भारत सरकार GOVERNMENT OF INDIA
खान मंत्रालय MINISTRY OF MINES
भारतीय खान ब्यूरो INDIAN BUREAU OF MINES
क्षेत्रीय खान नियंत्रक के कार्यालय
OFFICE OF THE REGIONAL CONTROLLER OF MINES

Phone: 0674-2352463;
TeleFax: 0674-2352490;
eMail: ro.bhubaneshwar@ibm.gov.in
Plot No.149, Pokhariput
BHUBANESWAR-751016

No. MPM/FM/24-ORI/BHU/2017-18 / 2729

Date: 13.02.2018

To

Smt. Nirupama Das, DGM-Geology,
Power of Attorney Holder,
M/s OMC Limited, OMC House,
Bhubaneswar, Odisha – 751001.

Sub: Approval of Modification of Mining Plan of South Kaliapani Chromite Mines over an area of 552.457 ha in Jajpur district of Odisha of M/s Odisha Mining Corporation Limited submitted under Rule-17 (3) of Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rules, 2016.

Ref: -

i. Your letter no. 04/OMC/PMC/18 dated 01.01.2018.
ii. This office letter of even no. dated 02.01.2018.
iii. This office letter of even no. dated 02.01.2018 addressed to the Director of Mines, Govt. of Odisha, copy endorsed to you.
iv. This office letter of even no. dated 19.01.2018.
v. Your letter no. 1888/OMC/PMC/17 dated 02.02.2018.

Sir,

In exercise of the power delegated to me vide Gazette Notification No. S.O. 1857(E) dated 18.05.2016, I hereby **Approve** the Modification of Mining Plan including Progressive Mine Closure Plan of South Kaliapani Chromite Mines over an area of 552.457 ha of M/s Odisha Mining Corporation Limited in Jajpur district of Odisha State submitted under Rule 17 (3) of Mineral Concession Rules, 2016. This approval is subject to the following conditions:

I. The Modification of Mining Plan is approved without prejudice to any other law applicable to the mine area from time to time whether made by the Central Government, State Government or any other authority and without prejudice to any order or direction from any court of competent jurisdiction.
II. The proposals shown on the plates and/or given in the document is based on the lease map /sketch submitted by the applicant/ lessee and is applicable from the date of approval.
III. It is clarified that the approval of aforesaid Modification of Mining Plan does not in any way imply the approval of the Government in terms of any other provision of Mines & Minerals (Development & Regulation) Act, 1957, or the Mineral Concession Rules, 2016 and any other laws including Forest (Conservation) Act, 1980, Environment (Protection) Act, 1986 or the rules made there under, Mines Act, 1952 and Rule & Regulations made there under.
IV. Indian Bureau of Mines has not undertaken verification of the mining lease boundary on the ground and does not undertake any responsibility regarding correctness of the boundaries of the leasehold shown on the ground with reference to lease map & other plans furnished by the applicant / lessee.
V. At any stage, if it is observed that the information furnished, data incorporated in the document are incorrect or misrepresent facts, the approval of the document shall be revoked with immediate effect.

AGM(Min) & MC

Contd. Page-2

VI. If this approval conflicts with any other law or court order/ Direction under any statute, it shall be revoked immediately.

VII. Validity of this document shall expire on 31.03.2020.

भवदीय / yours faithfully,

31/03/18

(HARKESH MEENA)
क्षेत्रीय खान नियंत्रक / Regional Controller of Mines

Encl: - One copy of approved Modification of Mining Plan

Copy for kind information to:-

1. The Director of Mines, Directorate of Mines, Government of Odisha, Heads of the Department Building, New Capital, Bhubaneswar- 751001, Odisha along with one copy of Review of Mining Plan by ***REGISTERED PARCEL.***

2. Shri A. K. Sahu, Qualified Person, RM & Mining Division, Mecon Limited, Ranchi-834002, Jharkhand.

3. Shri Sunil Kumar Kar, Qualified Person, M/s Odisha Mining Corporation Limited, OMC House, Post Box No.34, Bhubaneswar-751001,Odisha.

(HARKESH MEENA)
क्षेत्रीय खान नियंत्रक / Regional Controller of Mines

MODIFIED MINING PLAN
&
PROGRESSIVE MINE CLOSURE PLAN
(UNDER RULE 17(3) OF MCR 2016 & 23 OF MCDR 2017)

VOLUME – I (TEXT)

IN RESPECT OF SOUTH KALIAPANI LEASE

MINE CODE – 11ORI19007

IBM REGISTRATION NUMBER – IBM/4289/2011

LEASE AREA: 552.457 HECTARES

DIVERTED FOREST: 425.398 HECTARES, NON FOREST: 127.059 HECTARES

MINERAL: CHROME ORE

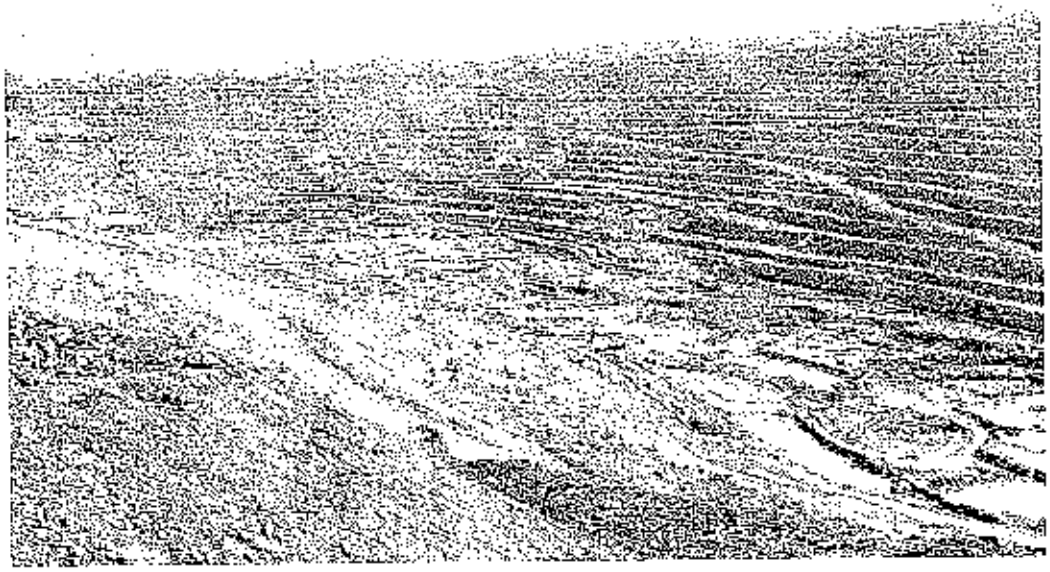
VILLAGE: KALIAPANI, DISTRICT: JAJPUR

TALUKA & P.S: SUKINDA, STATE: ODISHA

CATEGORY: FULLY MECHANISED (FM)

LEASE PERIOD: 22.1.1980 TO 21.1.2030

PLAN PERIOD: 1.4.2017 TO 31.3.2020



APPLICANT

ODISHA MINING CORPORATION LTD.
OMC HOUSE, BHUBANESWAR – 751001, ODISHA
E-MAIL: INFO@ODISHAMINING.COM
PHONE NO. 0674-2393431
FAX: 0674-2391629

PREPARED BY

Sunil Kumar Kar,
Deputy Manager (Mining)
OMC Ltd.
OMC House, P. B. No. 34, Bhubaneswar,
Odisha - 751001

Abinash Kumar Sahu,
Manager (Mining)
MECON Ltd,
Doranda, Ranchi
Jharkhand - 834002

CONTENTS

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

OMC | ODISHA NEW OPPORTUNITIES

CONSENT LETTER / UNDERTAKING / CERTIFICATE FROM THE LESSEE

1. The Modifications in the Mining Plan in respect of South Kaliapani Chromite Mine of M/s Odisha Mining Corporation Limited over an area of 552.457 hectares in village Kaliapani Taluka & PS : Sukinda in District : Jajpur, Odisha state submitted under Rule 17(3) of Minerals (Other than Atomic & Hydro Carbons Energy Minerals) Concession Rules, 2016 has been prepared by Qualified Persons, Sri Sunil Kumar Kar of M/s OMC Limited and Sri Abinash Kumar Sahu of M/s MECON Limited jointly.

This is to request the Regional Controller of Mines, Indian Bureau of Mines, Bhubaneswar to make any further correspondence regarding any correction of the Modifications in the Mining Plan with the said qualified persons at their address as given below:

Sunil Kumar Kar Dy. Manager (Mining) M/S Odisha Mining Corporation Limited. OMC house, Post Box no.- 34, Bhubaneswar, Odisha, Pin – 751001 Tel : 0674-2393431, 7395689, 2393389, Fax : 0674-2391629, 2396889, 2394772 E-mail : planningcellomc@gmail.com	Abinash Kumar Sahu Manager (Mining) RM & Mining Division MECON Limited Ranchi – 834002, Jharkhand Tel. 0651 – 2483441, 2483645, Fax. 0651 – 2482189, 2482214 E-mail : mining@meconlimited.co.in

We hereby undertake that all information/modification/updating as made in the said Modifications in the Mining Plan by the said qualified persons be deemed to have been made with our knowledge and consent and shall be acceptable on us and binding in all respects.

2. It is certified that the CCOM's Circular No. 2/2010 will be implemented and complied within 6 months by ORSAC, an agency authorized by the State Government.
3. It is certified that the Progressive Mine Closure Plan of South Kaliapani Chromite Mine of M/s Odisha Mining Corporation Limited over an area of 552.457 hectares complies with all statutory Rules, Regulations, Orders made by the Central or State Government, Statutory Organization, Court etc., which have been taken into consideration and wherever any specific permission is required, the lessee will approach the concerned authorities.
4. "The provision of Mines Act, Rules and Regulations made there under have been observed in the Modifications in the Mining Plan over an area of 552.457 hectares in Jajpur district of Odisha State belonging to South Kaliapani Chromite Mine of M/s Odisha Mining Corporation Limited and where specific permissions are required, the lessee will approach the DGMS. Further standards prescribed by DGMS in respect of miner's health will be strictly implemented".
5. The information furnished in the Modification of Mining Plan and Progressive Mine Closure Plan is true and correct to the best of our knowledge and records.
6. It is to undertake that all the measures proposed in this Progressive/Final Mine Closure Plan will be implemented in a time bound manner as proposed.

Place : Bhubaneswar
Date : 02.02.2018

Nominated Owner
(Managing Director)
M/s Odisha Mining Corporation Limited
OMC House, Bhubaneswar

OMC | ODISHA
NEW OPPORTUNITIES

Undertaking from Odisha Mining Corporation Limited, Bhubaneswar for compliance of Circular No.2/2010 and its addendum in respect of South Kaliapani Chromite Mine over an area of 552.457 Ha. in Jajpur District, Odisha.

We do hereby undertake to implement CCOM's Circular No. 2/2010 & its addendum regarding geo-referencing of the mining lease map & ML boundary pillars of South Kaliapani Chromite Mine within a period of six (6) months through ORSAC, an agency authorised by the State Government.

Mrs. Nirupama Das
AGM (Geology)
(Power of Attorney Holder)
M/s Odisha Mining Corporation Limited
OMC House, Bhubaneswar

CERTIFICATE FROM QUALIFIED PERSONS

The provisions of the Mineral Conservation & Development Rules 2017 have been observed in the preparation of **Modified Mining Plan for South Kaliapani chrome ore mining lease over an area of 552.457 Ha of M/s Odisha Mining Corporation Limited** in Jajpur District of Odisha State and whenever specific permissions are required, the applicant will approach the concerned authorities of Indian Bureau of Mines.

The information furnished in the mining plan is true & correct to the best of our knowledge.

SUNIL KUMAR KAR
Mining Engineer & Qualified Person

Place: Bhubaneswar **Name of the Qualified Person: Sunil Kumar Kar (Mining Engineer)**
Date: 02.02.18

Place: Ranchi **Name of the Qualified Person: Abinash Kumar Sahu (Geologist)**
Date: 02.02.18

ABINASH KUMAR SAHU
GEOLOGIST & QUALIFIED PERSON
MECON LTD. (RANCHI)

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Plate No. – 16	Financial Assurance Plan (1:2000)

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

MODIFIED MINING PLAN
SOUTH KALIAPANI LEASE (552.457 HA.)
LESSEE: THE ODISHA MINING CORPORATION LTD.

LIST OF ANNEXURES

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

SUMMARY OF PROPOSALS:

A summary of proposal of the review of mining plan is given below:

Proposed Exploration Programme

Proposed exploration for the ensuing plan period is given below:

Year	No. of Boreholes	Total Meterage	Purpose
2017-18	9	1800	To prove the barren zone of tailing pond and new waste dump and prove the continuity of Band-III & Band-V
2018-19	26	4950	
2019-20	13	3750	

Proposed Excavation Programme

The year-wise in-situ tentative excavation for the proposed plan period is given below.

Year	Pit no.	Total tentative Excavation (Mill. CuM)	Top Soil (Cu m)	OB/SB/IB (Mill. Cum)	ROM (Cum)		Mineral reject	ROM/ Waste Ratio
					Ore (Mill.Cum)	Sub grade (Mill. Cum)		
1	2	3	4	5	6	7	8	9
2017-18 (1.2.18 to 31.3.18)	Band – I	5.815	0	5.56	0.216	0.039	0	21.8
	Band-II	1.149	0.1	1.044	0	0.005	0	208.8
	Band-IV	4.002	0.281	3.721	0	0	0	0.0
	Band-IV Manual	0.013	0	0.003	0.008	0.002	0	0.3
	Total	10.979	0.381	10.328	0.224	0.046	0	38.3
2018-19	Band – I	7.095	0	6.855	0.238	0.002	0	28.6
	Band-II	0.552	0	0.498	0	0.054	0	9.2
	Band-IV	5.063	0.283	4.609	0.12	0.051	0	27.0
	Band-IV Manual	0.011	0	0.005	0.006	0	0	0.8
	Total	12.721	0.283	11.967	0.364	0.107	0	25.4
2019-20	Band – I	2.62	0	2.607	0.013	0	0	200.5
	Band-II	4.726	0.162	4.359	0.013	0.192	0	21.3
	Band-IV	6.277	0.124	5.867	0.219	0.067	0	20.5
	Band-IV Manual	0.056	0	0.039	0.012	0.005	0	2.3
	Total	13.679	0.286	12.872	0.257	0.264	0	24.7

The year-wise development & production quantity in tonnes for the proposed plan period is given below.

Year	Chrome Ore Production Qty., Million tonnes	Development Qty. Million Cu.m. (OB/IB)	Stripping Ratio (Cu.m./tons)
2017-18 (1.2.18 to 31.3.18)	0.832716	10.328625	12.40
2018-19	1.391228	11.967194	8.60
2019-20	1.385751	12.871763	9.29
Total	**3.609695**	**35.167582**	**9.74**

SUNIL KUMAR KAR
Mining Engineer & Qualified Person
Odisha Mining Corporation Ltd.

