill trending NNW to SSE, occurs between village Deogiri and Hospet town. The lease area occupies the crest and slopes of this range for about 1170m. the crest of lease hold comprises a narrow plateau of about 40 to 60 m. wide, with steep slopes towards East. The slopes are traversed by a few seasonal nallahs draining into the valley. These nallahs are small and narrow and act only as flood channels during rainy season and none of them are perennial. The lease area termed as core zone, is steeply sloping revenue land having thick iron ore float and iron ore reef.

The maximum and minimum elevation is 988 m. & 948m above MSL respectively.

(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 (Narihalla Reservior). 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.

There are 6 nalas existing in and around the ML area. Out of which, one is from western side and emptying into a tank near Byalakundi and another one originates from northern side is

flowing towards NW direction and emptying into Raya Channel. The remaining 4 nalals are originating from eastern side of ML area and flowing towards eastern direction and emptying into Narihalla Reservoir.

In the Plan Period, the lowest working proposed is 948 m above MSL which is about 388 m above the ground water table. In the Conceptual period, mine working is expected to reach 875m above MSL, which is 315 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 Ramanmalai 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)

c) Geology of the lease area:

The mineralized zones of Rama Iron Ore Mine, Mining Lease Area (ML No. 2621) 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
- Lateritic ore
- Iron Ore Formation
- Shale/ Phyllites/ Limonitic clay
- BHQ

Soil Cover

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.

Lateritic ore

The laterite ore is well exposed in the area, at higher altitude. The thickness of the laterite ore vary from 2 to 5m, at location observed in the working pits of the neighbouring mines. The lateritic ore observed in the area is highly porous, reddish to dull red colour. Pebbles, boulders of ferruginous matrix are embedded in the laterites.

Iron Ore Formation

In general the strike of the ore formation is due SE-NW with moderate angle of dips varying between 45^0 to 60^0 towards NE. the total strike length of the ore body exposed is about 1150m. The width of the out crop is at an average of 180-200 m.

The iron formation/deposit of this mine lease area is part of Ramanmalai Range and it is known for its good quality. There is one major Iron ore band passing through the lease area, with dimension 1150mx180m (Length x Width). The iron ore deposit occurs in the area, in the form of reef, with BHQ, Phyllite. The dip varies between 65˚ to 70˚, 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 about 33.50 Ha.

Shale/ Phyllites/ Limonitic Clay

Shale/ Phyllites/ Limonitic Clay are seen/exposed in the working of adjacent mines or at the contact with ore bands. The shale and ore band contact is very clear at places.

The shales in general strikes in NW-SE direction with moderate dip. Shales are soft to medium hard. The colour varies from reddish to brown. At places shale appear to have been metamorphosed to phyllites.

Banded Hematite Quartzite

BHQ is well exposed along the foot of the hill outside the lease area.

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 2 nos. of Core drill holes (94.50m) and 21 nos. of RC drill holes with a depth of 1344.0 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.**	
MRP-1	15	7	13.421	76	28	11.485	946.77	38.50
MRP-2	15	7	20.249	76	28	8.286	951.79	56.00
MRPR-3	15	7	26.043	76	28	5.626	968.25	70.00
MRPR-4	15	7	12.659	76	28	8.352	991.74	70.00
MRPR-5	15	7	9.771	76	28	9.655	991.27	80.00
MRPR-6	15	7	5.056	76	28	14.039	995.47	65.00
MRPR-7	15	7	28.157	76	28	2.951	974.82	60.00
MRPR -8	15	7	17.602	76	28	11.253	936.91	50.00

MRPR -9	15	7	23.523	76	28	8.716	948.03	55.00
MRPR -10	15	7	34.011	76	28	59.926	972.86	80.00
MRPR -11	15	7	35.995	76	28	57.759	978.48	80.00
MRPR -12	15	7	28.732	76	28	5.771	938.87	62.00
MRPR -13	15	7	26.951	76	28	8.073	933.41	50.00
MRPR -14	15	7	20.465	76	28	11.129	916.63	50.00
MRPR -15	15	7	31.224	76	28	2.912	944.35	50.00
MRPR -16	15	7	10.903	76	28	12.263	947.14	80.00
MRPR -17	15	7	18.519	76	28	6.003	988.49	55.00
MRPR -18	15	7	16.347	76	28	8.272	987.46	70.00
MRPR -19	15	7	7.29	76	28	13.015	987.57	72.00
MRPR -20	15	7	22.169	76	28	5.66	983.39	65.00
MRPR -21	15	7	9.029	76	28	17.177	926.29	60.00
MRPR -22	15	7	11.677	76	28	14.92	923.26	60.00
MRPR -23	15	7	15.003	76	28	13.795	924.58	60.00
TOTAL								**1438.5**

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

Total 1424 nos. of Samples of ore and waste from the boreholes were analysed. 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 XVII.**

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 3,78,61,249 (Indian Rupees Three crore seventy-eight lakhs sixty-one thousand two hundred and forty-nine).**

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 category. Therefore, to know the variation in the grade and recovery, ascertain the extent and depth of reserves/resources, lessee proposes to drill about 13 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 first year of the plan period. The Proposed position of the boreholes are marked in the Geological Plan **(Plate No. 4).**

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	6	100 m	330 m	-	-	Confirmation of Ore reserves, to ascertain the extent and depth of mineralization,
II	7	100 m	380 m	-	-	
III	-	-	-	-	-	
IV	-	-	-	-	-	
V	-	-	-	-	-	
Total	-	-	**710 m**	-	-	

Table 1.3 (b) Location of Proposed boreholes

Proposed Year	PBH	Sections
I	1	S1-S1’
	2	S1-S1’
	3	S2-S2’
	4	S2-S2’
	5	S3-S3’
	6	S5-S5’
II	7	S7-S7’
	8	S8-S8’
	9	S9-S9’
	10	S9-S9’
	11	S10-S10’
	12	S11-S11’
	13	S12-S12’

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

(i) Mineralisation

All the material 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 DETAILS OF IRON ORE ZONE INTERSECTED IN THE BOREHOLES (AT 45% Fe CUT-OFF)

Borehole Number	Intersection (m)		Thickness (m)	True Avg./Thick (m)	Grade (%)			Rice Ratio Fe/(SiO2+ Al2O3)	SiO2/ Al2O3	Fe/ Al2O3
	From	To			SiO_2	Fe	Al_2O_3			
MRP1	0.00	2.00	2	1.84	29.26	52.97	1.93	0.59	15.16	27.45
MRP1	4.00	5.00	1	0.92	30.10	46.91	1.02	0.66	29.51	45.99
MRP-1	18.00	20.50	2.5	2.30	15.00	54.17	4.77	0.36	3.14	11.36
MRP-2	0.00	26.00	26	23.92	21.27	49.03	7.82	0.59	2.72	6.27
MRPR-3	0.00	31.00	31	28.52	12.39	55.14	5.25	0.32	2.36	10.50
MRPR-4	0.00	67.00	67	61.64	8.06	54.34	8.42	0.30	0.96	6.45
MRPR-5	0.00	2.00	2	1.84	2.20	62.54	4.59	0.11	0.48	13.63
MRPR-5	11.00	15.00	4	3.68	12.90	52.11	10.49	0.45	1.23	4.97
MRPR-5	35.00	42.00	7	6.44	6.57	57.68	5.97	0.22	1.10	9.66
MRPR-5	68.00	74.00	6	5.52	14.24	48.53	11.89	0.54	1.20	4.08
MRPR-6	0.00	53.00	53	48.76	9.26	55.86	5.96	0.27	1.55	9.37
MRPR-7	0.00	44.00	44	40.48	6.51	60.91	3.97	0.17	1.64	15.34
MRPR-8	0.00	12.00	12	11.04	8.43	61.69	2.30	0.17	3.67	26.82
MRPR-9	0.00	4.00	4	3.68	10.51	57.31	3.70	0.25	2.84	15.49
MRPR-9	24.00	43.00	19	17.48	29.55	47.26	2.03	0.67	14.56	23.28
MRPR-10	0.00	57.00	57	52.44	9.14	59.25	3.79	0.22	2.41	15.63
MRPR-11	0.00	60.00	60	55.20	6.33	62.25	3.05	0.15	2.08	20.41
MRPR-12	0.00	56.00	56	51.52	22.76	50.48	2.92	0.51	7.79	17.29
MRPR-13	0.00	25.00	25	23.00	18.32	48.14	7.60	0.54	2.41	6.33
MRPR-14	0.00	16.00	16	14.72	20.98	51.90	2.30	0.45	9.12	22.57
MRPR-15	0.00	23.00	23	21.16	21.12	51.98	1.82	0.44	11.60	28.56
MRPR-15	31.00	32.00	1	0.92	15.32	49.98	3.57	0.38	4.29	14.00
MRPR-16	0.00	4.00	4	3.68	9.65	58.06	1.66	0.19	5.81	34.98
MRPR-16	72.00	80.00	8	7.36	26.39	50.29	1.02	0.55	25.87	49.30
MRPR-17	0.00	22.00	22	20.24	7.46	60.49	4.84	0.20	1.54	12.50
MRPR-18	0.00	62.00	62	57.04	16.45	56.17	2.48	0.34	6.63	22.65
MRPR-19	0.00	68.00	68	62.56	6.26	61.85	3.34	0.16	1.87	18.52
MRPR-20	0.00	65.00	65	59.80	6.64	60.92	3.15	0.16	2.11	19.34
MRPR-21	0.00	2.00	2	1.84	26.18	50.75	1.02	0.54	25.67	49.75
MRPR-21	7.00	8.00	1	0.92	29.74	47.94	1.53	0.65	19.44	31.33
MRPR-22	0.00	13.00	13	11.96	23.93	50.94	1.65	0.50	14.50	30.87