ABINASH KUMAR SAHU
GEOLOGIST & Q... PERSON
MECON LI...

Proposed Waste Dumping Programme

The location & configuration of the proposed OB/ IB dumps to accommodate the waste generated are given below:-

Year	Waste Dump	Qty. to be dumped	Dump Bottom RL	Dump Top RL	Total height
2017-18	WD1	5560250	130-140	190	50m
	WD2	4768375	130-165	174	40m
2018-19	WD1	6855173	190	310	120m
	WD2	5112021	174	194	40m
2019-20	WD2	12871763	194	270	76m

Proposed Environmental Protection Measures:

Year	Waste	Length of	Length of	No. of settling
2017-18	WD1	800	800	1
	WD2	800	800	1
2018-19	WD1	800	800	1
	WD2	800	800	1
2019-20	WD1	900	900	1
	WD2	1000	1000	1
Total	WD1	2500	2500	3
	WD2	2600	2600	3

Proposed Area Utilisation:

S N	Type of land use	Area of land use (in Ha)			The area considered as fully reclaimed and rehabilitated	Net area considered for calculation of financial assurance
		Area put into use at the start of plan period i.e. 1.10.17	Addl Area required During scheme period upto 31.03.20	Total Area at the end of the plan period		
1	Excavated Area	106.00	99.18	205.18	0	205.18
2	Storage for top-soil	0	0.00	0.00	0	0.00
3	Overburden dump	95.31	61.79	157.10	0	157.10
4	Mineral storage/	53.31	6.78	60.09	0	60.09
5	Infrastructure	13.69	8.44	22.13	0	22.13
6	Roads	8.65	0.02	8.67	0	8.67
7	Railways	0	0.00	0.00	0	0.00
8	Green belt	0	0.00	0.00	0	0.00
9	Tailing pond	0	20.00	20.00	0	20.00
10	Mineral separation	0	0.00	0.00	0	0.00
11	Township area	0	0.00	0.00	0	0.00
Total		**276.96**	**196.21**	**473.17**	**0**	**473.17**

SUNIL KUMAR KAR
Mining Engineer & Qualified Person
Odisha Mining Corporation Ltd.

ABINASH KUMAR SAHU
GEOLOGIST & QUALIFIED PERSON
MECON LTD. (RANCHI)

INTRODUCTION

South Kaliapani chromite lease of M/s OMC Ltd. is located in Jajpur Dist. of Odisha. The South Kaliapani lease was executed on 22.1.1980 for a period of 20 years. A copy of the lease deed is enclosed as Annexure -8. Application for renewal of the lease has been done before the expiry of the ML period and the lease was under deemed renewal stage. A copy of the receipt of the application is enclosed as Annexure-9. As per the MMDR Amendment Act 2015 the validity of the lease period was extended upto 31.03.2020. Subsequently, with the enactment of Mineral (Mining by Govt. Company) Rules, 2015, the original lease period of the said lease has been granted for 50 years i.e. from 22.1.1980 to 21.1.2030. The Supplementary Lease Deed in support of extension of the lease period up to 21.01.2030 has been executed on 12.08.2016. The copy of the supplementary lease deeds have been enclosed as Annexure – 8A.

The last scheme of mining was approved by IBM for the period from 1.4.2015 to 31.3.2020 vide letter No. MS/FM/26-ORI/BHU/2014-15/117 dated 16.04.2015. A copy of the approval letter has been enclosed as Annexure-16. The mine has been accorded environment clearance vide letter No. J-11015/407/2008-IA.II(M) dated 20.7.2010 for a production capacity of 1.40 million tonnes per annum. A copy of the same is enclosed as Annexure -11. A copy of the consent to establish granted by the state pollution control board, Odisha is enclosed as Annexure-12. Consents to operate have also been granted by the state pollution control board, Odisha under the Air & Water (Prevent & Control of Pollution) Act, which is valid upto 31.03.2020. A copy of the same is also enclosed as Annexure-13. The mines have also been accorded permission for diversion of 425.398 Ha. of forest land vide letter dated 25.02.2016. A copy of the letter in this regard has been enclosed as Annexure-14

In view of the amendment in 'The Mines and Minerals (Development & Regulation) Amendment Act, 2015, No. 10 of 2015 dated 26th March, 2015, the present submission is a Modified Mining Plan under the extended lease period for its approval under rule 17(3) MCR 2016 for the plan period from 01.04.2017 to 31.3.2020.

The present submission is a Modified Mining Plan (MMP) of the extended lease period for the period from 1.4.17 to 31.03.2020 under rule 17(3) of Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rules, 2016

अनुमोदित
APPROVED

अनुमोदित
APPROVED

13/02/17

क्षेत्रीय खान नियंत्रक
REGIONAL CONTROLLER OF MINES
भारतीय खान ब्यूरो
INDIN BUREAU OF MINES
भुवनेश्वर/BHUBANESWAR

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

1.0 GENERAL

a. **Name of applicant/ lessee/ Rule 45 registration No.**	**Shri R Vineel Krishna, IAS,** **Managing Director & Nominated Owner** **Odisha Mining Corporation Limited, Bhubaneswar, Odisha** **Smt. Nirupama Das,** **Power of Attorney Holder** **Odisha Mining Corporation Limited,** **Bhubaneswar - 751001, Odisha** A list of board of directors is enclosed as **Annexure-1**. A copy of the relevant extract from the minutes of the 416th meeting approved by Board regarding appointment of Nominated Owner of the mine is enclosed as **Annexure-2**. A copy of photo id & address proof of the nominated owner of the mine is enclosed as **Annexure-3.** A copy of the power of attorney in the name of Smt. Nirupama Das is enclosed as **Annexure–3A.** The number of state wise leases already held by the applicant/ applied for, indicating the type of minerals, areas, location etc is enclosed as **Annexure-6.**
Registration No. of OMC Ltd. under Rule 45	IBM/4269/30 ORI08087
Address	OMC House, Post Box No. 34 Bhubaneswar - 751001
District	Khurda
State	Odisha
Pin Code	751001
Phone	0674-2393431, 2395689, 2393389
Fax	0674-2391629, 2396889, 2394772
Gram	-
Telex	-
e-mail	info@orissamining.com; planningcellomc@gmail.com

b) Status of the applicant

Private individual	No
Cooperative Association	No
Private Company	No
Public Company	No
Public Sector Undertaking	**Yes**
Joint Sector Undertaking	No
Other (pl.specify)	Not Applicable

Certificate of incorporation is enclosed as **Annexure- 5.**

c) **Mineral(s) which is / are include in the prospecting license (For fresh grant)**	Not applicable
d) **Mineral(s) which is / are include in the lease deed**	Chrome Ore
e) **Mineral(s) which the applicant /lessee intends to mine**	Chrome Ore

[Sunil Kr. Kar, Mining Engineer]
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

f) Name of Qualified Person under rule 15(1) of MCR, 2016 preparing Mining Plan:

Name of the QP preparing the mining plan	Sunil Kumar Kar, Mining Engineer	Abinash Kumar Sahu Geologist
	Copy of the proof of qualification & experience of qualified persons satisfying the requirements under rule 15(1) of MCR 2016 who have prepared this document are enclosed as Annexure	
Address	Sunil Kumar Kar, Deputy Manager (Mining) OMC House, P. B. No. 34, Bhubaneswar, Odisha - 751001.	Abinash Kumar Sahu Manager (Mining) RM & Mining, MECON Ltd, Doranda,Ranchi – 834002, Jharkhand.
Phone	0674-2393431, 2395689, 2393389	0651 – 2481093, 2483355
Fax	674-2391629, 2396889, 2394772	0651 - 2482189, 2482214
e-mail	planningcellomc@gmail.com	mining@meconlimited.co.in
Telex	-	
Registration No.	-	
Date of grant / renewal	-	
Valid upto	-	

2.0 LOCATION AND ACCESSIBILITY

a) Lease Details (Existing Mine)

Name of Mine — South Kaliapani Chrome Ore Lease (Lease Area : 552.457 Ha)

Lat/long of any boundary point.

South Kaliapani lease is located in Jajpur district of Odisha state. It is located between 21°01'37.98768" to 21°03'25.10640" N North Latitude and between 85°46'39.53820" to 85°48'28.19916" E East Longitude. The location map is shown as Plate No.-1. The lat./ long. of all the boundary pillars are given below:-

Sl. No	Pillar No	GEOGRAPHIC COORDINATES		UTM COORDINATES	
		LONGITUDE	LATITUDE	EAST	NORTH
1	1	85° 46' 39.53820"	21° 02' 47.29236"	372994.727	2327777.211
2	2	85° 46' 45.45228"	21° 02' 36.76812"	373162.964	2327452.298
3	3	85° 46' 48.89244"	21° 02' 30.70716"	373260.838	2327265.182
4	4	85° 46' 51.35448"	21° 02' 26.38572"	373330.891	2327131.762
5	5	85° 46' 53.24880"	21° 02' 23.06004"	373384.798	2327029.094
6	6	85° 46' 56.57844"	21° 02' 17.20068"	373479.534	2326848.199
7	7	85° 47' 00.01464"	21° 02' 11.15124"	373577.302	2326661.426
8	8	85° 47' 05.97264"	21° 02' 00.66552"	373746.839	2326337.714
9	9	85° 47' 12.42204"	21° 01' 49.35792"	373930.376	2325988.605
10	10	85° 47' 14.08524"	21° 01' 46.40232"	373977.698	2325897.37
11	11	85° 47' 16.34820"	21° 01' 42.38544"	374042.089	2325773.358
12	12	85° 47' 17.82060"	21° 01' 39.99288"	374084.038	2325699.477
13	13	85° 47' 18.86964"	21° 01' 37.98768"	374113.854	2325637.592

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

Sl. No	Pillar No	GEOGRAPHIC COORDINATES		UTM COORDINATES	
		LONGITUDE	LATITUDE	EAST	NORTH
14	14	85° 47' 20.64912"	21° 01' 39.07344"	374165.481	2325670.586
15	15	85° 47' 26.39076"	21° 01' 42.48192"	374332.029	2325774.131
16	16	85° 47' 29.57820"	21° 01' 44.25348"	374424.452	2325827.9
17	17	85° 47' 34.19340"	21° 01' 47.08488"	374558.346	2325913.952
18	18	85° 47' 35.32020"	21° 01' 47.77608"	374591.031	2325934.956
19	19	85° 47' 36.62376"	21° 01' 48.47736"	374628.827	2325956.241
20	20	85° 47' 40.29000"	21° 01' 50.63556"	374735.17	2326021.804
21	21	85° 47' 44.11608"	21° 01' 52.93164"	374846.155	2326091.566
22	22	85° 47' 46.87584"	21° 01' 54.53760"	374926.192	2326140.345
23	23	85° 47' 48.21612"	21° 01' 55.31952"	374965.069	2326164.089
24	24	85° 47' 51.00612"	21° 01' 56.98812"	375045.996	2326214.792
25	25	85° 47' 56.27796"	21° 02' 0.04092"	375198.884	2326307.518
26	26	85° 47' 59.25732"	21° 02' 01.58676"	375285.246	2326354.399
27	27	85° 48' 03.33000"	21° 02' 04.12116"	375403.402	2326431.439
28	28	85° 48' 06.99768"	21° 02' 06.42084"	375509.809	2326501.357
29	29	85° 48' 12.71736"	21° 02' 09.85992"	375675.714	2326605.855
30	30	85° 48' 14.10768"	21° 02' 10.62636"	375716.021	2326629.123
31	31	85° 48' 18.73368"	21° 02' 13.34760"	375850.187	2326711.794
32	32	85° 48' 21.20976"	21° 02' 14.83044"	375922.001	2326756.86
33	33	85° 48' 24.83316"	21° 02' 16.95192"	376027.086	2326821.305
34	34	85° 48' 28.19916"	21° 02' 18.89196"	376124.692	2326880.227
35	35	85° 48' 25.11072"	21° 02' 23.51328"	376036.61	2327022.984
36	36	85° 48' 22.33512"	21° 02' 27.64464"	375957.435	2327150.621
37	37	85° 48' 20.51172"	21° 02' 30.38136"	375905.427	2327235.157
38	38	85° 48' 19.65276"	21° 02' 31.62012"	375880.923	2327273.431
39	39	85° 48' 16.94988"	21° 02' 35.70648"	375803.838	2327399.665
40	40	85° 48' 12.10248"	21° 02' 42.98820"	375665.599	2327624.61
41	41	85° 48' 10.57968"	21° 02' 45.08232"	375622.128	2327689.331
42	42	85° 48' 07.97328"	21° 02' 49.11576"	375547.829	2327813.91
43	43	85° 48' 02.43036"	21° 02' 57.35076"	375389.738	2328068.319
44	44	85° 47' 55.54140"	21° 03' 07.48944"	375193.239	2328381.553
45	45	85° 47' 50.80416"	21° 03' 14.41620"	375058.103	2328595.566
46	46	85° 47' 48.80580"	21° 03' 17.39340"	375001.114	2328687.547
47	47	85° 47' 47.27580"	21° 03' 19.66068"	374957.488	2328757.588
48	48	85° 47' 43.73376"	21° 03' 25.10640"	374856.517	2328925.811
49	49	85° 47' 36.60792"	21° 03' 20.88072"	374649.86	2328797.429
50	50	85° 47' 29.46192"	21° 03' 16.67628"	374442.619	2328669.72
51	51	85° 47' 28.66236"	21° 03' 16.31916"	374419.459	2328658.914
52	52	85° 47' 21.30648"	21° 03' 11.87460"	374206.107	2328523.866
53	53	85° 47' 11.84244"	21° 03' 06.31728"	373931.641	2328355.062
54	54	85° 47' 08.97828"	21° 03' 04.63284"	373848.573	2328303.903

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

Sl. No	Pillar No	GEOGRAPHIC COORDINATES		UTM COORDINATES	
		LONGITUDE	LATITUDE	EAST	NORTH
55	55	85° 47' 03.25608"	21° 03' 01.25892"	373682.622	2328201.419
56	56	85° 47' 01.06368"	21° 02' 59.97048"	373619.038	2328162.284
57	57	85° 46' 50.26872"	21° 02' 53.64960"	373305.957	2327970.308

Date of grant of lease	The South Kaliapani lease was executed on 22.1.1980 for a period of 20 years. A copy of the lease deed is enclosed as Annexure- 8. The supplementary lease deed has been executed on 12.01.2016 for the extended lease period upto 21.01.2030. A copy of the supplementary lease deed is enclosed as Annexure-8A. After the enactment of MMDR Amendment Act 2015 the validity of lease period was extended upto 31.03.2080. Subsequently, with the enactment of Mineral (Mining by Govt. Company) Rules, 2015, the original lease period of the said lease has been granted for 50 years i.e. from 22.1.1980 to 21.1.2030.
Period/Expiry Date	The Supplementary Lease Deed in support of the validity extension of the lease period has been enclosed as Annexure - 8A.
Name of lease holder	Odisha Mining Corporation Limited
Address	OMC House, Post Box No. 34 Bhubaneswar – 751001, Odisha
Tel.	0674-2393431, 2395689, 2393389
Fax	0674-2391629, 2396889, 2394772
e-mail	info@orissamining.com, planningcellomc@gmail.com
Mobile	+919437523701

b) **Details of applied / lease area with location map (fresh area/mine)**

Forest (Specify)	Area, Ha)	Non Forest (Specify)	Area, Ha)
Reserve Forest	-	Waste Land	51.57
Demarcated Protected Forest (Diverted)	72.821	Grazing Land	0.42
Village Forest	-	Agriculture Land	4.01
Un-demarcated Protected Forest (Diverted)	352.577	Others (Non Forest)	71.059
Total	**425.398**	**Total**	**127.059**

Total lease area / applied area	552.457 Ha
District & State	District : Jajpur, State : Odisha
Taluka	Sukinda
Village	Kaliapani, Gurujangpal, Sukurangi and Saruabil.
Whether the area falls under Coastal Regulation Zone (CRZ)? If yes, details thereof	No

Lease plan of South Kaliapani chrome ore lease is shown in Plate No. 2.

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

Existence of public road/railway line, if any nearby and approximate distance

South Kaliapani Chromite deposit in Sukinda ultramafic complex is located in Sukinda Tahasil of Jajpur district in Orissa. The mine is connected with the nearest railhead at Jajpur–Keonjhar Road on Howrah–Bhubaneswar–Chennai line of SE railway by an all weather road of 53 km via Duburi and Tomka. The leasehold area is linked with Daitari-Paradeep Express Highway. State Capital at Bhubaneswar and district head quarter at Jajpur Road is located at road distances of 150 km and 65 km respectively from South Kaliapani leasehold area. The deposit is covered under Survey of India toposheet no. 73 G/16 at latitudes 21°01'38.4" N - 21°03'25.1" N and longitudes 85°46'39.4" - 85°48'28.2"E. The leasehold area covers part of Mahagiri Protected forest block no. 27 of Sukinda range and also village limits of Kaliapani, Gurujangpal, Sukurangi and Saruabil.

Toposheet No. with latitude & longitude of all corner boundary point/pillar

The deposit is covered under Survey of India toposheet no. 73 G/16. It is located between 21°01'37.98768" to 21°03'25.10640" N North Latitude and between 85°46'39.53820" to 85°48'28.19916" E East Longitude. The location map is shown as Plate No.-1. The lat./ long. of all the boundary pillars are given in the chapter 2.0 (a) of the MMP.

c) **Attach a general location map showing area and access routes. It is preferred that the area be marked on a Survey of India topographical map or a cadastral map or forest map as the case may be. However, if none of these are available, the area may be shown on an administrative map:**

The same has been shown in the key plan as Plate No. – 1.

3.0 DETAILS OF APPROVED MINING PLAN / SCHEME OF MINING (if any)

3.1 Date and reference of earlier approved MP/ SOM:

The last scheme of mining was approved by IBM for the period from 1.4.2015 to 31.3.2020 vide letter MS/FM/26-ORI/BHU/2014-15/117 dated 16.04.2015. The copy of approval letter in this respect has been enclosed as Annexure-16.

The details of earlier approval of Scheme of Mining and Mining Plans has been given in the table below

Document	Date of approval	Letter No.	Period
Scheme of Mining	16.04.2015	MS/FM/26-ORI/BHU/2014-15/224	2015-20
Mod. To approved Scheme of Mining	22.08.2014	MSM/FM/30-ORI/BHU/2013-14/2027	2014-15
Scheme of Mining	22.03.2010	314(3)/2009-MCCM(CZ)/MS-41	2010-15
Scheme of Mining	22.03.2007	314(3)/2006-MCCM(CZ)/S-15	2005-10

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.

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

3.3 Give review of earlier approved proposal (if any) in respect of exploration, excavation, reclamation etc.

Achievements against the proposals envisaged in the approved mining scheme for the period w.e.f 2015-16 to 2017-18 (actual upto December2017) and the justification thereof for deviations, if any, is mentioned below:

i) **Exploration:**

Year	Nos. of boreholes		
	Planned	Actual	Reason for deviation
2015-16	35 Nos. / 7050 m	05 nos/289 .00 m	Shortfall is due to lack of forest clearance over the entire lease area.
2016-17	10 Nos / 2000 m	11 nos completed / 1841m	After getting forest clearance from MOEF & CC, the state forest deptt. is handed over the area partly. Then outsourced agency has been engaged for exploration work.
2017-18	10 Nos./2450m	12 Nos./2922.50 m	No deviation

Expenditure incurred in various prospecting operations.

Year	Expenditure in Lakhs(approx.)
2015-16	14.45
2016-17	101.5
2017-18 till date(as on 31.10.2017)	178.85
Total:-	294.8

ii. **Mine Development and Exploitation**

Overall Targets for Ore and Waste removal

Year	ROM (in tones)		OB (in cu.m.)		Stripping ratio	
	Planned	Actual	Planned	Actual	Planned	Actual
2015-16	1110319	830015	4127928	2666805.07	3.72	3.21
2016-17	1098524	1008820	4463232	3560287.87	4.06	3.53
2017-18 (till Dec. 17)	1076727	132280	4308096	2926289	4.00	22.12

Reason for deviation

Year -2015-16

Due to non-availability of Forest clearance the mining operation was restricted within the approved area for which the excavation of ore and OB against the proposed quantity could not be possible.

Year 2016-17:

Though the Forest Clearance is obtained on dtd. 25.02.2016, but due to delay in handing over of the area by the forest department, the mining operation is restricted within the approved area. The balance forest land was handed over by forest department on dtd.21.07.2017.The copy of letter in this regard has been enclosed as Annexure-14.

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

Year 2017-18:

Modified Mining plan is being prepared for the period for enhancement of production upto 1.4 MTPA for utilization of the total lease area and production from all the major chromite bands of the deposit

iii. Afforestation

The achievement position as against the target in respect of afforestation is given in the table below.

Overall Targets for Afforestation

Year	Afforestation, Nos	
	Planned	Actual, Nos.
2015-16	2500	3130
2016-17	500	4993
2017-18	500	1500

iv. Land Reclamation and Rehabilitation:

In the mining scheme period it was not proposed to reclaim & rehabilitate any mined out area of land. Obviously there is no deviation in this part.

v. Waste dump management:

Year	Waste generated, in cubic meters	Location where the waste will be disposed, along with its name & quantity disposed in cu.m	Achievement
2015-16	4127928	WD1-4127928	2662805.67 m^3
2016-17	4463232	WD1-4463232	3560287.21 m^3
2017-18 (up to DEC'17)	4308096	WD1 / WD2	2926289 m^3

The details of the protective measures envisaged for the dump with year wise proposed reclamation/ rehabilitation measures are given below:-

	Proposal				Achievement		
Year	Waste Dump No.	Length of garland drain, m	Length of retaining wall, m	No. of settling pits	Length of garland drain, m	Length of retaining wall, m	No. of settling pits
2015-16	WD1	600	600	1 No.	600	600	2
2016-17	-	-	-	-	1400	1400	5
2017-18	WD2	500	500	1 No	400	400	5

vi. Control of dust, Noise and ground vibration:

It was proposed to carry out sampling of air, water and noise periodically and take mitigation measures to limit the pollution level of these parameters. Monitoring of the air quality, noise quality, water quality etc have been regularly carried out as per the norms and details of environmental monitoring report is attached as Annexure 20.

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

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(Qualified Person)

3.4 Give status of compliance of violations pointed out by IBM

The violations pointed out during the period 01.04.2015 till date and their compliance status as submitted to IBM by OMC has been enclosed as Annexure – 15.

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

Order of suspension of mining operations was issued by Indian Bureau of Mines under rule 13(2) of MCDR 1988 vide letter dated 06.06.2016. Copy of the letter enclosed at Annexure-15

Subsequently revocation of the above order of suspension was issued by Indian Bureau of Mines under rule 13(2) of MCDR 1988 vide letter dated 25.07.2016. Copy of the letter enclosed at Annexure-15

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:

Under the Rule 3(1) of Mineral (Mining by Govt. Company) Rules, 2015 as notified by Ministry of Mines on 03.12.2015, the original lease period of the South Kaliapani chrome ore lease has been granted for 50 years i.e. from 22.1.1980 to 21.1.2030. The Supplementary Lease Deed in support of extension of the lease period up to 21.01.2030 has been executed on 12.08.2016 (Copy enclosed as Annexure-8A).

In view of the amendment in 'The Mines and Minerals (Development & Regulation) Amendment Act, 2015, No. 10 of 2015 dated 26th March, 2015, the present submission is a Modified Mining Plan under the extended lease period for its approval under rule 17(3) MCR 2016 for the plan period from 01.04.2017 to 31.3.2020.

Apart from the above, it may be noted that as the lessee has now obtained diversion for the entire forest land & due to the increased demand of chrome ore, modifications in the approved scheme of mining have been proposed for increase in ore production commensurate with safe & scientific mining of the deposit.

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

PART – A

1.0 GEOLOGY AND EXPLORATION

a) Briefly describe the topography, drainage pattern, vegetation, climate, rainfall data of the area applied/mining lease area.

i. Physiography & Drainage

The mine lease is located in southern part of funnel shaped Sukinda Valley which extends from east to west with the open end facing west. The northern part of the Sukinda Valley is marked by Daitari hill range which rises sharply from about 140 m above mean sea level to more than 600 mRL. There are peaks exceeding 800 mRL in Daitari hill range. At places Hills are marked by very steep escarpments. The southern part of the valley is bounded by Mahagiri hill range, which also is very steep and rises to more than 600 mRL. In Mahagiri hill range also there are a few bare rocky cliffs. The hills are densely forested. The mine lease is between 132 m RL in the north and 250 m RL in the south-west and slopes from north to south. The principal drainage channel of the Sukinda valley is Damsal nala which flows from east to west and traverses towards north of the lease area. Several seasonal and perennial channels flow down from the Daitari hill range and the Mahagiri hill range to join the Damsal Nala. A few of the drainage channels emerging from Mahagiri hill range flow north and north-west through the South Kaliapani Mine lease to join Damsal Nala. Damsal Nala gradually bends towards the south-west and on emerging from the Sukinda valley turns south to join the Brahmani River.

ii. Vegetation

In this part of the Mahagiri P.F., the forests consist of grasslands with widely spaced mature trees, of which, Sal (Shorea robusta), Asan (Terminalia tomentosa), Mahul (Madhuca indica), Mango (Mangifera indica), Bahada (Terminalia bellirica) and Tendu (Diospyros melanoxylon) are prominent.

iii. Climate & Rainfall of the Lease Area

The study area lies in tropical region where climate is characterised by very hot summers and cool winters. Summer is typically from March to June when daily average maximum temperature ranges from a maximum of 39°C during daytime to a minimum of 22°C at night. Winter is from November to February when daily average maximum temperature during day goes up to 32°C and minimum temperature at night becomes as low as 15°C. The average annual rainfall as recorded at IMD observatory at Cuttack is 1475.3 mm. The Southwest monsoon lasts from mid June to mid September and the area gets more than 75% of the annual rainfall during this period.

b) Brief descriptions of Regional Geology with reference to location of lease/applied area.

Regional Geology

The chromite bearing ultramafics of Sukinda area have intruded in to the Precambrian metamorphites in the form of a lopolith. The intrusive has width of 2-5 km and extends for about 20 km in ENE-WNW direction from Kansa in the east to Maruabil and beyond in the west. The ultramafic body consists essentially of magnesium-rich dunite devoid of chromite bands and subordinate amount of pyroxenite devoid of chromite mineralization. The pyroxenite is relatively fresh but the dunite –peridotite members are highly serpentinised and intensely lateritised. The granite is exposed at several places. However, generalized Stratigraphy of Sukinda ultramafic complex (Sahoo, 1974) is as follows:-

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

Recent to Pleistocene		Soil, Alluvium, Laterities
	Unconformity	
		Dolerite, Granite, Gabbro-diorite
Precambrian	Ultramafics	Pyroxenite, Dunite-peridotite with chrome ore
	Meta-sediments and meta-volcanics	Gritty quartzite Meta-Volcanics
	Base not seen	

Small exposures of diorite rocks are found in Kathpal and Bhimtanagar. Besides,several dolerite dykes have intruded into the ultramafics, quartzites as well as the granites. This happens to be the last stage of igneous activity in this Precambrian terrain. Soil, alluvium and laterite of recent origin are overlying the ultramafics uncomformably.

c) **Detailed description of geology of the lease area such as shape and size of the mineral/ore deposit, disposition various litho-units indicating structural features if any etc. (Applicable for Mining Plan for grant & renewal and not for Scheme of Mining/Modifications in the approved mining plan/scheme of Mining).**

Not applicable as the present submission is a Modified Mining Plan.

d) **(i) Name of prospecting /exploration agency :**

1. Indian Bureau of Mines
2. Odisha Mining Corporation Ltd.

(ii) Address

1. Indian Bureau of Mines
   Indira Bhawan, Civil Lines,
   Nagpur- 440 001
2. Odisha Mining Corporation Ltd.
   OMC House, Post Box No. 34
   Bhubaneswar - 751001

(iii) E mail address and phone no.

1. Indian Bureau of Mines
   Phone + 91 712 2560041,
   Fax + 91 712 2565073,
2. M/s Odisha Mining Corporation Ltd.
   Phone (0674) 2393431, 2395689, 2393389

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.**

The geological mapping of the area has been done. However, no pitting / trenching work has been carried out as the area needs to be explored with deep core drills only.

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

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

A summary of boreholes drilled in the lease is furnished in the table below

Block	No. of Boreholes	Total meterage	Spacing	Max. depth	Min. Depth
Band-I	173 Nos (Core)	20048.8	50 m x 25 m to 100m x 100m grid	415 m	07.70m
Band-II	167 Nos (Core)	12614	50 m x 25 m to 100m x 100m grid	136 m	13.30m
Band-III	10 Nos (Core)	547.3	50 m x 25 m grid	80.7 m	33.00m
Band-IV	143 Nos (Core)	12842	50 m x 25 m to 100m x 100m grid	205 m	11.00m
Band-V	2 Nos (Core)	66	-	44	22.00m
Proving of Barren/Possible Chrome mineralisation	12 Nos (Core)	1920	-	230	100m

The year wise details of Boreholes drilled in different bands during 1979 to 2017-18(as on 31.10.2017) in South-Kaliapani ML is shown in the table below

YEAR	NO OF BHS	TOTAL METERAGE
As on 31.03.1994	170	15478.20
1994-95	12	1424.50
1995-96	6	517.50
1996-97	0	0.00
1997-98	0	0.00
1998-99	0	0.00
1999-2000	23	1408
2000-01	19	1013
2001-02	0	0.00
2002-03	4	294
2003-04	11	930
2004-05	17	1005
2005-06	24	1573
2006-07	20	1446
2007-08	19	1104
2008-09	53	5268
2009-10	68	9119.3
2010-11	10	814.5
2011-12	8	805
2012-13	7	723
2013-14	6	590
2014-15	2	27.8
2015-16	5	289
2016-17	11	1841
2017-18(As on 31.10. 2017)	12	2367.3
Cumulative (as on 31.10.17)	**507**	**48038.10**

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

All the above boreholes have been shown in the geological plan at Plate No. 4.