(iv) Mineralization 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, hematite, goethite, siderite require expensive roasting or flotation processes. Although when the grains are coarse, hematite ore may get treated with low cost. Mineralization factor is the ratio of net ore bearing area to gross area. It is referred as the co-efficient of impurities.

Out of the mining lease area of 0.3380 sq.km, the mineralized area is 0.3097 sq.km. Hence, the mineralization factor for Rama Iron Ore Mine Lease Area is 0.92.

(v) Physical Characteristics of the Iron Ore

The ore are massive $\pm$ laminated, soft laminated and blue dust. Principal ore minerals are hematite + magnetite, goethite and limonite. 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 lateritization and the laterite area is very less (2-3%), The haematitic ore persists even beyond the level of exploration as could be visualize from the geological cross sections (S-3, S-4, S-5 & S-9). Silica to Alumina ratio ranges between 0.479 and 25.666 with the average of 3.375 indicating low level of lateritization; whereas the Iron to Alumina ratio for the Rama Iron Ore Mine, Mine Lease Area (ML No. 2621) is 14.855. The ore in general, is rich in iron [>58%Fe], but they also contain 1-7% Al_2O_3.

(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 over the lease area of more than 1.2 km which allow us to presume that the iron ore zone has wide persistence continuity. Moreover, iron ore has been extracted from Kumaraswamy range not only by NMDC but also by SMIORE since Independence. However, Dalmia International has been extracting the ore from NEB range since Independence only for exploitation. Therefore, UNFC code pertains to economical, feasibility and geological axis of (G1) have been assigned. The estimation of ore reserves at 45% Fe cut off is given in Table-1.5.

It reveals that the iron ore band extends over the strike length of 1150.0m along the NNW-SSE with in the average wide area of 180.00 m and upto the vertical depth 61.64m. A total of 31.53 m.t. of net reserves with average grade of 56.60% Fe, 12.86% SiO_2 and 3.81% Al_2O_3 have been estimated.

A summary of the category wise Geological reserve estimated for this mine is given in table below:

Table-1.5: Geological Reserves

Category	UNFC	Geological Reserves (tonnes)
Proved	111	14776973.00
Probable	122	16754635.00
	Total	**31531608.00**
	Average Fe %	**56.60%**
Source: Table-4, Page No. 24 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 12 geological cross sections serially numbered S1 – S1' to S12 – S12' from northeast to southwest (along N65°E – S65°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 (122) category of UNFC. Correction factor of 1.15 for thickness of iron ore in strike direction has been applied. Similarly, a correction factor of 0.92 has been applied to get the true thickness.

Area explored under different level of exploration has been marked on the geological plan **(Plate No. 4).**

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 1.6.

TABLE-1.6: SECTION-WISE, BOREHOLE-WISE, CATEGORY-WISE MINEABLE RESERVES ESTIMATED BY CROSS SECTION METHOD

Sl.No.	Section Number	Borehole Number	Intersection (m)		Diff (m)	True Width (m)	Average sectional Influence (m)	Area (Sq.m) (111)	Area (Sq.m) (122)	Bulk Density	Reserves (Tonnes) (111)	Reserves (Tonnes) (122)	Total Reserve and Resources	Grade		
			From	To										Fe%	SiO2%	Al2O3%
1	S1-S1'	MRPR-6	0	53	53	48.76	37.6	4927.8215	2440.813	3.0	**555858.27**	**275323.71**	**831181.97**	55.86	9.25	5.96
2	S2-S2'	MRPR-19	0	68	68	62.56	92.8	5798.5374	2059.51	3.0	1614312.8	573367.58	2187680.4	61.85	6.26	3.34
		MRPR-21	0	2	2	1.84	92.8	569.10	530.06	3.0	158437.44	147568.7	306006.14	50.75	26.18	1.02
		Sub-Total :									**1772750.3**	**720936.29**	**2493686.5**			
3	S3-S3'	MRPR-22	0	13	13	11.96	102.9	0	1407.8402	3.0	0	434600.27	434600.27	50.94	23.93	1.65
		MRPR-5	0	2	2	1.84	102.9	0	26.4027	3.0	0	8150.5135	10459.826	62.54	2.2	4.59
		MRPR-5	11	15	4	3.68	102.9	0	240.8498	3.0	0	74350.333	95416.261	52.11	12.9	10.49
		MRPR-5	35	42	7	6.44	102.9	0	556.3002	3.0	0	171729.87	220386.67	57.68	6.57	5.97
		MRPR-5	68	74	6	5.52	102.9	0	411.9412	3.0	0	127166.25	171119.99	48.53	14.24	11.8
		MRPR-16	0	4	4	3.68	102.9	0	4028.6437	3.0	0	1243642.3	173775.28	58.06	9.65	1.66
		MRPR-16	72	80	8	7.36	102.9	0	640.05	3.0	0	197583.44	254756.44	50.29	26.39	1.02
		Sub-Total :									**0**	**2257223**	**1360514.7**			
4	S4-S4'	MRPR-4	0	67	67	61.64	99.8	4505.0258	0	3.0	1348804.7	0	1348804.7	54.34	8.06	8.42
		MRP-1	0	2	2	1.84	99.8	863.6528	0	3.0	258577.65	0	258577.65	52.97	29.26	1.93
		MRPR-1	18	20.5	2.5	2.3	99.8	290.3182	0	3.0	86921.269	0	86921.269	54.17	15	4.77
		Sub-Total :									**1694303.6**	**0**	**1694303.6**			
5	S5-S5'	MRPR-18	0	62	62	57.04	97.55	5530.51	2100.82	3.0	1618503.8	614804.97	2233308.7	56.17	16.45	2.48
		MRPR-8	0	12	12	11.04	97.55	1651.8953	512.1	3.0	483427.16	149866.07	633293.22	61.69	8.43	2.3
		Sub-Total :									**2101930.9**	**764671.04**	**2866601.9**			
6	S6-S6'	MRPR-17	0	22	22	20.24	98.6	2090.31	75.6	3.0	618313.7	22362.48	640676.18	60.49	7.46	4.84
		MRPR-2	0	26	26	23.92	98.6	2015.17	0	3.0	596087.29	0	596087.29	49.03	21.27	7.82
		MRPR-14	0	16	16	14.72	98.6	1953.03	660.35	3.0	577706.27	195331.53	773037.8	51.9	20.98	2.3
		Sub-Total :									**1792107.3**	**217694.01**	**2009801.3**			
7	S7-S7'	MRPR-20	0	65	65	59.8	104.9	0	8200.1	3.0	0	2580571.5	2580571.5	60.92	6.64	3.15
		MRPR-9	0	4	4	3.68	104.9	0	401.7	3.0	0	126414.99	126414.99	57.31	10.51	3.7
		MRPR-9	24	43	19	17.48	104.9	0	3013.1	3.0	0	948222.57	948222.57	47.26	29.55	2.03
		Sub-Total :									**0**	**3655209**	**3655209**			