The extent and location of mineralized area is given in the table below

Ore band	UTM Co-ordinates	Area
Band-I	2327391N – 2328307N 373322E – 373870E	Non Forest/Diverted Forest
Band-II	2327270 N – 2328436N 373602 E – 374203 E	Non Forest/Diverted Forest
Band-III	2327604 N – 2327600N 375690 E – 376120 E	Non Forest/Diverted Forest
Band-IV	2325918 N – 2327296N 374031 E – 375878 E	Diverted Forest

All the mineralized area of Band-I, II & IV have been explored under G1 level of Exploration. Approximately 90% of the Band-III has been explored under G1 category. Borehole proposals have been given for exploring Band-V in G2 level initially.

The UNFC boundaries are constructed as per the present status of exploration under MEMC rules 2015. As per the prescribed table of IBM, Exploration already carried in the M.L area as indicated above is given under UNFC norms as follows:

Status of Exploration as per UNFC

Item of Information	Lease Area explored as per UNFC norms (in Ha.) as on Date					Remarks/ comments including reasons for not carrying out the exploration as per UNFC norms.
	Total Lease area (552.457)= A+B+C+D+E					
	G1 Level	G2 Level	G3 Level	Explored and found non-mineralized with level of exploration (Remark)	Unexplored lease area	
	A	B	C	D	E	
Area as per level of Exploration	169.2464	NIL	NIL	31.5122 (G2)	351.6984	(BARREN PROVING)
No. of BH Drilled	495	-	-	12	-	
No. of BH considered for Resource Estimation	427	-	-	12	-	
Meterage Drilled	46118.1	-	-	1920	-	
Grid Interval	50 m x 25m to 100m x 100m grid	-	-	200x200	-	
Scale of Mapping	1:2000	1:2000	1:2000	1:2000	1:2000	

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

iii) **Details of samples analysis indicating type of sample (surface/sub-surface from pits/trenches/borehole etc) Complete chemical analysis for entire strata for all radicals may be undertaken for selected samples from a NABL accredited Laboratory or Government laboratory or equivalent. Entire mineralized area may be analyzed meter wise with 10% of check samples. (At least for 10% of total samples may be analyzed, in accordance to BIS and reports from NABL accredited/other government laboratory)**
A total of 6202 Nos. of samples have been drawn for analysis for Band-I & II, 135 Nos. of samples for Band-III and 596 Nos. of samples have been drawn for Band-IV. Also 12 Nos. of samples have been drawn for Band-V. Apart from the above 171 nos. of samples have been drawn from boreholes drilled for proving barren area/possible chromite mineralization. The details of samples tested at NABL accredited laboratory has been enclosed as Annexure-18.

iv) **Expenditure incurred in various prospecting operations.**
The total cost involvement for the exploratory drilling from FY 2015-16 till date is approximately Rs. 2.95 crores. The documentary evidence in support of expenditure incurred towards contractual drilling has been enclosed as Annexure-28.

f) **The surface plan of the lease area may be prepared on a scale of 1: 1000 or 1: 2000 with contour interval of maximum of 10 m depending upon the topography and size of the area duly marked by grid lines showing all features indicated under Rule 28(1)(a) of MCDR 2017.**
The surface plan of the leasehold area is enclosed as Plate No. 3. However, the mine has permission to prepare the drawing in a scale of 1: 4000.

g) **For preparation of geological plan, surface plan prepared on a scale of 1: 1000 or 1: 2000 scale specified under para 1.0 (f) of Part A of the format may be taken as the base plan. The details of exploration already carried out along with supporting data for existence of mineral, locations proposed exploration, various lithounits along with structural features, mineralized/ore zone with grade variation if any may be marked on the geological plan along with other features indicated under Rule 32 (1)(b) of MCDR 2017.**
The geological plan of the leasehold area showing all the above features is enclosed as Plate No. 4 However, the mine has permission to prepare the drawing in a scale of 1: 4000.

h) **Geological sections may be prepared on natural scale of geological plan at suitable interval across the lease area from boundary to boundary.**
The geological sections of the leasehold area showing all the above features is enclosed as Plate No. 5

i) **Broadly indicate the future programme of exploration with due justification(duly marking on Geological plan year wise location in different colours) taking into consideration the future tentative excavation programme planned in next five years.**

The detail of the proposed boreholes to be drilled to cover the entire ML area in a time bound manner is given in the following table. The proposal of boreholes are given in a manner so as to explore the area of proposed tailing pond and waste dump area in first year and before commencement of waste dumping.

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(Qualified Person)

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(Qualified Person)

The location of proposed boreholes have been shown in the Geological Plan as Plate No.-4

YEAR	PBHID	Easting	Northing	Angle	Bearing	Land type	Proposed Depth (in mtrs)	TOTAL METERAGE
2017-18(1.11.17 to 31.3.2018)	PBH-1	1950	150	50°	N33°W	Forest (Div.)	200	1400
	PBH-2	1950	350	50°	N33°W	Forest (Div.)	200	
	PBH-3	1750	150	50°	N33°W	Forest (Div.)	200	
	PBH-4	1750	350	50°	N33°W	Forest (Div.)	200	
	PBH-5	1550	200	50°	N33°W	Forest (Div.)	200	
	PBH-6	1550	400	50°	N33°W	Forest (Div.)	200	
	PBH-7	1350	200	50°	N33°W	Forest (Div.)	200	
	PBH-8	1350	400	50°	N33°W	Forest (Div.)	200	
	PBH-9	1150	200	50°	N33°W	Forest (Div.)	200	
2018-19	PBH-10	950	800	50°	N33°W	Forest (Div.)	150	4950
	PBH-11	1150	800	50°	N33°W	Forest (Div.)	150	
	PBH-12	1350	800	50°	N33°W	Forest (Div.)	150	
	PBH-13	-50	700	50°	N33°W	Forest (Div.)	200	
	PBH-14	1650	870	60°	S33°E	Forest (Div.)	150	
	PBH-15	1650	920	60°	S33°E	Forest (Div.)	200	
	PBH-16	1550	870	60°	S33°E	Forest (Div.)	150	
	PBH-17	1550	920	60°	S33°E	Forest (Div.)	200	
	PBH-18	1450	900	60°	S33°E	Forest (Div.)	150	
	PBH-19	1450	950	60°	S33°E	Forest (Div.)	200	
	PBH-20	1750	700	50°	S33°E	Forest (Div.)	200	
	PBH-21	1950	750	50°	S33°E	Forest (Div.)	200	
	PBH-22	2050	2300	50°	S33°E	Forest (Div.)	200	
	PBH-23	2050	2100	50°	S33°E	Forest (Div.)	200	
	PBH-24	2050	1900	50°	S33°E	Forest (Div.)	200	
	PBH-25	2050	1700	50°	S33°E	Forest (Div.)	200	
	PBH-26	2050	1500	50°	S33°E	Forest (Div.)	200	
	PBH-27	2050	1300	50°	S33°E	Surface Right (NG)	150	
	PBH-28	1850	1700	50°	S33°E	Forest (Div.)	200	
	PBH-29	1850	1500	50°	S33°E	Forest (Div.)	200	
	PBH-30	1650	1500	50°	S33°E	Forest (Div.)	200	
	PBH-31	1850	1000	50°	S33°E	Forest (Div.)	150	
	PBH-32	2050	1100	50°	S33°E	Surface Right(NG)	150	
	PBH-33	1850	2100	50°	S33°E	Forest (Div.)	200	
	PBH-34	1650	1700	50°	S33°E	Forest (Div.)	200	
	PBH-35	1450	1600	50°	S33°E	Forest (Div.)	200	
	PBH-36	1450	2200	50°	S33°E	Forest (Div.)	200	
2019-20	PBH-37	150	2306	70°	S33°E	Non Forest	550	3750
	PBH-38	450	2312	50°	S33°E	Non Forest	300	
	PBH-39	750	2404	75°	S33°E	Non Forest	550	
	PBH-40	850	2380	60°	S33°E	Forest (Div.)	300	
	PBH-41	950	2380	60°	S33°E	Forest (Div.)	300	
	PBH-42	1050	2390	75°	S33°E	Forest (Div.)	550	

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YEAR	PBHID	Easting	Northing	Angle	Bearing	Land type	Proposed Depth (in mtrs)	TOTAL METERAGE
	PBH-43	1300	2300	50°	S33°E	Forest (Div.)	200	
	PBH-44	900	250	50°	N33°W	Forest (Div.)	200	
	PBH-45	700	250	50°	N33°W	Forest (Div.)	200	
	PBH-46	500	300	50°	N33°W	Forest (Div.)	200	
	PBH-47	300	350	50°	N33°W	Forest (Div.)	200	
	PBH-48	100	400	50°	N33°W	Forest (Div.)	200	
	Total meterage							10500

All the boreholes are of coring type.

j) **Reserves and Resources as per UNFC with respect to the threshold value notified by IBM may be furnished in a tabular form as given below: (Area explored under different level of exploration may be marked on the geological plan and UNFC code for area considered for different categories of reserve/resources estimation may also be marked on geological cross sections). Submit a feasibility/pre-feasibility study report along with financial analysis for economic viability of the deposit as specified under the UNFC field guidelines may be incorporated.**

The summary of the reserves established as per UNFC in the last approved scheme of mining at 10% Cr_2O_3 cut off and as on 31.03.2015 is given below:-

Reserves and Resources as per UNFC as per approved Scheme of Mining

Sl. No	Reserve Category (UNFC Classification)	Qty. in Tonnes	Avg. Grade (Cr_2O_3,%)
1	Proved Mineral Reserves (111)	11.115	48.70%
2	Probable Mineral Reserves (112)	NIL	NA
3	Feasibility Mineral Resource (211)	27.47	44.77%
	Feasibility Mineral Resource (212)	NIL	NA
4	Remaining measured resource (331)	NIL	NA
5	Indicated Resource (332)	NIL	NA
6	Inferred Resource (333)	NIL	NA
7	Reconnaissance Resource (334)	NIL	NA

Depletion of Reserves

Depletion of reserves are calculated on the basis of production of ore made between 1.4.2015 to 30.09.2017. The total production is given in Table – 3.2.

(Table – 3.2) Year – wise Production, in tonnes

Year	Production, t
2015-16	8,30,015
2016-17	10,08,820
2017-18 (till Sep 2017)	1,32,280

Additional reserves established category-wise

The reserves as on 31.3.2015 have already been updated in the last approved scheme of mining on the basis of exploration data available upto 31.3.2015. The same has already been reported in table 3.1 above. Further exploration has been carried out in the present scheme period in Band-I,II, III, IV & V.

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Category wise updated reserve with grade

The reserves have been re-assessed considering the Minerals (Evidence of Mineral Contents) Rules, 2015. The ore envelopes have been re-constructed considering the fresh guidelines. While preparing the ore sections, the extension of ore intercepts in boreholes have been restricted within G1 limit i.e. 50m. While constructing the 3D ore body model in the software package SURPAC, projections of ore envelopes on either side of the sections have been restricted within 25m.

The details of re-assessment of reserves in the software package SURPAC has been detailed as below

The re-assessment of the reserves has been carried out at a Cr_2O_3 cut off of 10% as per the UNFC guidelines. The reserve/resource assessment was carried out in the Mine Planning software package "GEOVIA SURPAC". The following were utilized as basic input data for the preparation of geological model.

i. Contour data of updated pit position and surface topography
ii. Borehole logging data generated from exploration of different bands done by Directorate of Mining & Geology (DMG), Govt. Odisha and OMCL

A summary of the exploration carried out for G1/G2 areas indicating mapping, drilling (No./ spacing), sample drawn/ analyzed etc is given in the table below:-

Block	No. of Boreholes	Total meterage	Spacing	Samples drawn	Max. depth	Level of exploration
Band-I	173 Nos (Core)	20048.8	50 m x 25 m to 100m x 100m grid	6202	415 m	G1
Band-II	167 Nos (Core)	12614	50 m x 25 m to 100m x 100m grid		136 m	G1
Band-III	10 Nos (Core)	547.3	50 m x 25 m grid	135	80.7 m	G1
Band-IV	143 Nos (Core)	12842	50 m x 25 m to 100m x 100m grid	596	205 m	G1
Band-V	2 Nos (Core)	66	-	12	44	G1
Proving of Barren/Possible Chrome mineralisation	12 Nos (Core)	1920	-	171	230	G1/G2

Sixty (60) experiments were conducted for determination of bulk densities of different bands in ore & waste. The copies of test results are enclosed at Annexure- 18 .The samples were drawn from different ore bands in South Kaliapani as well as in the adjoining Sukrangi lease. 53 sample values were subjected to regression analysis by plotting bulk density values against the Cr_2O_3% grade of each sample. The details of samples subjected to regression analysis is given in the table below.