8	S8-S8'	MRPR-3	0	31	31	28.52	100.5	0	5108.09	3.0	0	1540089.1	1540089.1	55.14	12.39	5.25
		MRPR-13	0	25	25	23	100.5	0	2816.1	3.0	0	849054.15	849054.15	48.14	18.32	7.6
		Sub-Total :									**0**	**2389143.3**	**2389143.3**			
9	S9-S9'	MRPR-7	0	44	44	40.48	91.8	4250.0	1810.01	3.0	1170450	498476.75	1668926.8	60.91	6.51	3.97
		MRPR-12	0	56	56	51.52	91.8	4080.05	1394.3	3.0	1123645.8	383990.22	1507636	50.48	22.76	2.92
		Sub-Total :									**2294095.8**	**882466.97**	**3176562.7**			
10	S10-S10'	MRPR-15	0	23	23	21.16	100.56	0	5207.4	3.0	**0**	**1570968.4**	**1570968.4**	51.98	21.12	1.82
11	S11-S11'	MRPR-10	0	57	57	52.44	98.7	4350.28	3572.8	3.0	**1288117.9**	**1057906.1**	**2346024**	59.25	9.14	3.79
12	S12-S12'	MRPR-11	0	60	60	55.2	91.2	3592.4	5740.1	3.0	**982880.64**	**1570491.4**	**2553372**	62.25	6.33	3.05
										TOTAL	**12482045**	**15362033**	**26947370**	**56.6**	**12.86**	**3.81**
										NET RESOURCES			**25600001**			

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 to arrive at the net geological reserves
iv. Correction factor of 1.15 for thickness of ore body in strike direction and 0.92 for true thickness based on the drilling.
v. Configuration of the ore body has been done based on the exploration data and the cross sections were prepared accordingly.
vi. 50 m on either side of the iron ore intersection of the bore holes has been placed under G1 (111) and the rest under G2 (122) under UNFC.
vii. Reserve estimate has been made up to buffer zone of mine lease area (7.5m from mine lease boundary).

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	14776973.00	56.60%
Probable	122	16754635.00	
Total		**31531608.00**	

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	11,857,942	56.60 %
Probable	122	14,593,932	
Total		**25,600,001**	

Table – 1.7: Total resources in tonnes as on 01.01.2017

Level of Exploration	Iron Ore(tonnes)	Average Grade
G1 - Detailed Exploration	11,857,942	**56.60**
G2 - General Exploration	14,593,932	
G3 – Prospecting	-	
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 Rama Iron Ore Mine, (ML No. 2621), over an average strike length of 1150.0m, 180.00m wide and up to an average thickness (depth) of 61.64m, 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) and (122) 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 1150.0m length along NNW direction with an average wide area of 180.00m. A total 31.53 m.t. of net-reserves estimated with an average grade of 56.60% Fe, 12.86% SiO_2 and 3.81% Al_2O_3.

RICE RATIO

Fe : SiO_2 + Al_2O_3 ratio is 0.29 for the entire lease hold area [S1-S1' to S12-S12']. The Al_2O_3: SiO_2 ratio is 3.375 and Al_2O_3 : Fe is 14.485 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			*56.60% Fe*
1.Proved Mineral Reserve	*111*	*11,857,942*	
2.Probable Mineral Reserve	*122*	*14,593,932*	
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*		
6.Reconnaissance Mineral Resource	*334*		
Total Reserve + Resources		***25,600,001***	

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, mechanized mining method. The mine pit was worked in unsystematic/haphazard manner by selective mining leaving leaner grade of ore/non mineralized portion in between. The benches were worked in uneven manner and no regular and systematic benches are formed. The total number of 9-14 benches are worked in the mining pits. Main pit was developed in the NW – SE directions along the strike almost for a length of 1 km. Initially for about 100 m, the pit has only two benches with an overall pit slope angle of about 45^0. In continuation to above development work, as lateritic ore was exposed in 2nd bench for another 300 to 350 m (approx.), two more benches were developed, the 3rd bench having a height of 10-11 m and 4th bench having a height of 3-4 m (sub bench). For the last 500 – 550 m (approx.) towards extreme S.E. direction, the pit is very well developed having total 10 benches. Bench height is varying from 5-8 m with width 5-7 m. No major waste dump was available within lease area.

ii) Proposed Method for Excavation

Fully mechanized open cast method of mining by drilling and blasting and by deploying HEMM equipments like hydraulic excavators, wheel loaders, tippers, will be undertaken. To make optimum exploitation of the mineral deposit, the mine will be developed by making benches with a height and width of 8m each and keeping the necessary berm width. The bench slope angle will be maintained at 70^0-80^0 with an overall pit slope angle of 45^0. The direction of advancement will be towards western as well as eastern side of the proposed working area. The ROM excavated was processed in the crushing and screening plants to obtain the lump and fine ore as product mix.

In order to achieve the targeted production, the different mining activities in this mine will be done in daylight hours (12 hours).

The operation involves excavation of the ore and waste by drilling and blasting. Ore excavated from the mine will be taken to the crushing and screening plant in the ML area for screening

and sizing. Further ancillary machinery like Water sprinklers, Road Graders, Dozers, Weighing machines etc., will also be deployed. The finished products, i.e. lump ore (10-40 mm) and fine ore (0-10 mm) will be loaded in to tippers and will be stocked at the 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 single major pit having the dimension given below:

Pit Number	Dimension LXWX D	Top RL	Bottom RL	No. of benches
1	840 X 180 X 47	995	948	4

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. 6A to 6E & 6F)** 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 soil (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	524105.0	-	97441.0	426664.0	-	-	0.23
II	I	491369.7	-	64703.0	426666.7	-	-	0.15
III	I	534113.8	-	107457.5	426656.3	-	-	0.25
IV	I	557807.7	-	131141.0	426666.7	-	-	0.31
V	I	525642.8	-	98987.5	426655.3	-	-	0.23
Total		**2633039.0**	**-**	**499730.0**	**213309.0**	**-**	-	**0.23**

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	1474874	-	194882	1279992	-	-	0.15
II	I	1409406	-	129406	1280000	-	-	0.10
III	I	1494884	-	214915	1279969	-	-	0.17
IV	I	1542282	-	262282	1280000	-	-	0.20
V	I	1477941	-	197975	1279966	-	-	0.15
Total		**7399387**	-	**999460**	**6399927**	-	-	**0.154**

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. 6A & its Section Plate no. 6F**, the benches are proposed to be formed between 980 and 964 m. Above MSL with 2 benches of width and height of 8 m each. The average ore to waste ratio works out to be 1:0.23 (in cum) and 1:0.15 (in tonnes). The total saleable ore amounts to 1,279,992 tonnes, while, the total waste of 194,882 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. 6B & its Section Plate No. 6F**, the benches are proposed to be formed between 972 and 964 m. Above MSL with 1 bench of width and height of 8 m each. The average ore to waste ratio works out to be 1:0.15 (in cum) and 1:0.10 in tonnes. The total saleable ore amounts to 1,280,000 tonnes, while, the total waste of 129,406 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. 6C & its Section Plate No. 6F**, the benches are proposed to be formed between 964 and 956 m. Above MSL with 1

bench of width and height of 8 m each. The average ore to waste ratio works out to be 1:0.25 (in cum) and 1:0.17 in tonnes. The total saleable ore amounts to 1,279,969 tonnes, while, the total waste of 214,915 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. 6D & its Section Plate No. 6F**, the benches are proposed to be formed between 964 and 956 m. Above MSL with 1 bench of width and height of 8 m each. The average ore to waste ratio works out to be 1:0.31 (in cum) and 1:0.20 in tonnes. The total saleable ore amounts to 1,280,000 tonnes, while, the total waste of 262,282 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. 6E & its Section Plate No. 6F**, the benches are proposed to be formed between 956 and 948 m. Above MSL with 2 benches of width and height of 8 m each. The average ore to waste ratio works out to be 1:0.23 (in cum) and 1:0.15 in tonnes. The total saleable ore amounts to 1,279,966 tonnes, while, the total waste of 197,975 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	25600001.10	1279992.00	24320009.10
II	24320009.10	1280000.00	23040009.10
III	23040009.10	1279969.00	21760040.10
IV	21760040.10	1280000.00	20480040.10
V	20480040.10	1279966.00	19200074.10

Level wise Production & Development calculation sheet, for the plan period is given below:

First Year

PRODUCTION AND DEVELOPMENT PLAN FOR I YEAR

Section S1-S1'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+988	50	428	21,400	60,990	2,140	-	-	-	2,140
+980	50	920	46,000	131,100	4,600	-	-	-	4,600
+972	50	173	8,650	24,653	865	-	-	-	865
+964	50	218	10,900	31,065	1,090	-	-	-	1,090
Total				**247,808**	**8,695**			**-**	**8,695**
Total Ore					***Total waste***				

Section S2-S2'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+988	92	64	5,888	16,781	589	9	828	1,656	2,245
+980	92	678	62,376	177,772	6,238	15	1,380	2,760	8,998
+972	92	68	6,256	17,830	626	-	-	-	626
+964	92	129	11,868	33,824	1,187	-	-	-	1,187
Total				**246,206**	**8,639**			**4,416**	**13,055**
Total Ore					***Total waste***				

Section S3-S3'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+988	103	26	2,678	7,632	268	41	4,223	8,446	8,714
+980	103	0	-	-	-	406	41,818	83,636	83,636
+972	103	12	1,236	3,523	124	35	3,605	7,210	7,334
+964	103	0	-	-	-	77	7,931	15,862	15,862
Total				**11,155**	**391**			**115,154**	**115,545**
Total Ore					***Total waste***				

Section S4-S4'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+988	100	88	8,800	25,080	880	27	2,700	5,400	6,280
+980	100	395	39,500	112,575	3,950	95	9,500	19,000	22,950
+972	100	70	7,000	19,950	700	20	2,000	4,000	4,700
+964	100	124	12,400	35,340	1,240	10	1,000	2,000	3,240
Total				**192,945**	**6,770**			**30,400**	**37,170**
Total Ore					***Total waste***				

Section S5-S5'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+988	97	133	12,901	36,768	1,290	-	-	-	1,290
+980	97	732	71,004	202,361	7,100	-	-	-	7,100
+972	97	98	9,506	27,092	951	-	-	-	951
+964	97	158	15,326	43,679	1,533	-	-	-	1,533
Total				**309,900**	**10,874**			**-**	**10,874**
Total Ore					***Total waste***				

Section S6-S6'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench	Sectional	Sectional	Volume	Quantity @	waste @	Sectional	Volume	Quantity @	TOTAL
level	influence	area		3 b.d	2 b.d	area		2 b.d	WASTE
				with 95% Rec.	with 5% rec				
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+980	98	285	27,930	79,601	2,793	-	-	-	2,793
+972	98	77	7,546	21,506	755	-	-	-	755
+964	98	135	13,230	37,706	1,323	-	-	-	1,323
Total				**138,812**	**4,871**			**-**	**4,871**
Total Ore					***Total waste***				

Section S7-S7'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench	Sectional	Sectional	Volume	Quantity @	waste @	Sectional	Volume	Quantity @	TOTAL
level	influence	area		3 b.d	2 b.d	area		2 b.d	WASTE
				with 95% Rec.	with 5% rec				
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+980	105	266	27,930	79,601	2,793	-	-	-	2,793
+972	105	60	6,300	17,955	630	-	-	-	630
+964	105	119	12,495	35,611	1,250	-	-	-	1,250
Total				**133,166**	**4,673**			**-**	**4,673**
Total Ore					***Total waste***				

TOTAL ORE	***1,279,992***
TOTAL WASTE	***194,882***
ORE TO WASTE RATIO	***1:0.15***

Second Year

PRODUCTION AND DEVELOPMENT PLAN FOR II YEAR

Section S1-S1'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+972	50	1009	50,450	143,783	5,045	5	250	500	5,545
+964	50	267	13,350	38,048	1,335	-	-	-	1,335
Total				**181,830**	**6,380**			**500**	**6,880**
Total Ore					***Total waste***				

Section S2-S2'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+972	92	882	81,144	231,260	8,114	23	2,116	4,232	12,346
Total				**231,260**	**8,114**			**4,232**	**12,346**
Total Ore					***Total waste***				

Section S3-S3'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+972	103	198	20,394	58,123	2,039	217	22,351	44,702	46,741
Total				**58,123**	**2,039**			**44,702**	**46,741**
Total Ore					***Total waste***				

Section S4-S4'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+972	100	478	47,800	136,230	4,780	-	-	-	4,780
Total				**136,230**	**4,780**			**-**	**4,780**
Total Ore					***Total waste***				

Section S5-S5'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+972	97	749	72,653	207,061	7,265	-	-	-	7,265
+964	97	188	18,236	51,973	1,824	-	-	-	1,824
Total				**259,034**	**9,089**			**-**	**9,089**
Total Ore					***Total waste***				

Section S6-S6'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+972	98	635	62,230	177,356	6,223	-	-	-	6,223
Total				**177,356**	**6,223**			**-**	**6,223**
Total Ore					***Total waste***				

Section S7-S7'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+972	105	638	66,990	190,922	6,699	6	630	1,260	7,959
Total				**190,922**	**6,699**			**1,260**	**7,959**
Total Ore					***Total waste***				

Section S8-S8'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+972	100	18	1,800	5,130	180	169	16,900	33,800	33,980
Total				**5,130**	**180**			**33,800**	**33,980**
Total Ore					***Total waste***				

Section S9-S9'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+972	92	153	14,076	40,117	1,408	-	-	-	1,408
Total				**40,117**	**1,408**			**-**	**1,408**
Total Ore					***Total waste***				

TOTAL ORE	***1,280,001***
TOTAL WASTE	***129,406***
ORE TO WASTE RATIO	***1:0.10***

Third Year

PRODUCTION AND DEVELOPMENT PLAN FOR III YEAR									
Section S1-S1'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+964	50	762	38,100	108,585	3,810	-	-	-	3,810
Total				**108,585**	**3,810**			**-**	**3,810**
Total Ore					***Total waste***				
Section S2-S2'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+964	92	901	82,892	236,242	8,289	-	-	-	8,289
Total				**236,242**	**8,289**			**-**	**8,289**
Total Ore					***Total waste***				
Section S3-S3'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+964	103	0	-	-	-	426	43,878	87,756	87,756
Total				**-**	**-**			**87,756**	**87,756**
Total Ore					***Total waste***				
Section S4-S4'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+964	100	472	47,200	134,520	4,720	-	-	-	4,720
Total				**134,520**	**4,720**			**-**	**4,720**
Total Ore					***Total waste***				
Section S5-S5'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+964	97	548	53,156	151,495	5,316	-	-	-	5,316
Total				**151,495**	**5,316**			**-**	**5,316**
Total Ore					***Total waste***				

Section S6-S6'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+964	98	608	59,584	169,814	5,958	113	11,074	22,148	28,106
Total				**169,814**	**5,958**			**22,148**	**28,106**
Total Ore					***Total waste***				

Section S7-S7'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+964	105	812	85,260	242,991	8,526	50	5,250	10,500	19,026
Total				**242,991**	**8,526**			**10,500**	**19,026**
Total Ore					***Total waste***				

Section S8-S8'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+964	100	406	40,600	115,710	4,060	248	24,800	49,600	53,660
Total				**115,710**	**4,060**			**49,600**	**53,660**
Total Ore					***Total waste***				

Section S9-S9'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+964	92	460	42,320	120,612	4,232	-	-	-	4,232
Total				**120,612**	**4,232**			**-**	**4,232**
Total Ore					***Total waste***				

TOTAL ORE	***1,279,969***
TOTAL WASTE	***214,915***
ORE TO WASTE RATIO	***1:0.17***

Fourth Year

PRODUCTION AND DEVELOPMENT PLAN FOR IV YEAR

Section S1-S1'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+956	50	1237	61,850	176,273	6,185	-	-	-	6,185
Total				**176,273**	**6,185**			**-**	**6,185**
Total Ore					***Total waste***				

Section S2-S2'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+956	92	1020	93,840	267,444	9,384	-	-	-	9,384
Total				**267,444**	**9,384**			**-**	**9,384**
Total Ore					***Total waste***				

Section S3-S3'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+956	103	0	-	-	-	548	56,444	112,888	112,888
Total				**-**	**-**			**112,888**	**112,888**
Total Ore					***Total waste***				

Section S4-S4'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+956	100	592	59,200	168,720	5,920	-	-	-	5,920
Total				**168,720**	**5,920**			**-**	**5,920**
Total Ore					***Total waste***				

Section S5-S5'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+956	97	882	85,554	243,829	8,555	-	-	-	8,555
Total				**243,829**	**8,555**			**-**	**8,555**
Total Ore					***Total waste***				