Sl. No	Grade (% Cr_2O_3)	Bulk Density	Sl. No	Grade (% Cr_2O_3)	Bulk Density
1	57.38	4.07	28	47.75	2.83
2	61.18	4.12	29	23.8	1.81
3	61.43	3.39	30	45.99	2.69
4	10.88	1.67	31	14.57	2.1

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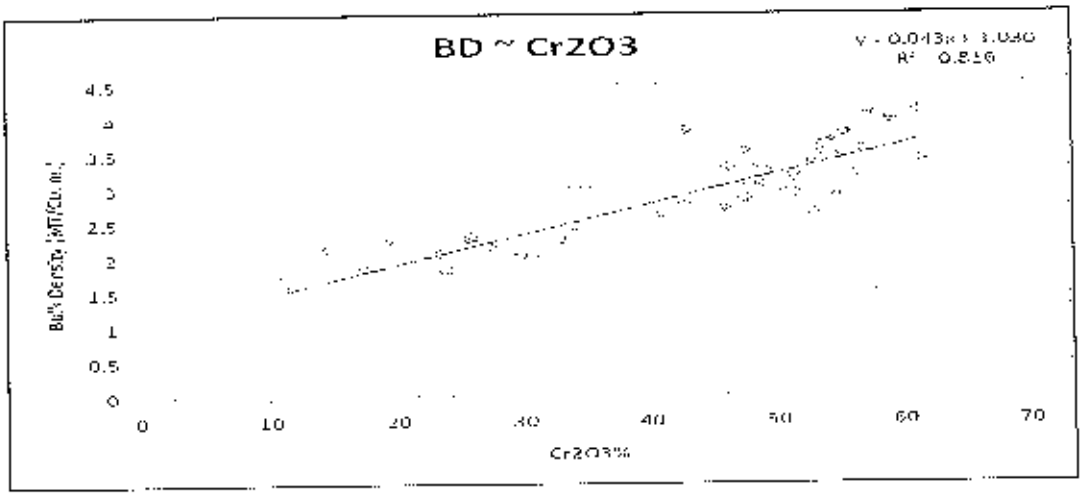
(Qualified Person)

Sl. No	Grade (% Cr_2O_3)	Bulk Density	Sl. No	Grade (% Cr_2O_3)	Bulk Density
5	59.04	3.98	32	53.96	3.61
6	53.2	3.47	33	40.78	2.58
7	55.35	3.79	34	34.18	2.43
8	48.76	3.01	35	54.97	2.87
9	42.95	2.77	36	23.42	2.15
10	54.21	3.67	37	27.35	2.16
11	47.89	3.05	38	17.47	1.83
12	56.61	3.58	39	49.52	3.22
13	53.83	3.62	40	51.55	3.01
14	47.62	3.52	41	56.11	3.16
15	54.86	3.42	42	52.96	3.39
16	42.95	3.82	43	51.44	3.18
17	11.01	1.58	44	25.83	2.25
18	52.96	2.62	45	50.92	2.93
19	24.56	1.81	46	51.59	2.92
20	18.1	1.78	47	25.83	2.29
21	48.89	3.3	48	33.18	2.24
22	18.61	1.83	49	31.15	2.07
23	30.01	2.04	50	47.75	2.83
24	49.02	3.13	51	47.75	3.06
25	25.83	2.29	52	46.37	3.28
26	33.18	2.24	53	19.24	2.22
27	31.15	2.07			

The following linear regression equation was established from the X-Y scatter plot of bulk density (BD) & Cr_2O_3% value of samples.

y = 0.043 x +1.030 at a correlation coefficient of 0.903

Where, y = Bulk density
x = Grade in Cr_2O_3 %



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The regression equation was used as tonnage factor for computation of reserves of different chromite band. On basis of the above geological works carried out, the area covered under Band–I-S&N, Band-II-S&N, Band – IV can be considered under G1 category of the geological axis as per the UNFC classification of reserves.

Parameters considered for estimation of Mineral Resources

(a) The threshold value considered as per the IBM guidelines is 10% Cr_2O_3.

(b) The entire data has been transferred to form a geological database in an ore body modeling software namely 'SURPAC'.

(i) **Preparation of Database**

Four basic files namely collar, survey, assay and litho files are required in Comma Separated Value (CSV) format for further processing by SURPAC Software. Ore type wise litho codes used for database preparation is given below.

(ii) Delineation of Ore Geometry and Construction of Ore Body

Preparation of Transverse Sections

Boreholes were displayed in SURPAC graphics window alongwith litho, Cr_2O_3%. Transverse sections were drawn across the strike of different chromite bands with the following details

Band	Baseline orientation	Grid From/To	No. of Sections	Distance between adj. sections (m)
I-South	N57°E- S57°W	50E-1200E	24	50
I-North	N80°W- S80°E	150W-200E	8	50
II-South	N57°E- S57°W	0-1850E	24	100 (0-1150E)/
II-North	N80°W- S80°E	300E-1000E	15	50
III	N57°E- S57°W	1800E-1900E	3	50
IV	N57°E- S57°W	1750W-500E	46	50

The ore envelopes were delineated at each section considering Cr_2O_3% cut-off of 10%. Since the ore body continues in further down-depth direction the transverse section should have been open towards the downward directions. But for ore-body modeling in the software, closed geological domain has to be considered. Hence string sections of ore were closed considering suitable influence of the borehole intercepts of ore.

The reserves have been re-assessed considering the Minerals (Evidence of Mineral Contents) Rules, 2015. The ore envelopes have been re-constructed considering the fresh guidelines. While preparing the ore sections, the extension of ore intercepts in boreholes have been restricted within G1 limit i.e. 50m. The downhole extension of orebody from the ore intercept of the bottom most borehole has been reduced within the prescribed limit i.e 50m.

Preparation of Digital Terrain Model (DTM) of Surface Topography

The digitized contour of updated surface plan with Z values have been transformed into digital terrain model (DTM) utilizing the principle of triangulation and wire framing of points with X, Y and Z co-ordinates. Digital terrain model is the most effective way of representing a surface in three dimensional computerized form. It is an important tool to calculate volume between two or more surfaces. The digital terrain model of surface topography with drill holes of South Kaliapani deposit is shown in the figure below:-

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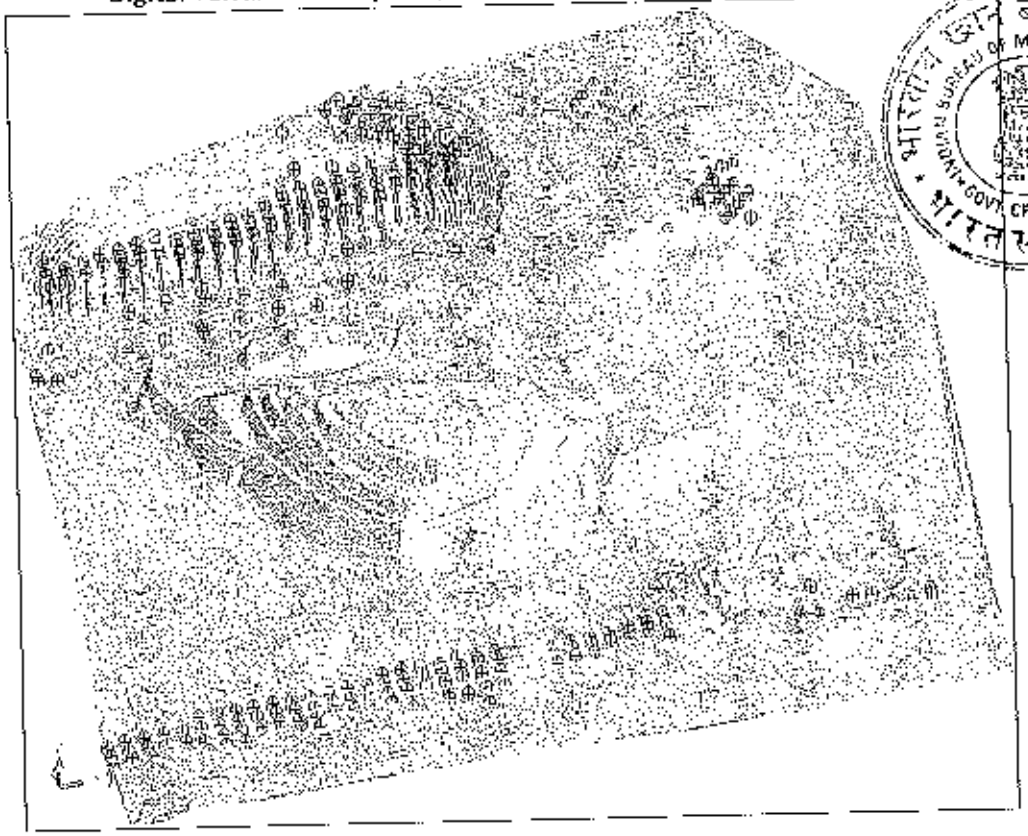
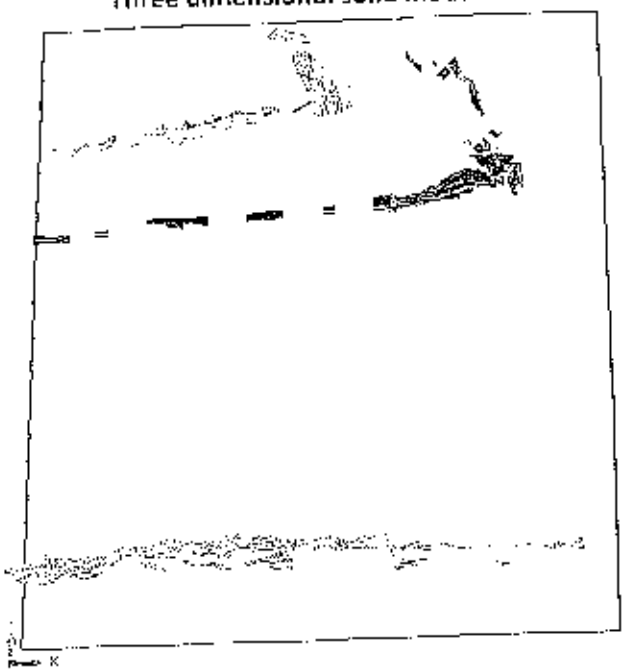
Digital Terrain Model (DTM) of Surface Topography with boreholes



3-D Solid Modeling of Ore Body

The bandwise ore zones of the respective transverse cross sections have been connected/ joined to form band-wise solid ore body models. Ore type-wise 3-D solid model of South Kaliapani deposit is presented in the figure below:-

Three dimensional solid model



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(iii) Geo-statistical analysis (Variogram modeling)

The continuity of mineralization in different directions can be well judged through analysis of variograms. In addition, the range of influence of sample in different directions can be deciphered. A variogram is evaluated with respect to sill, range and nugget effect. The variogram function is defined as follows.

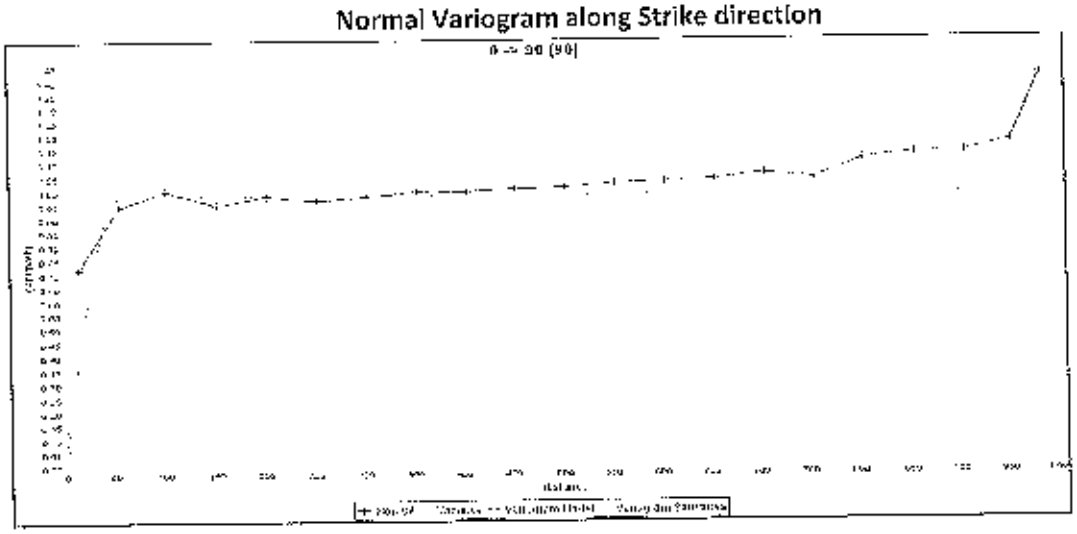
$$\gamma(h) = 1/2n \sum [z(x+h) - z(x)]^2$$

where, n = Number of sample pairs at distance 'h'
γ (h) = Variogram value at distance 'h'
Z(x) = Assay value at point x
Z(x+h) = Assay value at point x+h

The γ(h) is calculated for different distance pair 'h' and is plotted against distance pair. As the distance pair increases the γ(h) value also increases and levels off after certain distance pair. The distance pair at which the γ(h) value levels off is known as 'Range' beyond which samples become statistically independent without any correlation. This distance provides an idea of range of influence of a particular sampling point. The value of γ(h) at which the graph levels off is known as 'sill'. This value is related to the theoretical variance of the data set. 'Nugget' is the value of γ(h) at zero distance pair. The inherent variability of the data is represented by nugget. The deposit with zero or very low nugget effect possesses uniform grade distribution.

Variogram modeling has been carried out for determining the spatial variability of mineralisation & grade distribution in different directions. Composites (0.5m length) of each ore containing Cr2O3% were individually used for variogram modeling. In order to ascertain the variability of deposit of South Kaliapani lease, composites all the samples of 0.5 m length within the leasehold were extracted & the normal variograms of composited assay data have been developed along strike & dip direction of the deposit and also along borehole depth. The fitted Variogram model along strike, dip and along the borehole direction of the deposit is shown in figures below. The variogram model parameter for the above directions is presented in the table below. Results of variogram modeling for above three directions for South Kaliapani Chromite deposit is given in table below.

Normal Variogram along Strike direction



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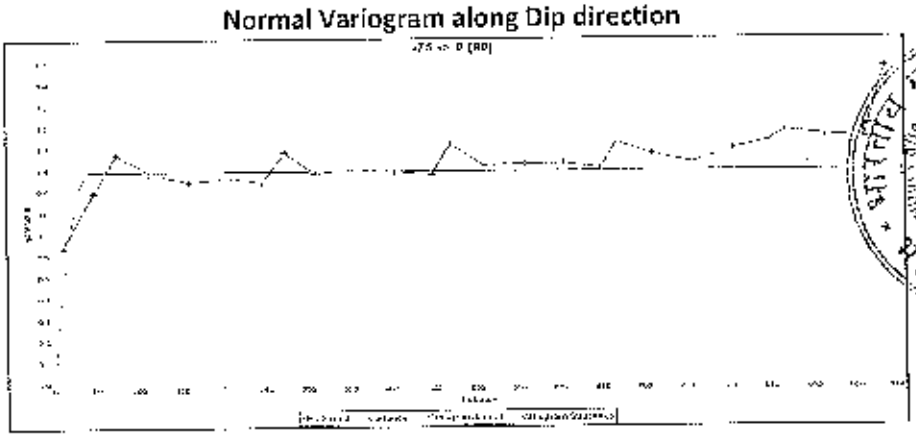
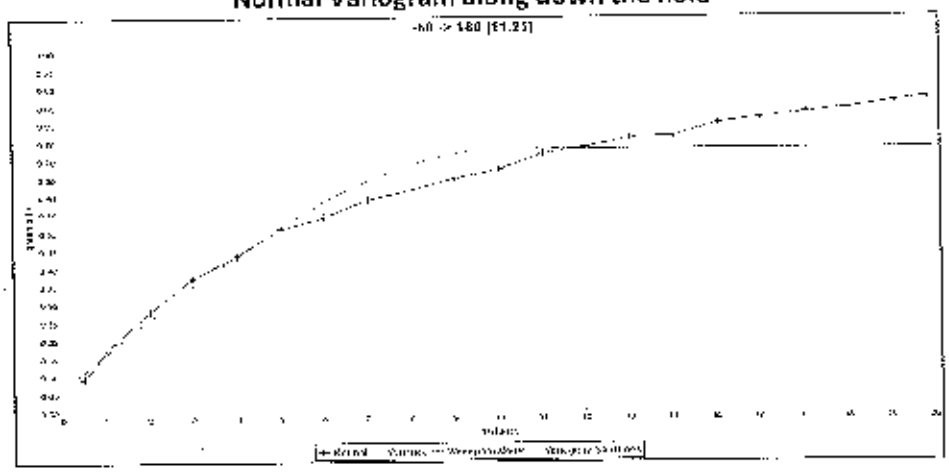
Normal Variogram along Dip direction



Normal Variogram along down the hole



Variogram model parameters in three orthogonal directions

Sl. No.	Direction	Azimuth	Plunge	Spread	Lag	Maximum Distance
1	Along Dip Direction	0	-75	90	40 m	1000 m
2	Along Strike direction	90	0	90	50 m	1000 m
3	Along Borehole depth	180	-60	11.25	1 m	20 m

Results of variogram modeling in three orthogonal directions

Sl. No.	Direction	Nugget	Sill	Range
1	Along Dip Direction	0.063469	0.150617	20.000
2	Along Strike direction	0.063469	0.917745	55.941
3	Along Borehole depth	0.063469	0.663822	10.245

Validation of Variogram

The variogram are then validated and used for further block modelling.