Section S6-S6'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+956	98	360	35,280	100,548	3,528	487	47,726	95,452	98,980
Total				**100,548**	**3,528**			**95,452**	**98,980**
Total Ore					***Total waste***				

Section S7-S7'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+956	105	1080	113,400	323,190	11,340	43	4,515	9,030	20,370
Total				**323,190**	**11,340**			**9,030**	**20,370**
Total Ore					***Total waste***				

TOTAL ORE	***1,280,003***
TOTAL WASTE	***262,282***
ORE TO WASTE RATIO	***1:0.20***

Fifth Year

PRODUCTION AND DEVELOPMENT PLAN FOR V YEAR

Section S1-S1'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+956	50	52	2,600	7,410	260	-	-	-	260
+948	50	1036	51,800	147,630	5,180	-	-	-	5,180
Total				**155,040**	**5,440**			**-**	**5,440**
Total Ore					***Total waste***				

Section S2-S2'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+956	92	56	5,152	14,683	515	-	-	-	515
+948	92	903	83,076	236,767	8,308	-	-	-	8,308
Total				**251,450**	**8,823**			**-**	**8,823**
Total Ore					***Total waste***				

Section S3-S3'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+948	103	369	38,007	108,320	3,801	234	24,102	48,204	52,005
Total				**108,320**	**3,801**			**48,204**	**52,005**
Total Ore					***Total waste***				

Section S4-S4'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+956	100	53	5,300	15,105	530	-	-	-	530
+948	100	538	53,800	153,330	5,380	-	-	-	5,380
Total				**168,435**	**5,910**			**-**	**5,910**
Total Ore					***Total waste***				

Section S5-S5'

		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+956	97	56	5,432	15,481	543	-	-	-	543
+948	97	715	69,355	197,662	6,936	-	-	-	6,936
Total				**213,143**	**7,479**			**-**	**7,479**
Total Ore					***Total waste***				

Section S6-S6'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+956	98	67	6,566	18,713	657	-	-	-	657
+948	98	191	18,718	53,346	1,872	535	52,430	104,860	106,732
Total				**72,059**	**2,528**			**104,860**	**107,388**
Total Ore					***Total waste***				

Section S7-S7'									
		MINEABLE RESERVE			Intercalated	WASTE			
Bench level	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	waste @ 2 b.d with 5% rec	Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+956	105	69	7,245	20,648	725	-	-	-	725
+948	105	972	102,060	290,871	10,206	-	-	-	10,206
Total				**311,519**	**10,931**			**-**	**10,931**
Total Ore					***Total waste***				

TOTAL ORE	***1,279,966***
TOTAL WASTE	***197,975***
ORE TO WASTE RATIO	***1:0.15***

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

There are three OB dumps i.e. ROM-1, ROM-2 and ID mixed with waste OB material ROM boulders, located within the ML area. ROM-1 is on eastern side and ROM-2 is on western side of the ML area. The dump height varies from 5 to 10 m and slope angle is 45^0 to 50^0 . ID is a very small dump lying within the pit.

The details are given below:

Waste Dump No.	Top RL	Bottom RL	Extent in Ha.	Height in m	Volume (Cum)
ROM-1	925	914	0.19	11.00	20900.0
ROM-2	984	978	0.76	6.00	45600.0
ID	941	936	0.02	5.00	1000.0

Material available in ROM stocks will be dispatched from mine site through E-auction, which will be taken up by government agency. Also there is no proposal for re-handling of ID, as the mine workings are proposed far away from the dump location, during the plan period.

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

Year wise Production and Development plans and sections are enclosed in 1:2000 scale (Plate No. 6A to 6E).

Also combined production and development sections are enclosed in 1:2000 scale (Plate No. 6F).

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 hard 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 carried out by rail-road combination to JSW steel plant. Trucks of 10/16/21 tons capacity will be used to transport the product. 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 4 X 3 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 fly-rock 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 1.4 Cum Bucket excavators and shifted by using 20 T dumpers to the Crushing and Screening plant for processing. Waste material will be dumped in the proposed Temporary dump 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, which is treated as calibrated lump ore.

In soft zone the ore will be directly excavated by excavator/loader and loaded into 20 tonnes tippers and transported to screening plant. The hard and oversize product will be transported to

the crushing unit. The fines and C-ore will be 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 (+45% Fe) is being consumed by the plant itself, where further beneficiation and upgradation of ore will be carried out.

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 1.28 MT is considered as the feasible production level based on the capacity of reserves which is approved by CEC and communicated by the Department of Mines and Geology **(Annexure II).**

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. 3)** and Geological Plan **(Plate no. 4)** and It is proposed to work in the sections from S1-S1' to S12-S12' during the plan period. The benches will be properly developed for a height of 8m & width of at least 8m. Accordingly the proposals are made in the benches particularly in the proved ore zone limit with a production quantity of 1.28 MTPA.

The year wise benches proposed to be worked both in ore and overburden are shown in P&D plans **(Plate no. 6A to 6E)** & Cross Sections **(Plate No. 6F)** for the plan period.

e) The layout of mine workings, pit road layout, the 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. 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.

During the first five years, it is proposed to produce 1.28 million tonnes of iron ore per annum at a stripping ratio of 1:0.20 (Maximum) about 0.99 Million tonnes of waste is required to be handled during the first five-year plan period.

The waste mainly consists of shale/Phylite. The waste generated will be dumped in the proposed temporary dump, located towards the north-western side of the lease as per R & R plan. The area demarcated for the temporary waste dump in this plan period is 3.7 Ha. Which is sufficient as it can hold 0.755 Million Cum and the expected waste generation of about 0.50 Million Cum in this plan period.

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
First	7.80	2	980-964
Second	9.70	1	972-964
Third	9.70	1	964-956
Fourth	10.30	1	964-956
Fifth	11.10	2	956-948

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

Year	Topsoil		Waste	Mineral Rejects		
	Reuse/ Spreading	Storage	Temporary Dump	Blending	Storage	Beneficiation
First	-	-	194882	-	-	-
Second	-	-	129406	-	-	-
Third	-	-	214915	-	-	-
Fourth	-	-	262282	-	-	-
Fifth	-	-	197975	-	-	-

f) Conceptual Mining plan

The mineable reserves estimated are 25.60 million tons and with the proposed production of 1.28 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 2.9 and 2.10) are provided with a specific timeline which already detailed in Table 2.11, 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 30.97 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-2.7: UPL Parameters

Area (ha)	Pit Dimension			
	Length (m)	Width (m)	Depth (m)	Slope
30.97	1141	300	113	45^{o}

The ultimate pit limit is demarcated on the Geological Plan and Cross Sections are enclosed as **Plate no. 4** and **Plate no. 5** respectively. Location of proposed workings are shown in the year wise layout plans, - **Plate 6A to 6E.**

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 consists of shale/Phylite. The waste generated will be dumped in the proposed temporary dump, located towards the north-western side of the lease as per R & R plan. The area demarcated for the temporary waste dump in this plan period is 3.7 Ha. Which is sufficient as it can hold 0.755 Million Cum and the expected waste generation of about 0.50 Million Cum in this plan period.

Backfilling of the mined out area will be carried out, to dispose the waste generated during the conceptual period. There is no mineral reject generation during plan period as all the +45% Fe material produced will be sent to JSW Steel plant.

iv) 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 **28.12 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 2.8: Particulars of area under encroachment are given below:

Particulars	Area (ha)
Mine pit	-
Over Burden Dumps	-
Others	28.12
Total	**28.12**

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 arresting structures should be constructed as per design. The height of the dumps and their terraces should be strictly maintained as per the design permitted for the purpose in the statutory clearances such as E.C., Mining Plan, Scheme of Mining, etc. Fresh dumping of waste should be carried out by adopting retreating method starting from bottom and reaching up to the top by creating terraces at every 10 m height with a top width of 6-8 m. Berms should be provided at the toe of each terrace to avoid water flow over the dump slopes. Wherever necessary, garland drains should be provided and connected to the vertical drains and finally to the check dams followed by Silt Settling Tanks (SSTs) to control run-off from the slopes. Haul road and mine approach road should also be provided with stone pitched drains. Inactive dumps should be vegetated with suitable plantation immediately after the terraces are made. All the plantation activities should 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 dumps which are having adverse conditions like steep slopes, poor soil fertility and instability and lack of moisture content. This will also enable to achieve good growth of vegetation cover over the dump slopes. Enriched plantation may also be adopted on top flat area and sloping area depending upon the condition.

i) Existing Waste/ Over Burden Dumps

There are three OB dumps i.e. ROM-1, ROM-2 and ID mixed with waste OB material ROM boulders, located within the ML area. ROM-1 is on eastern side and ROM-2 is on western side of the ML area. The dump height varies from 5 to 10 m and slope angle is 45 to 50 degrees. The dumps are partially covered with natural vegetation of *Chromolaena odorata, Lantana camara, Tecoma stans, Calotropis gigante*a and other grasses. ID is a very small dump lying within the pit and need to be re-handled during mining operation. The waste dumps should be

rehabilitated by adopting suitable measures. However, a toe wall and garland for ROM-1 has been proposed to protect its further erosion to outside the lease area.