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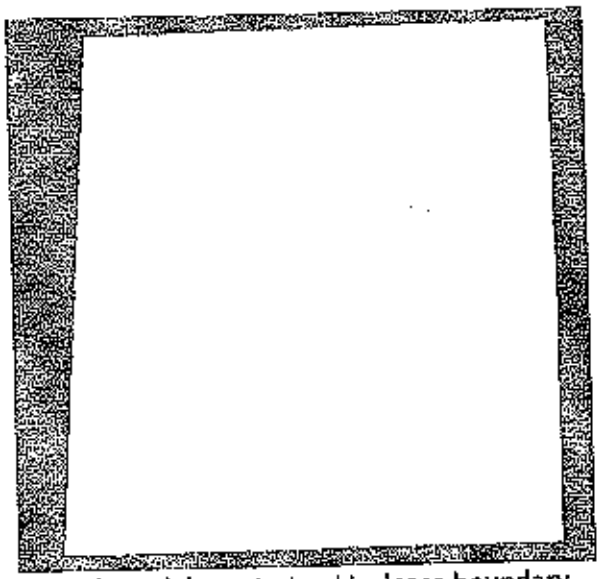
(iv) Block Modeling

The entire deposit is divided into no. of judiciously chosen sub-blocks for proper estimation of grade and quantity, keeping in view of the structural discontinuity of the deposit, extent etc. The estimated blocks in the block model has been used for optimum pit generation, mine planning and production scheduling.

- Selection of Block Size
  Considering the accuracy desired, borehole spacing and mining constraints, a unit block of 1.5 m × 1.5 m × 1.5 m has been considered, in X × Y × Z directions, for block wise grade estimation.
- Development of Block Model
  In order to cover the entire extent of South Kaliapani chrome ore deposit in three dimensions, a dummy block model with unit block sizes as indicated above have been generated. An constrained block model is shown in the figure below:-
- Addition of Attributes
  Attributes are the properties of individual block such as Cr_2O_3%, specific gravity, ore type etc. These attributes were added in the dummy block model using suitable technique.
- Application of Constraints
  Constraints are the logical combination of spatial operators and objects such as DTM of surface contour, solid model of ore zone, block etc. with which the block model can be enveloped/ intersected with respect to inside/ outside and above/ below their spatial position. *The block model developed for South Kaliapani chrome ore deposit has been constrained with the surface DTM and updated pit positions, mining lease boundary, statutory safety barriers, individual quarry boundaries as well as ore type-wise 3-D solid models as developed and discussed in the preceding paragraphs.* In this way, the blocks have been enveloped within ore zone boundary and surface topography for the purpose of grade interpolation and reserves estimation.



Block model constrained by lease boundary

- Block model estimation

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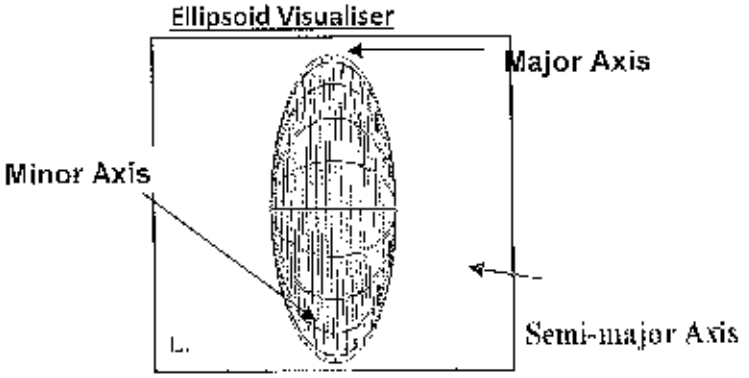
Block model estimation parameters such as anisotropic ratio, search distances etc. were derived from the results of variogram analysis discussed in previous para. South Kaliapani chrome ore deposit is uniform in mineralisation it is not erratic in behaviour. The coefficient of variation of grades in all the ores are low indicating uniform grade distribution and the deposit has also been explored at almost uniform grid along dip and strike direction, the globally accepted technique of Inverse Square Distance (ISD) method has been used for ore reserve estimation for different ore types. The parameters for reserve estimation have been derived from the statistical and geo-statistical analysis done previously. A search ellipsoid as indicated below has been used to select samples for assigning grade to the blocks. The axial parameters and its search orientation were derived from the results of geo-statistical analysis.



The tonnage factor for conversion of volume of solid into ore tonnage has been derived from the regression equation established from the bulk density experiments.

For estimation resources the following parameters have been considered:-

Measured resources: -

- The entire exploratory drill holes with grid spacing of 50m X 50 m & below has been considered as G1 category and has been categorized under 331 as per UNFC code.

On the basis of UNFC guidelines the resources can be categorized on the basis of different levels of exploration as under

Level of Exploration	Resources in million tons	Grade
G1-Detailed exploration	15.01	44.08% Cr_2O_3
G2-Generalexploration	NIL	NIL
G3-Prospecting	NIL	NIL
G4 – Reconnaissance	NIL	NIL

The details of the reserves/ resources established at 10% cut off for South Kaliapani deposit as on 31.12.2017 is given in table below. The detailed calculation of the quarry-wise reserves/ resources established at 10% Cr_2O_3, cut off for South Kaliapani deposit as on 31.12.2017 is given in Annexure 35.

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Resource type	Total tonnage at cut-off (+10% Cr_2O_3,), Million tons	Remarks
Measured mineral resources (331)	15.01/ 44.08% Cr_2O_3	All bands

Resource type	Total tonnage at cut-off (+40% Cr_2O_3,), Million tons	Remarks
Measured mineral resources (331)	10.72/ 47.91% Cr_2O_3	All bands

Feasibility Study was then carried out as enclosed in Annexure – 36 and the reserves/ resources classified thereafter for the G1 areas comprising of Band-IV-S&N, Band-III-S&M part of Band-V are given below:-

RESERVES				REMAINING RESOURCES				
Category	Quantity (Mineable)	Break-up land wise		Potentially Economic (Non-mineable)	Quantity	Constraints wise quantities		Remaining Measured Resources
Proved (111)	5.69/ 49.4% Cr_2O_3	4.70/ 48.64% Cr_2O_3	Diverted forest land	Feasibility Mineral Resources (211)	9.32/ 40.41% Cr_2O_3	5.94/ 47.36% Cr_2O_3	Below economic o/c Ultimate pit limit	Nil
		0.99/ 52.99% Cr_2O_3	Non-forest land			3.38/ 28.21% Cr_2O_3	Mined Sub grade	

k) **Furnish detailed calculation of reserves/resources section wise (When the mine is fully mechanized and deposit is of complex nature with variation of size , shape of mineralized zones, grade due to intrusion within ore zone etc, an attempt may be made to estimate reserves/resources by slice plan method). In case of deposits where underground mining is proposed, reserve/resources may be estimated by level plan method, as applicable, as per the proposed mining parameters.**

The detailed calculation of the level wise resources established at 10% Cr_2O_3 is furnished in the table below

Cr_2O_3	Z (mRL)	Volume	Tonnes	Cr_2O_3%
10.0 -> 40.0	-134.0 -> -128.0	252	667	37.65
10.0 -> 40.0	-128.0 -> -122.0	969	2421	34.4
10.0 -> 40.0	-122.0 -> -116.0	2205	5165	31
10.0 -> 40.0	-116.0 -> -110.0	3447	7728	28.88
10.0 -> 40.0	-110.0 -> -104.0	4318	9294	26.78
10.0 -> 40.0	-104.0 -> -98.0	4996	10423	25.15
10.0 -> 40.0	-98.0 -> -92.0	5605	11299	23.29
10.0 -> 40.0	-92.0 -> -86.0	5909	11539	21.58
10.0 -> 40.0	-86.0 -> -80.0	6125	11777	20.78
10.0 -> 40.0	-80.0 -> -74.0	6370	12198	20.58
10.0 -> 40.0	-74.0 -> -68.0	6581	12597	20.56
10.0 -> 40.0	-68.0 -> -62.0	6797	13010	20.56

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

Cr_2O_3	Z (mRL)	Volume	Tonnes	Cr_2O_3%
10.0 -> 40.0	-62.0 -> -56.0	7015	13509	20.89
10.0 -> 40.0	-56.0 -> -50.0	6930	13562	21.79
10.0 -> 40.0	-50.0 -> -44.0	6347	12900	23.9
10.0 -> 40.0	-44.0 -> -38.0	4799	10192	26.19
10.0 -> 40.0	-38.0 -> -32.0	3220	6938	27.11
10.0 -> 40.0	-32.0 -> -26.0	4344	8938	24.62
10.0 -> 40.0	-26.0 -> -20.0	4344	9008	24.89
10.0 -> 40.0	-20.0 -> -14.0	4485	9478	25.79
10.0 -> 40.0	-14.0 -> -8.0	12658	26686	25.51
10.0 -> 40.0	-8.0 -> -2.0	17727	39164	28.71
10.0 -> 40.0	-2.0 -> 4.0	13251	29853	30.43
10.0 -> 40.0	4.0 -> 10.0	7576	16701	29.51
10.0 -> 40.0	10.0 -> 16.0	9901	23694	32.91
10.0 -> 40.0	16.0 -> 22.0	17318	42263	33.45
10.0 -> 40.0	22.0 -> 28.0	23798	55377	30.86
10.0 -> 40.0	28.0 -> 34.0	21121	47033	28.55
10.0 -> 40.0	34.0 -> 40.0	19401	43284	28.79
10.0 -> 40.0	40.0 -> 46.0	40245	89312	28.63
10.0 -> 40.0	46.0 -> 52.0	54346	120792	28.68
10.0 -> 40.0	52.0 -> 58.0	49800	112639	29.59
10.0 -> 40.0	58.0 -> 64.0	42701	96389	29.48
10.0 -> 40.0	64.0 -> 70.0	52034	113248	27.64
10.0 -> 40.0	70.0 -> 76.0	68549	150833	28.18
10.0 -> 40.0	76.0 -> 82.0	74221	164048	28.38
10.0 -> 40.0	82.0 -> 88.0	79185	175953	28.66
10.0 -> 40.0	88.0 -> 94.0	79240	177328	29.1
10.0 -> 40.0	94.0 -> 100.0	76138	169255	28.7
10.0 -> 40.0	100.0 -> 106.0	80635	175784	27.73
10.0 -> 40.0	106.0 -> 112.0	92160	203992	28.7
10.0 -> 40.0	112.0 -> 118.0	99011	222259	29.42
10.0 -> 40.0	118.0 -> 124.0	92168	205125	29.16
10.0 -> 40.0	124.0 -> 130.0	98784	215146	28.15
10.0 -> 40.0	130.0 -> 136.0	103060	227069	28.71
10.0 -> 40.0	136.0 -> 142.0	104702	232071	28.94
10.0 -> 40.0	142.0 -> 148.0	117738	260226	28.73
10.0 -> 40.0	148.0 -> 154.0	108574	238404	28.57
10.0 -> 40.0	154.0 -> 160.0	77138	162598	26.92
10.0 -> 40.0	160.0 -> 166.0	41444	91216	28.83
10.0 -> 40.0	166.0 -> 172.0	33770	76753	29.84
10.0 -> 40.0	172.0 -> 178.0	24052	54485	29.73
10.0 -> 40.0	178.0 -> 184.0	7533	17293	31.09
10.0 -> 40.0	184.0 -> 190.0	3455	7387	27.56
10.0 -> 40.0	190.0 -> 196.0	1578	3217	23.96
10.0 -> 40.0	196.0 -> 202.0	737	1435	21.46
10.0 -> 40.0	202.0 -> 208.0	6	12	20.22
Sub Total	***10-40% Cr_2O_3***	***1940814***	***4280970***	***28.53***