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

Engineering measures for waste dump management for existing as well as proposed temporary dump are listed below in Table 2.9.

Table 2.9: Proposed engineering measures for management of waste dumps (ML No. 2621)									
Location	Items	Particulars of works	No	Dimension in m				Qty.	Unit
				Length	Width		Height		
					Top	Bottom			
Temporary Dump TD-1	TW-1: Toe wall at the toe of waste dump	Foundation in hard soil mixed with boulders including hard rock	1.0	438.00	2.00		0.60	525.60	cum
		Plain cement concrete (1:4:8) in foundation	1.0	438.00	1.70		0.15	111.69	cum
		RR Stone masonry Dry	1.0	438.00	1.00	3.00	2.00	1752.00	cum
	GD-1	Garland drain below the toe wall	1.0	447.00	2.00	1.00	1.00	670.50	cum
ROM Stock-1	TW-2: Toe wall at the toe of waste dump	Foundation in hard soil mixed with boulders including hard rock	1.0	100.00	2.00		0.60	120.00	cum
		Plain cement concrete (1:4:8) in foundation	1.0	100.00	1.70		0.15	25.50	cum
		RR Stone masonry Dry	1.0	100.00	1.00	3.00	2.00	400.00	cum
	GD-2	Garland drain below the toe wall	1.0	110.00	2.00	1.00	1.00	165.00	cum
Garland Drain along approach road									
	GD-3	Drain along approach road	1.0	870.00	1.50	1.00	1.00	1087.50	cum

iii) Surface Water Management Plan

Naturally, no rain water accumulates in the lease area. The rain water flows from hill slopes usually does not accumulate till it reaches the lower valleys. Hence, the drainage pattern is sub-dendritic in nature and is typical of the hilly areas of this region.

There are 6 nalas exists in and around the ML area. Out of which, one is from western side and emptying into a tank near Byalakundi and another one originates from northern side is flowing towards NW direction and emptying into Raya Channel. The remaining 4 nalals are originating from eastern side of ML area and flowing towards eastern direction and emptying into Narihalla Reservoir.

The proposed engineering measures for the surface water management of the ML area are given in **Table 2.10.**

Check Dams:

i.) **Loose Boulder Check Dam (LBCD)**: The LBCDs are Random Rubble Dry Stone Masonry in nature and are usually proposed for gullies having a width of about 5-10 m and bed slope of less than 10%. A total number of **12 LBCDs** are proposed for the nalas.

ii.) **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 waste lands. Altogether, **7 GCDs** are proposed for the nalas in the ML area.

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

iv.) **Brush Wood Check Dam (BWCD):** A total number of **110 BWCDs** are proposed. These structures are to be implemented at the conceptual stage in the ML area

v.) **Log Wood Check Dam (LWCD):** A total number of **150 LWCDs** are proposed. These structures are to be implemented at the conceptual stage in the ML area.

Water harvesting structures:

i) **Rain Water Harvesting Pit (RWHP):** The function of the RWHP is to recharge ground water by harvesting runoff along the nalas. A total number of **6 RWHPs** are proposed for the nalas in the lease area.

ii) **Silt Settling Tank (SST):** The function of SST is to protect the runoff of the mine from carrying silted water outside the ML area as it enables settling of silt in the runoff water. One **SST** is proposed in the nala to which connect the runoff from the proposed temporary dump (TD-1) at the plan period.

Table 2.10: Proposed bio-engineering measures for surface water management (ML No. 2621)

Location	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
	GCD-1	1.0	12.00	1.00	2.00	2.00	36.00	Cum
	RWHP-1	1.0	10.00	10.00	5*5	3.00	1.00	No.
	SMCD-1	1.0	20.00	1.00	2.00	3.00	20.00	m
N-2	LBCD-3	1.0	8.00	1.00	2.00	1.00	12.00	Cum
	LBCD-4	1.0	10.00	1.00	2.00	1.50	22.50	Cum
	GCD-2	1.0	12.00	1.00	2.00	2.00	36.00	Cum
	GCD-3	1.0	15.00	1.00	3.00	3.00	90.00	Cum
	RWHP-2	1.0	10.00	10.00	5*5	3.00	1.00	No.
	SMCD-2	1.0	30.00	1.00	2.00	3.00	30.00	m
N-3	LBCD-5	1.0	8.00	1.00	2.00	1.50	18.00	Cum
	LBCD-6	1.0	10.00	1.00	2.00	1.50	22.50	Cum
	GCD-4	1.0	15.00	1.00	3.00	3.00	90.00	Cum
	RWHP-3	1.0	10.00	10.00	5*5	3.00	1.00	No.
	SMCD-3	1.0	20.00	1.00	2.00	3.00	20.00	m
N-4	LBCD-7	1.0	10.00	1.00	2.00	1.50	22.50	Cum

	LBCD-8	1.0	12.00	1.00	2.00	1.50	27.00	Cum
	GCD-5	1.0	15.00	1.00	3.00	3.00	90.00	Cum
	RWHP-4	1.0	10.00	10.00	5*5	3.00	1.00	No.
	SMCD-4	1.0	30.00	1.00	2.00	3.00	30.00	m
N-5	LBCD-9	1.0	8.00	1.00	2.00	1.50	18.00	Cum
	LBCD-10	1.0	10.00	1.00	2.00	1.00	15.00	Cum
	GCD-6	1.0	15.00	1.00	3.00	3.00	90.00	Cum
	RWHP-5	1.0	10.00	10.00	5*5	3.00	1.00	No.
	SMCD-5	1.0	30.00	1.00	2.00	3.00	30.00	m
N-6	LBCD-11	1.0	6.00	1.00	2.00	1.00	9.00	Cum
	LBCD-12	1.0	8.00	1.00	2.00	1.50	18.00	Cum
	GCD-7	1.0	10.00	1.00	2.00	3.00	45.00	Cum
	RWHP-6	1.0	10.00	10.00	5*5	3.00	1.00	No.
	SMCD-6	1.0	13.00	1.00	2.00	2.00	13.00	m
TD-1	SST-1	1.0	20.00	10.00	-	3.00	1.00	No.
For Proposed Temporary Dump (TD-1)	BWCD	50.0	2.00	-	1.50	1.00	100.00	m
	BWCD	30.0	3.00	-	1.50	1.00	90.00	m
	BWCD	20.0	4.00	-	1.50	1.00	80.00	m
	BWCD	10.0	5.00	-	1.50	1.00	50.00	m
	LWCD	60.0	4.00	-	2.00	1.00	240.00	m
	LWCD	40.0	5.00	-	2.00	1.00	200.00	m
	LWCD	30.0	6.00	-	2.00	1.00	180.00	m
	LWCD	20.0	7.00	-	2.00	1.00	140.00	m
	LBCD	30.0	4.00	1.00	2.00	1.50	270.00	cum
	LBCD	20.0	5.00	1.00	2.00	1.50	225.00	cum
	LBCD	10.0	6.00	1.00	3.00	1.50	180.00	cum
	LBCD	10.0	8.00	1.00	3.00	2.00	320.00	cum

AFFORESTATION

After excluding the area finally classified under green belt (2.20 ha), the area to be afforested in ML-2621 at the conceptual stage of the mine has been worked out to be 31.60 ha (i.e., 33.80 – 2.20). The afforestation covering 1000 trees and 2500 shrubs per ha, inclusive of maintenance for five years has been worked out as per the norms of State Forest Department, Karnataka.

Work of afforestation will be carried out in close coordination 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 shall be made through:

- Propagules (seeds, tubers, corms, bulbs, rhizomes and roots) stored in the topsoil; 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-2.11: Implementation Schedule of Mitigation / Engineering Measures

Type	Particulars of work	Years				
		1	2	3	4	5
Plantation on Encroached area as per CEC		√	√	√		
Surface water management						
Check Dams	Loose Boulder check dam	√				
	Gabion Check Dam	√				
	Stone Masonry Check Dam	√				
Rain Water Harvesting structure	Rain water harvesting pit	√				
	Silt Settling Tank	√				
Greenbelt development		√				
Environmental monitoring & watch –ward		√	√	√		

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-2621	2.20	2.57	5.65

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 1.28 MTPA has been planned. This envisages handling of 0.29 million tonnes (maximum during the plan period) of waste per year.

In order to achieve the targeted production, the different mining activities will be planned during the daylight hours (from 6 AM to 6 PM). The effective working hours will be nine and that is used to calculate the fleet of mining machineries. 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	1	102	Diesel	250

(2) Loading Equipment

Type	Nos.	Bucket capacity Cum	Motive power	H.P.
Excavator	4+1	1.4	Diesel	200
Excavator	1	0.9	Diesel	150
Excavator-cum-rock breaker	1	0.9-1.1	Diesel	150
Front end Loader	2	2.6	Diesel	200

(3) Haulage and Transport Equipment

(a) Haulage within the Mining Leasehold

Type	Nos.	Body capacity Cum	Motive power	H.P.
Tippers/Dumpers	12	16	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	150	TPH	-	350
Screening Unit	1	150-250	TPH		100
Weigh Bridge	4	60	T	-	-
Water Tanker	6	10	KL	-	-
Mobile Tower Lights	4	4	KVA	-	-
D.G Sets	2	100	KVA	-	-
Bus	1	40 Seater			
Jeeps	3	5 Seater			
Diesel Tankers	1	8	KL		150
Explosive Van	1	-			
Maintenance Van	1	-			150
Ambulance	1				

Calculations:

a) Drilling Equipment

In the plan period, the maximum quantity to be handled is 1.28 million tonnes of Ore and waste 0.26 (maximum out of five years) million tonnes of waste totalling to approximately 1.57 million tonnes PA. 30% of the total quantity requires drilling and blasting.

Assumptions Bulk Density: 2.5 T/ CuM Mines will operate during daylight hours only so effective working hours will be-9 Hours.		
Drilling		
Specification of drill machine		
Diameter of drill Maximum operating	**:**	102 mm
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)	**:**	3 m
Spacing (S)	**:**	4 m
Volume of earth to be broken/loosen per hole	**:**	B x S x H = 3 x 4 x 8 = 96 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)	**:**	557808 m^3
Volume of material which requires drilling and blasting, as per the nature of the deposit is around 30% of the total excavation	**:**	167342 m^3/year
Number of holes to be drilled/year	**:**	167342 ÷ 96 = 1744

Number of holes to be drilled per day considering 300 work days in a year	:	1744 ÷ 300 = 5.82 or 6 numbers
Total meterage of drilling/day (length of blast hole = 8.8m including sub grade-drilling)	:	6×8.8 = 52.8 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	:	52.8÷270 = 0.2
Considering Availability as 90% and Utilisation 90% No. Of Drill Required		0.2 say-1

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

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)	:	35 s
Swell factor (S)	:	0.8
Swing factor (for 90^{o} swing) Fs	:	1
Overall utilization (E)	:	0.6
Time Scheduling		
Working days per year	:	300 days
Available working hours per day	:	12
Total available hours/year	:	12 x 300 = 3600

Total material to be handled		
Production of ore/year	**:**	1.28 x 10^6 T
Handling of waste/year	**:**	0.29 x 10^6 T
Total material to be handled/year	**:**	1.57 x 10^6 T
Avg density (ρ_{avg})	**:**	2.5 te/m^3
No. of Excavators Required		
Effective production per year/excavator = **(**CxFxSx3600x ρ_{avg} x total available hours x E**)** ÷ **(**T x Fs**)**	**:**	(1.4*0.8*0.8*3600*2.5*3600*0.60) ÷ (35*1) = 497664 T
No. of excavator required	**:**	1.57 x 10^6 ÷ 497664 = 3.15
Requirement of Excavator as per availability	**:**	4

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

**Another one 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 be generated during the proposed period of mining for ore removing ROM. Calculation for no. of dumper required for transportation of ROM and waste material to their respective sites is based on 1 km hauling distance from the quarries within the leasehold area.

Loading time		
Effective dumper capacity		20 T
Tonnes per pass of excavator bucket C x S x F x ρ_{avg}		2.24 T
No of passes required to load the dumper		20 ÷ 2.24 = 8.92
Actual no. of passes		8
Swing Time		35s
Dumper loading time		8*35/60 = 4.67 min
Spotting time		0.3 min
Load travel speed		20 km/h
Empty travel speed		1.5*20 = 30 km/h

Load travel time (haul road distance/load travel speed) x 60		1*60/20 = 3 min
Empty travel time (haul road distance/empty travel speed) x 60		1*60/30 = 2 min
Dumping time		1.5 min
Total no of dumpers required per excavator (spotting time + loading time + load travel time + dumping time + empty travel time) ÷ (spotting time + loading time)		(0.3+4.67+3+1.5+2) ÷ (0.3+4.67) = 2.30 ~ 3
Total no of dumper required (total no of excavator* no of dumper / excavator)		4*3 = 12

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

Calculations:

DRILLING AND BLASTING

a) Drilling

The actual requirement of drilling and blasting is 30% 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)	**Ore**	3.0 T/Cum
	Waste	2.0 T/Cum
Spacing	3.0 m	
Burden	4 m	
Average Depth	8.8 m (including sub grade drilling)	
Powder Factor	7 T/kg	

Particular	Value	Unit
Maximum volume of material to be excavated (in any year of plan period)	557807.7	Cum
Volume of material require drilling and blasting, (as per the nature of the deposit is around 30% of the total excavation as those are hard and massive in nature)	167342.31	Cum
Total Tonnage by Drilling & Blasting	462684.6	T
Total Tonnage by Drilling & Blasting/Month	462684.6/12 = 38557.05	T
Powder Factor	7	T/Kg
Total Explosive Required/Month	38557.05/7 = 5508.15	Kg
Base Charge Required@20%	1102.0	Kg

Column Charge(ANFO) @ 80%	4406.0	Kg
Nonel (Shock Tubes) Required in meter @14 Mtrs./Hole in month	146x14 = 2044	m
Blasting Frequency /week	2	
Total Blast/Month	4x2= 8	
Ordinary Detonator Required @4/Blast	8x4 = 32	No.
Safety Fuse in Meter @ 1.25 Mtrs /OD	32x1.25=40	m

Blasting Pattern:

Spacing, Burden, Depth of holes, explosive charge, stemming etc... For each hole will be decided as per the strata conditions. In general, spacing and Burden of 4X3 and depth of 8 Mts will be followed. Loading of holes with explosives and hooking up of holes with millisecond relays/delays will be carried out as per the Blast design to minimize the charge per delay and reduce the total firing time. **Rectangular pattern** will be generally used for designing the blast and proper hook up will also be ensured. To control the vibration and fly rock excel, delay detonators will be used as shock-tube (NONEL) initiation system to achieve better fragmentation and to increase the safety standards in the mines.

In order to reduce vibration generated in the course of blasting operations, millisecond delay detonators will be used. Hole to hole delay is 17 ms, while row to row delay is 42 ms. In the hole itself DTH delay of 200-450 ms is given.

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 Ltd. obtains requisite permission for storage, transport and use of Explosives.

M/s JSW Steel LTD. has been awarded multiple mines following the 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 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 988 mRL and maximum depth will be around 948 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 (Narihalla Reservior). 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/Phylite, Clay

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

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	-	-	-	194882	-	-	-
Second	-	-	-	129406	-	-	-
Third	-	-	-	214915	-	-	-
Fourth	-	-	-	262282	-	-	-
Fifth	-	-	-	197975	-	-	-

b) Dumping area:

The waste material will be disposed off in the proposed temporary dump located towards North western side of the lease. Apart from it there are three OB dumps i.e. ROM-1, ROM-2 and ID mixed with waste OB material ROM boulders, located within the ML area. ROM-1 is on eastern side and ROM-2 is on western side of the ML area. The dump height varies from 5 to 10 m and slope angle is 45^0 to 50^0 . ID is a very small dump lying within the pit.