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

Cr2O3	Z (mRL)	Volume	Tonnes	Cr2O3%
40.0 -> 100.0	-212.0 -> -206.0	218	751	55.96
40.0 -> 100.0	-206.0 -> -200.0	1596	5486	55.96
40.0 -> 100.0	-200.0 -> -194.0	3109	10682	55.96
40.0 -> 100.0	-194.0 -> -188.0	3881	13337	55.96
40.0 -> 100.0	-188.0 -> -182.0	4204	14446	55.96
40.0 -> 100.0	-182.0 -> -176.0	4386	15068	55.96
40.0 -> 100.0	-176.0 -> -170.0	4519	15479	55.72
40.0 -> 100.0	-170.0 -> -164.0	4514	15317	55
40.0 -> 100.0	-164.0 -> -158.0	4889	16325	53.78
40.0 -> 100.0	-158.0 -> -152.0	5011	16502	52.73
40.0 -> 100.0	-152.0 -> -146.0	5097	16652	52.11
40.0 -> 100.0	-146.0 -> -140.0	5575	18158	51.85
40.0 -> 100.0	-140.0 -> -134.0	6017	19398	51.09
40.0 -> 100.0	-134.0 -> -128.0	6224	19853	50.34
40.0 -> 100.0	-128.0 -> -122.0	5753	18299	50.19
40.0 -> 100.0	-122.0 -> -116.0	5152	16331	49.96
40.0 -> 100.0	-116.0 -> -110.0	4209	13317	49.84
40.0 -> 100.0	-110.0 -> -104.0	3475	10945	49.54
40.0 -> 100.0	-104.0 -> -98.0	2969	9457	50.4
40.0 -> 100.0	-98.0 -> -92.0	2920	9465	51.59
40.0 -> 100.0	-92.0 -> -86.0	3313	10669	51.08
40.0 -> 100.0	-86.0 -> -80.0	3947	12772	51.44
40.0 -> 100.0	-80.0 -> -74.0	4885	16153	53.05
40.0 -> 100.0	-74.0 -> -68.0	7012	23218	53.23
40.0 -> 100.0	-68.0 -> -62.0	10468	34344	52.59
40.0 -> 100.0	-62.0 -> -56.0	14448	47420	52.61
40.0 -> 100.0	-56.0 -> -50.0	18260	59450	52.02
40.0 -> 100.0	-50.0 -> -44.0	22401	71776	50.8
40.0 -> 100.0	-44.0 -> -38.0	27158	85584	49.56
40.0 -> 100.0	-38.0 -> -32.0	31854	99569	48.95
40.0 -> 100.0	-32.0 -> -26.0	35748	111555	48.81
40.0 -> 100.0	-26.0 -> -20.0	40577	127115	49.07
40.0 -> 100.0	-20.0 -> -14.0	46661	147296	49.6
40.0 -> 100.0	-14.0 -> -8.0	47775	153361	50.86
40.0 -> 100.0	-8.0 -> -2.0	53432	174646	52.31
40.0 -> 100.0	-2.0 -> 4.0	76212	247795	52.04
40.0 -> 100.0	4.0 -> 10.0	102066	330120	51.64
40.0 -> 100.0	10.0 -> 16.0	119150	385367	51.65
40.0 -> 100.0	16.0 -> 22.0	133177	429803	51.53
40.0 -> 100.0	22.0 -> 28.0	135452	438213	51.68
40.0 -> 100.0	28.0 -> 34.0	100760	326031	51.64
40.0 -> 100.0	34.0 -> 40.0	85459	274454	51.09
40.0 -> 100.0	40.0 -> 46.0	81044	259790	50.97
40.0 -> 100.0	46.0 -> 52.0	76022	245771	51.58
40.0 -> 100.0	52.0 -> 58.0	79955	259585	51.89
40.0 -> 100.0	58.0 -> 64.0	96769	310376	51.04
40.0 -> 100.0	64.0 -> 70.0	102407	327412	50.81
40.0 -> 100.0	70.0 -> 76.0	96154	305542	50.36
40.0 -> 100.0	76.0 -> 82.0	88667	279124	49.68

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

40.0 -> 100.0	82.0 -> 88.0	84200	263788	49.34
40.0 -> 100.0	88.0 -> 94.0	88895	278503	49.27
40.0 -> 100.0	94.0 -> 100.0	93412	291836	49
40.0 -> 100.0	100.0 -> 106.0	119519	375589	49.47
40.0 -> 100.0	106.0 -> 112.0	128087	405376	49.99
40.0 -> 100.0	112.0 -> 118.0	128014	404742	49.87
40.0 -> 100.0	118.0 -> 124.0	128514	405805	49.72
40.0 -> 100.0	124.0 -> 130.0	139794	442539	49.89
40.0 -> 100.0	130.0 -> 136.0	141637	450736	50.26
40.0 -> 100.0	136.0 -> 142.0	131063	415238	49.95
40.0 -> 100.0	142.0 -> 148.0	123299	385290	48.93
40.0 -> 100.0	148.0 -> 154.0	102118	313713	47.7
40.0 -> 100.0	154.0 -> 160.0	71376	214870	46.23
40.0 -> 100.0	160.0 -> 166.0	46983	139855	45.39
40.0 -> 100.0	166.0 -> 172.0	17431	51462	44.82
40.0 -> 100.0	172.0 -> 178.0	3087	8882	43.1
40.0 -> 100.0	178.0 -> 184.0	466	1305	41.13
40.0 -> 100.0	184.0 -> 190.0	13	37	40.61
Sub Total	***40-100% Cr_2O_3***	***3372860***	***10719145***	***50.29***
Grand Total	**10-100% Cr_2O_3**	**5313673**	**15000114**	**44.08**

The geological resources in different Ore bands inside the lease are shown in the table below

Band	Cr2o3	Volume	Tonnes	Cr2o3
1	10.0 -> 40.0	438137	982015	29.13
	40.0 -> 100.0	1501465	4857212	51.63
Sub Total		1939603	5839227	47.85
2	10.0 -> 40.0	1008796	2135084	26.34
	40.0 -> 100.0	182871	561060	47.7
Sub Total		1191667	2696143	30.78
4	10.0 -> 40.0	493880	1163871	32.06
	40.0 -> 100.0	1688523	5300873	49.33
Sub Total		2182404	6464744	46.22
Grand Total		5313673	15000114	44.08

The cross validation report of the resource estimation has been enclosed as Annexure-40

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

I) Mineral reserves/Resources:

Mineral Resources: (Mineral resources may be estimated purely based on level of exploration, with reference to the threshold value of minerals declared by IBM)

The details of the reserves/ resources established at 10% Cr_2O_3 cut off is given in the table below:-

Sl. No	Reserve Category (UNFC Classification)	Qty. in Tonnes	Avg. Grade (Cr_2O_3,%)
1	Proved Mineral Reserves (111)	5.69	49.4%
2	Probable Mineral Reserves (112)	NIL	NA
3	Feasibility Mineral Resource (211)	9.32	40.41%
	Feasibility Mineral Resource (212)	NIL	NA
4	Remaining measured resource (331)	NIL	NA
5	Indicated Resource (332)	NIL	NA
6	Inferred Resource (333)	NIL	NA
7	Reconnaissance Resource (334)	NIL	NA

2.0 MINING

A. OPEN CAST MINING:

a) Briefly describe the existing as well as proposed method for excavation with all design parameters indicating on plans /sections.

The South Kaliapani Chromite mines come under Category-A (Fully Mechanized category) as per the IBM guideline. The deposit is worked by opencast mining method with formation of benches. Working benches are kept 6 m high and minimum 11 m wide. The conventional mining method deploys use of 115-150 mm diameter drills and blasting with low density (LD) cartridge explosives. 30-40 t capacity dumper/ tipper with matching capacity hydraulic excavators/ loaders for loading and transportation of ore to sale plots and transportation of waste/ sub grade materials to their respective dumps/ stock yards have been envisaged in this plan period.

In general the stratum is very soft however, occasional drilling & blasting is being carried out in the ore patches only for improved fragmentation. For the purpose of carrying out drilling, 115-150 mm diameter down the hole (DTH) blast-hole drills are deployed. The drilling pattern for 115-150 mm diameter holes is at a burden of 2-3m and spacing of 3-4m. The bench height has been kept at 6 m. Therefore keeping into account the factor for sub grade drilling & extra drilling to take care of hole collapse, the depth of the hole is around 6.5 m.

Around 2.5-4.5 cu.m bucket capacity hydraulic excavators (diesel powered) is being used in conjunction with 30-40 t capacity dumpers. The ROM is being segregated at the mining face itself as ore/ beneficiable ore/ sub-grade ore depending into the content of Cr_2O_3 in it. If the Cr_2O_3 content in the ore is more than 40% it is being considered into direct ore, if the Cr_2O_3 content in the ore is in between 10-40% it is being considered as beneficiable ore /sub grade ore. Accordingly the ore is being stacked into their respective stacking plots. Waste & sub grade materials generated is being transported to their respective dumping/ stacking locations. Front end loader of around 1.5-3.0 cu.m bucket capacity is being deployed to load the ore/ subgrade grade ore from the respective stacking plots.

Regular sampling of the ore at mine face itself is being carried out for on-face segregation of ore/ sub grade ore. As per the permission granted by DGMS under regulation 106(2)(b), the bench configurations adopted at South Kaliapani chromite mine is given below:-

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

Sl. No.	Parameters	D-quarry	F-quarry
1.	Quarry Size (L x W x D)	1366 m x 738 m x 120 m	570 m x 235 m x 128 m
2.	Top Bench RL	138 mRL	181.5 mRL
3.	Bottom Bench RL	18 mRL	53.5 mRL
4.	Maximum Bench Height	6 m	1.5 m
5.	Minimum Bench Width	11 m	2.5
6.	No. of benches in ore	9	12
7.	No. of benches in waste	11	15
8.	Ultimate pit slope angle	< 25 deg.	< 25 deg.
9.	UPL RL	-50 mRL	58 mRL

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b) Indicate year-wise tentative Excavation in Cubic Meters indicating development, ROM, pit wise as in table below.

I. In-situ Tentative Excavation:

Year	Pit no.	Total tentative Excavation (Mill. CuM)	Top Soil (Cu m)	OB/SB/IB (Mill. Cum)	ROM (Cum)		Mineral rejects (Waste)	Stripping Ratio
					Ore (Mill.Cum)	Sub grade (Mill. Cum)		
1	2	3	4	5	6	7	8	9
2017-18 (1.1.18 to 31.3.18)	Band – I	5.815	0	5.56	0.216	0.039	0	21.8
	Band-II	1.149	0.1	1.044	0	0.005	0	208.8
	Band-IV	4.002	0.281	3.721	0	0	0	0.0
	Band-IV Manual	0.013	0	0.003	0.008	0.002	0	0.3
	Total	10.979	0.381	10.328	0.224	0.046	0	38.3
2018-19	Band – I	7.095	0	6.855	0.238	0.002	0	28.6
	Band-II	0.552	0	0.498	0	0.054	0	9.2
	Band-IV	5.063	0.283	4.609	0.12	0.051	0	27.0
	Band-IV Manual	0.011	0	0.005	0.006	0	0	0.8
	Total	12.721	0.283	11.967	0.364	0.107	0	25.4
2019-20	Band – I	2.62	0	2.607	0.013	0	0	200.5
	Band-II	4.726	0.162	4.359	0.013	0.192	0	21.3
	Band-IV	6.277	0.124	5.867	0.219	0.067	0	20.5
	Band-IV Manual	0.056	0	0.039	0.012	0.005	0	2.3
	Total	13.679	0.286	12.872	0.257	0.264	0	24.7

The year-wise development & production quantity in tonnes for the proposed plan period is given below.

Year	Chrome Ore Production Qty., Million tonnes	Development Qty. Million Cu.m. (OB/IB)	Stripping Ratio (Cu.m./tons)
2017-18(1.1.18 to 31.3.18)	0.832716	10.328625	12.40
2018-19	1.391228	11.967194	8.60
2019-20	1.385751	12.871763	9.29
Total	3.609695	35.167582	9.74

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

The band wise production schedule in different grade range (saleable/subgrade) is furnished in the table below

2017-18				
ORE BAND	Cr2O3 RANGE	Volume	Tonnes	Cr2O3
BAND-1	10.0 -> 40.0	39311	93825	32.24
	40.0 -> 100.0	216825	701432	51.65
BAND-2	10.0 -> 40.0	4805	8637	18.15
BAND-4	10.0 -> 40.0	0	0	0
BAND-4 Manual	10.0 -> 100.0	9607	28822	43.68
Total	**10.0 -> 100.0**	**270548**	**832716**	**48.84**

2018-19				
ORE BAND	Cr2O3 RANGE	Volume	Tonnes	Cr2O3
BAND-1	10.0 -> 40.0	2404	5205	27.93
	40.0 -> 100.0	238543	784057	52.71
BAND-2	10.0 -> 40.0	54505	98153	18.39
BAND-4	10.0 -> 40.0	51050	124593	33.27
	40.0 -> 100.0	119676	359762	46.1
BAND-4 Manual	10.0 -> 100.0	6486	19458	44.75
Total	**10.0 -> 100.0**	**472664**	**1391228**	**46.63**

2019-20				
ORE BAND	Cr2O3 RANGE	Volume	Tonnes	Cr2O3
BAND-1	10.0 -> 40.0	33	74	28.43
	40.0 -> 100.0	13882	44247	50.28
BAND-2	10.0 -> 40.0	192253	407102	26.35
	40.0 -> 100.0	13366	38685	43.44
BAND-4	10.0 -> 40.0	66842	166075	34.55
	40.0 -> 100.0	219648	685250	48.78
BAND-4 Manual	10.0 -> 100.0	14773	44318	40.06
Total	**10.0 -> 100.0**	**520797**	**1385751**	**40.10**

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

The reserve production section wise has been calculated for different bands as per the following table

SECTION WISE PRODUCTION OF RESERVES FOR FY 2017-18

	Cross-section	Cross-sectional Area, Sq. m	Length of influence, m	Volume, cu. m	Tonnage, Tonnes
Band 1 South	200e	65.2921	50	3264.605	9793.815
	250e	252.9856	50	12649.28	37947.84
	300e	317.6846	50	15884.23	47652.69
	400e	490.67	50	24533.5	73600.5
	450e	480.65	50	24032.5	72097.5
	500e	490.78	50	24539	73617
	600e	444.77	50	22238.5	66715.5
	650e	260.11	50	13005.5	39016.5
	700e	335.87	50	16793.5	50380.5
	800e	445.18	50	22259	66777
	900e	193.5007	50	9675.035	29025.105
	950e	387.76	50	19388	58164
	1000e	314.9788	50	15748.94	47246.82
	1050e	370.65	50	18532.5	55597.5
	1100e	720.67	50	36033.5	108100.5
Band 1 North	0	39.092	50	1954.6	5863.8
	50e	373.2093	50	18660.465	55981.395
	100e	790	50	39500	118500
Band 2 south	1400e	7.1821	50	359.105	1077.315
	1450e	28.4547	50	1422.735	4268.205
	1550e	24.4085	50	1220.425	3661.275
	1650e	3.1796	50	158.98	476.94
	1700e	30.2066	50	1510.33	4530.99
	1750e	40.272	50	2013.6	6040.8
Band 2 North	850e	81.8429	50	4092.145	12276.435
Band 4	1450e	7.361	50	368.05	1104.15
	1500e	57.8732	50	2893.66	8680.98
	1550e	62.8818	50	3144.09	9432.27
	1600e	23.2206	50	1161.03	3483.09
	1650e	25.5411	50	1277.055	3831.165
	Total for FY 2017-18				**1074941.58**