The details are given below:

Table 4.2: Existing Waste Dumps

Waste Dump No.	Top RL	Bottom RL	Extent in Ha.	Height in m
ROM-1	925	914	0.19	11.00
ROM-2	984	978	0.76	6.00
ID	941	936	0.02	5.00

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 from mining will be handled separately and transported to the proposed temporary dump, located towards North western side of the.

Details of dumps including their location, capacity is indicated in the table below:

Dump no.	Section	Dump Elevation		Sectional Area (m^2)	Section Influence	Volume (M Cum)
		Top RL	Bottom RL			
Temporary Dump (TD)	S11-S11'	972	920	2578.0	140	0.361
	S12-S12'	984	935	4377.0	90	0.394
					TOTAL	**0.755**

Year wise build-up of dumps is given below:

Year	Area (Ha.)	No. of stages	Level in mRL
First	1.11	2	944-922
Second	1.30	3	953-944
Third	1.80	4	964-953
Fourth	2.26	4	975-964
Fifth	2.46	5	982-975

No sub-grade generation is proposed in this plan period. Details of protective measures as per R&R plan prepared by ICFRE is as follows:

Proposed engineering measures for management of Temporary Dump (ML No. 2621)									
Location	**Items**	**Particulars of works**	**No**	**Dimension in m**				**Qty.**	**Unit**
				Length	**Width**		**Height**		
					Top	**Bottom**			
Temporary Dump TD-1	TW-1: Toe wall at the toe of waste dump	Foundation in hard soil mixed with boulders including hard rock	1.0	438.00	2.00		0.60	525.60	cum
		Plain cement concrete (1:4:8) in foundation	1.0	438.00	1.70		0.15	111.69	cum
		RR Stone masonry Dry	1.0	438.00	1.00	3.00	2.00	1752.00	cum
	GD-1	Garland drain below the toe wall	1.0	447.00	2.00	1.00	1.00	670.50	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 Ltd.	+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 is are stipulated buyers.

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 useful 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.

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

i) A mobile crushing plant of 150 tonnes/hour and screening unit of 150-250 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 (ROM)	100%
Cal. Ore (+10 to -40 mm)	30%
Fines (-10mm)	70%

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 275 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 102 people and also generates indirect employment to around 100 people. Most of the work force employed by the lessee are 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	52
Maintenance Dept. Staff	5
Office Staff	5
Total	**62**

Category: Semi-Skilled

Designation	No. of Persons
Helpers	13
Drivers	15
Total	**28**

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 clearance 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 waste. This is estimated to be about 60% of the total mining operations 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

Sl. No.	Particulars	Land use pattern at the beginning of Plan Period (Area in Ha)
1.	Area for mining	10.85
2.	Area for waste dump	
3.	Roads	1.32
4.	Green Belt/ 7.5m safety zone	2.20
5.	ROM Stock	0.95
6.	Virgin/ Unbroken area	18.48
	Total	**33.80**

8.1.2 Water regime:

Naturally, no rain water accumulates in the lease area. The rain water flows from hill slopes usually does not accumulate till it reaches the lower valleys. Hence, the drainage pattern is sub-dendritic in nature and is typical of the hilly areas of this region.

There are 6 nalas existing in and around the ML area. Out of which, one is from western side and emptying into a tank near Byalakundi and another one originates from northern side is flowing towards NW direction and emptying into Raya Channel. The remaining 4 nalals are originating from eastern side of ML area and flowing towards eastern direction and emptying into Narihalla Reservoir.

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 analyzed 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 level 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 analyzed 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

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^{0}C and 20^{0}C, 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 13 villages and the demographic profile of the villages are given below:

Sl. No.	Name of the village	Total Population
1.	Ramgad	271
2.	Daulatpur	2764
3.	Yeswanthanagar	6847
4.	Sushila nagar	4977
5.	Siddapur	1468
6.	Venkatgiri	1814
7.	Jaysinghpur	2714
8.	Gunda	891
9.	Sandur	37431
10.	Byalakundi	1074
11.	Garaga	2258
12.	Nagalapur	5568

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 9)**

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 even when the mining is not in operation. Whenever the mine is in operation in future, following measures have to be taken up to reduce the impact of mining on air quality:

i. Introduction of wet drilling
ii. The state-of-the-art dust suppression system
iii. Fixing permanent pipe sprinklers along the haul road in the mine lease area
iv. Development of greenbelt

iii) Water quality:

The dumping of waste on steep slopes on the higher altitude without providing adequate Toe protection to withstand the earth pressures from the surcharge, coupled with unscientific dumping in to the flow course of natural drainage in the mine shall contribute to impairment/deterioration of water quality. The major impact on water quality 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 into the local seasonal streams flowing through the mine area.

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 minimize 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.

A small temple **Rama Mandir,** which is situated in the vicinity of mine, outside the lease area. Temple is situated beyond the active mining zone.

Considering the presence of Historical monument in the vicinity of the mine, controlled blasting techniques will be adopted to minimise the ground vibrations at the structure. Since the ore formation is soft & powdery in nature, deep hole blasting will be limited to 30% of total requirement. A vibration study will also be taken up by a government approved agency, to ensure that the vibration caused by blasting is within the permissible limits for sensitive structures. Measures suggested by the same agency will be implemented during the course of mining.

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.

8.3 Progressive reclamation Plan:

8.3.1. Mined-Out Land:

The existing land use pattern is as follows:

Table-8.3 Existing Land use plan

Sl. No.	Particulars	Land use pattern at the beginning of Plan Period (Area in Ha)
1.	Area for mining	10.85
2.	Area for waste dump	
3.	Roads	1.32
4.	Green Belt/ 7.5m safety zone	2.20
5.	ROM Stock	0.95
6.	Virgin/ Unbroken area	18.48
	Total	**33.80**

Source; Existing land use plan

Table-8.4 Proposed Land use plan

Sl. No.	Particulars	Land use pattern at the end of Plan Period (Area in Ha)
1.	Area for mining	10.92
2.	Area for waste dump	-
3.	Roads	1.32
4.	Green Belt/ 7.5m safety zone	2.20
5.	Infrastructure (C&S plant, Office, Weigh bridge etc.)	0.51
6.	Temporary Dumps	2.48
7.	Mineral Storage	0.50
8.	Engineering Measures	0.21
9.	Virgin/ Unbroken area	15.66
	Total	**33.80**

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, geotextile 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. 6A to 6E).**

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 mitigate 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

Items	Details	Year-wise Proposed measures					Remarks
		1st	2nd	3rd	4th	5th	
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)	-	-	-	-	-	The mineral reserves/ resources are still persisting. No proposal reclamation and rehabilitation by backfilling.
	Void Filled by waste/ tailing (Area in Ha.)	-	-	-	-	-	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)	0.73	0.73	0.74	-	-	Greenbelt development in the 7.5 m safety zone all along the mine boundary
	Afforestation for area under encroachment (Ha)	9.37	9.37	9.38	-	-	-

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 ore 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 40 km. & 9 Km. from mine head respectively.

Using cell phone 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.

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

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	10.85	0.07	10.92	0.00	10.92
2	Storage for topsoil	-	-	-	-	-
3	Waste dump site	-	2.48	2.48	0.00	2.48
4	Mineral storage	0.95	-0.45	0.50	0.00	0.50
5	Infrastructure-Workshop, Admin. Building etc.	-	0.51	0.51	0.00	0.51
6	Roads	1.32	-	1.32	0.00	1.32
7	Railways	-	-	-	-	-
8	Tailing pond	-	-	-	-	-
9	Effluent treatment plant	-	-	-	-	-
10	Mineral separation plant	-	-	-	-	-
11	Township area	-	-	-	-	-
12	Green belt/Afforestation	2.20	-	2.20	0.00	2.20
12A	Engineering measures (retention wall, Garland drain, Settling tank etc.)	-	0.21	0.21	0.00	0.21
13	Others -*Un used*	18.48	0.00	15.66	0.00	0.00
	Grand Total	**33.80**	**2.82**	**33.80**	**0.00**	**18.14**

As per the provision of Rule 27(1) of MCDR, 2017 Financial Assurance is not applicable *"for a mining lease granted through the auction or the mining lease granted under the provisions of clause (b) or clause (c) of sub-section (2) of section 10A, wherein the Mine Development and Production Agreement has been signed between the lessee and the State Government."*

Financial area assurance plan is enclosed in 1:2000 **(Plate 11).**

B P Pandey

Qualified Person