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

SECTION WISE PRODUCTION OF RESERVES FOR FY 2018-19					
	Cross-section	Cross-sectional Area, Sq. m	Length of Influence, m	Volume, cu. m	Tonnage, Tonnes
Band 1 South	100e	240.0905	50	12004.525	36013.575
	150e	93.1274	50	4656.37	13969.11
	200e	480.51	50	24025.5	72076.5
	250e	570.19	50	28509.5	85528
	300e	902.55	50	45127.5	135382.5
	400e	478.8351	50	23941.755	71825.265
	450e	191.0764	50	9553.82	28661.46
	500e	456.8828	50	22844.14	68532.42
	600e	650.12	50	32506	97518
	700e	551.5778	50	27578.89	82736.67
	800e	790.65	50	39532.5	118597.5
	900e	293.2278	50	14661.39	43984.17
	950e	510.81	50	25540.5	76621.5
	1000e	179.66	50	8983	26949
	1050e	26.2136	50	1310.68	3932.04
Band 1 North	100e	15.4008	50	770.04	2310.12
Band 2 south	1300e	14.6964	50	734.82	2204.46
	1350e	91.0107	50	4550.535	13651.605
	1400e	53.1235	50	2656.175	7968.525
	1500e	185.918	50	9295.9	27887.7
	1550e	191.1403	50	9557.015	28671.045
	1600e	150.5087	50	7525.435	22576.305
	1650e	97.3647	50	4868.235	14604.705
	1700e	134.6087	50	6730.435	20191.305
	1750e	5.119	50	255.95	767.85
Band 2 North	850e	2.0476	50	102.38	307.14
Band 4	50e	175.6641	50	8783.205	26349.615
	100e	338.6859	50	16934.295	50802.885
	150e	198.666	50	9933.3	29799.9
	200e	45.1101	50	2255.505	6766.515
	300e	153.8254	50	7691.27	23073.81
	350e	105.6993	50	5284.965	15854.895

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

	400e	166.7091	50	8335.455	25006.365
	650e	49.283	50	2464.15	7392.45
	700e	100.0858	50	5004.29	15012.87
	800e	173.1053	50	8655.265	25965.795
	850e	100.227	50	5011.35	15034.05
	900e	162.8901	50	8144.505	24433.515
	950e	47.9881	50	2399.405	7198.215
	1000e	16.7412	50	837.06	2511.18
	1100e	263.6646	50	13183.23	39549.69
	1150e	290.87	50	14543.5	43630.5
	1200e	511.017	50	25550.85	76652.55
	1250e	306.12	50	15306	45918
	1500e	20.7766	50	1038.83	3116.49
	1550e	7.7458	50	387.29	1161.87
	1600e	19.8432	50	992.16	2976.48
	1650e	46.4723	50	2323.615	6970.845
TOTAL FOR YEAR (2018-19)					**1598647.455**

SECTION WISE PRODUCTION OF RESERVES FOR FY 2019-20

	Cross-section	Cross-sectional Area, Sq. m	Length of Influence, m	Volume, cu. m	Tonnage, Tonnes
Band 1 South	300e	137.207	50	6860.35	20581.05
	400e	18.3749	50	918.745	2756.235
	500e	28.8633	50	1443.165	4329.495
	600e	104.7644	50	5238.22	15714.66
	700e	36.3894	50	1819.47	5458.41
	800e	234.077	50	11703.85	35111.55
	950e	18.1241	50	906.205	2718.615
Band 1 North	100e	7.0539	50	352.695	1058.085
Band 2 south	1150e	81.0806	50	4054.03	12162.09
	1300e	102.0287	50	5101.435	15304.305
	1350e	105.0005	50	5250.025	15750.075
	1450e	490.88	50	24544	73632
	1500e	160.2246	50	8011.23	24033.69
	1550e	124.451	50	6222.55	18667.65
	1600e	242.1305	50	12106.525	36319.575
	1650e	402.1325	50	20106.625	60319.875

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

	1700e	560.69	50	28034.5	84103.5
	1750e	217.3832	50	10869.16	32607.48
	1850e	1189.43	50	59471.5	178414.5
Band 2 North	700e	75.7785	50	3788.925	11366.775
	750e	109.1086	50	5455.43	16366.29
	800e	62.1578	50	3107.89	9323.67
	850e	967.45	50	48372.5	145117.5
	900e	923.78	50	46189	138567
Band 4	50e	183.0045	50	9150.225	27450.675
	100e	156.2609	50	7813.045	23439.135
	150e	66.9726	50	3348.63	10045.89
	200e	138.0321	50	6901.605	20704.815
	250e	69.0902	50	3454.51	10363.53
	300e	190.67	50	9533.5	28600.5
	350e	131.214	50	6560.7	19682.1
	400e	274.3988	50	13719.94	41159.82
	450e	78.4337	50	3921.685	11765.055
	500e	41.6726	50	2083.63	6250.89
	600e	115.5517	50	5777.585	17332.755
	650e	201.7708	50	10088.54	30265.62
	700e	348.5699	50	17428.495	52285.485
	800e	277.65	50	13882.5	41647.5
	850e	282.8619	50	14143.095	42429.285
	900e	193.9852	50	9699.26	29097.78
	950e	178.86	50	8943	26829
	1000e	378.91	50	18945.5	56836.5
	1100e	368.5	50	18425	55275
	1150e	152.4015	50	7620.075	22860.225
	1200e	94.6263	50	4731.315	14193.945
	1250e	42.6402	50	2132.01	6396.03
	1300e	219.6984	50	10984.92	32954.76
	1350e	171.55	50	8577.5	25732.5
	1500e	61.5043	50	3075.215	9225.645
	1550e	82.3034	50	4115.17	12345.51
	1600e	54.144	50	2707.2	8121.6
	1650e	100.1795	50	5008.975	15026.925
	1850e	8.9658	50	448.29	1344.87
TOTAL FOR YEAR (2019-20)					1659447.42

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

The section wise calculations of volume of overburden in plan period has been furnished in the table below

FY 2017-18				
	Cross-section	Cross-sectional Area, Sq. m	Length of Influence, m	Volume, cu.m
Band 1 South	100e	506.0457	50	25302.29
	150e	957.995	50	47899.75
	200e	1467.3184	50	73365.92
	250e	2621.481	50	131074.1
	300e	3329.2203	50	166461
	350e	6271.1296	50	313556.5
	400e	6350.8476	50	317542.4
	450e	6387.0885	50	319354.4
	500e	6440.332	50	322016.6
	550e	7414.0765	50	370703.8
	600e	6170.9715	50	308548.6
	650e	5347.68	50	267384
	700e	4963.7549	50	248187.7
	750e	4607.784	50	230389.2
	800e	4292.6202	50	214631
	850e	7935.5092	50	396775.5
	900e	7745.1797	50	387259
	1000e	5790.5711	50	289528.6
	1050e	5732.9081	50	286645.4
	1100e	4916.8225	50	245841.1
Band 1 North	50w	1199.09	50	59954.5
	0	975.4501	50	48772.51
	50e	451.16	50	22558
	100e	1758.0985	50	87904.93
	150e	1363.77	50	68188.5
	200e	763.81	50	38190.5
Band 2 south	50e	201.09	50	10054.5
	250e	6754.1577	50	337707.9
	450e	8260.0414	50	413002.1
	650e	7194.7987	50	359739.9
	850e	8797.5919	50	439879.6
	950e	8141.1904	50	407059.5
	1100e	4073.702	50	203685.1
	1150e	4634.538	50	231726.9
	1200e	3174.3891	50	158719.5
	1250e	2623.8421	50	131192.1
	1300e	3217.9145	50	160895.7
	1350e	812.1903	50	40609.52
	1400e	1115.376	50	55768.8

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

	1450e	1420.6	50	71030
	1500e	1343.9714	50	67198.57
	1550e	1184.8734	50	59243.67
	1600e	691.45	50	34572.5
	1650e	434.7032	50	21735.16
	1700e	304.0762	50	15203.81
	1750e	223.5929	50	11179.65
Band 2 North	350e	1002.1418	50	50107.09
	450e	400.62	50	20031
	850e	984.7	50	49235
Band 4	50e	2545.4147	50	127270.7
	100e	2469.69	50	123484.5
	150e	1494.9267	50	74746.34
	200e	546.9	50	27345
	250e	452.69	50	22634.5
	300e	894.93	50	44746.5
	350e	1497.848	50	74892.4
	400e	1961.3563	50	98067.82
	450e	2543.6849	50	127184.2
	500e	3567.0385	50	178351.9
	600e	5456.4142	50	272820.7
	650e	5634.9439	50	281747.2
	700e	3900.58	50	195029
	800e	4426.2517	50	221312.6
	850e	4338.5165	50	216925.8
	900e	4092.5828	50	204629.1
	950e	4086.1617	50	204308.1
	1000e	3963.5274	50	198176.4
	1100e	96.361	50	4818.05
	1450e	15.73	50	786.5
	1600e	5.3	50	265
TOTAL FOR FY 2017-18				**11337156**

FY 2018-19				
	Cross-section	Cross-sectional Area, Sq. m	Length of Influence, m	Volume, cu. m
Band 1 South	100e	9236.0292	50	461801.5
	150e	11270.8723	50	563543.6
	200e	13190.2772	50	659513.9
	250e	14113.2757	50	705663.8
	300e	13049.9645	50	652498.2
	350e	8902.7528	50	445137.6

(Sunil Kr. Kar, Mining Engineer)
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(Abinash Kr. Sahu, Geologist)
(Qualified Person)

	400e	6020.6519	50	301032.6
	450e	6253.2119	50	312660.6
	500e	5714.006	50	285700.3
	550e	6462.7606	50	323138
	600e	6355.3177	50	317765.9
	650e	7737.35	50	386867.5
	700e	7090.7851	50	354539.3
	750e	7718.0745	50	385903.7
	800e	5304.8866	50	265244.3
	850e	3349.8934	50	167494.7
	900e	2515.929	50	125796.5
	1000e	1644.18	50	82209
	1050e	1407.1588	50	70357.94
	1100e	715.09	50	35754.5
Band 1 North	100e	67.1502	50	3357.51
Band 2 South	250e	11234.8825	50	561744.1
	450e	7471.2841	50	373564.2
	650e	8366.66	50	418333
	850e	2758.5369	50	137926.8
	950e	1443.45	50	72172.5
	1100e	257.89	50	12894.5
	1150e	94.8566	50	4742.83
	1200e	276.6	50	13830
	1250e	496.42	50	24821
	1300e	684.2631	50	34213.16
	1350e	586.2437	50	29312.19
	1400e	938.6205	50	46931.03
	1500e	1218.0864	50	60904.32
	1550e	1183.7067	50	59185.34
	1600e	1059.93	50	52996.5
	1650e	703.28	50	35164
	1700e	524.25	50	26212.5
	1750e	510.48	50	25524
Band 2 North	850e	543	50	27150
Band 4	50e	2107.4774	50	105373.9
	100e	1856.203	50	92810.15

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

	150e	2036.7397	50	101837
	200e	2499.02	50	124951
	250e	2697.1055	50	134855.3
	300e	3109.9596	50	155498
	350e	3307.9162	50	165395.8
	400e	3472.6244	50	173631.2
	450e	4161.9524	50	208097.6
	500e	4366.3354	50	218316.8
	600e	4460.5593	50	223028
	650e	4102.34	50	205117
	700e	3829.6928	50	191484.6
	800e	3179.9683	50	158998
	850e	3725.5208	50	186276
	900e	4113.3709	50	205668.5
	950e	4807.5616	50	240378.1
	1000e	5165.2022	50	258260.1
	1100e	3864.081	50	193204.1
	1150e	3015.1803	50	150759
	1200e	1769.654	50	88482.7
	1250e	1155.2927	50	57764.64
	1600e	8.15	50	407.5
	1750e	43.95	50	2197.5
TOTAL FOR FY 2018-19				12566396

FY 2019-20				
	Cross-section	Cross-sectional Area, Sq. m	Length of Influence, m	Volume, cu. m
Band 1 South	350e	1378.2421	50	68912.105
	400e	2733.98	50	136699
	450e	2019.9223	50	100996.115
	500e	381.766	50	19088.3
	550e	5040.06	50	252003
	600e	6355.3177	50	317765.885
	650e	3360.59	50	168029.5
	700e	3330.8134	50	166540.67
	750e	3152.3841	50	157619.205
	800e	1916.4473	50	95822.365
	850e	1526.8044	50	76340.22

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

	900e	912.6	50	45630
Band 2 South	650e	426.93	50	21346.5
	1100e	2236.9951	50	111849.755
	1150e	2261.3808	50	113069.04
	1200e	3498.2028	50	174910.14
	1250e	3338.416	50	166920.8
	1300e	4241.6178	50	212080.89
	1350e	4306.0761	50	215303.805
	1400e	4794.26	50	239713
	1450e	9359.6527	50	467982.635
	1500e	5474.7422	50	273737.11
	1550e	7160.5302	50	358026.51
	1600e	5809.6616	50	290483.08
	1650e	4886.1249	50	244306.245
	1700e	6126.6662	50	306333.31
	1750e	7252.8268	50	362641.34
	1850e	5987.0457	50	299352.285
Band 2 North	300e	1803.697	50	90184.85
	650e	732.95	50	36647.5
	700e	1104.1413	50	55207.065
	750e	1735.6732	50	86783.66
	800e	3108.9452	50	155447.26
	850e	9450.0591	50	472502.955
	900e	5302.7477	50	265137.385
Band 4	50e	1940.8899	50	97044.495
	100e	1757.4611	50	87873.055
	150e	1821.7384	50	91086.92
	200e	1954.3585	50	97717.925
	250e	2647.0207	50	132351.035
	300e	2980.2249	50	149011.245
	350e	3838.9659	50	191948.295
	400e	4462.4165	50	223120.825
	450e	5581.6462	50	279082.31
	500e	5580.5422	50	279027.11
	600e	5769.4	50	288470
	650e	5781.2184	50	289060.92
	700e	6078.0661	50	303903.305
	800e	4841.4297	50	242071.485

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

	850e	4902.4996	50	245124.98
	900e	5379.7083	50	268985.415
	950e	5343.6509	50	267182.545
	1000e	4782.783	50	239139.15
	1100e	4376.919	50	218845.95
	1150e	4903.0588	50	245152.94
	1200e	4112.77	50	205638.5
	1250e	3711.2032	50	185560.16
	1300e	4991.9227	50	249596.135
	1350e	1989.0207	50	99451.035
	1500e	96.48	50	4824
	1550e	526.35	50	26317.5
	1600e	184.5422	50	9227.11
	1650e	65.6	50	3280
	1750e	113.37	50	5668.5
	1850e	56.4	50	2820
TOTAL FOR FY 2019-20				**11653996.33**

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

Not applicable, as dump re-handling has not been envisaged.

c) Enclose individual year wise development plans and sections showing pit layouts, dumps, stacks of mineral reject, if any, etc. in case of 'A' category mines. Composite development plans showing pit layouts, dumps, stacks of mineral reject, if any, etc. and year wise sections in case of 'B' category mines.

The year wise pit development & production plan at the end of FY 2017-18 to FY 2019-20 is shown in Plate No.-6A to PLATE NO.-6C. The sections of the year wise pit are shown in Plate No.-6D TO 6G.

d) Describe briefly giving salient features of the proposed method of working indicating Category of mine.

The South Kaliapani Chromite mines come under Category-A (Fully Mechanized category) as per the IBM guideline. The deposit is worked by opencast mining method with formation of benches. Working benches are kept 6 m high and minimum 11 m wide. The conventional mining method deploys use of 115-150 mm diameter drills and blasting with low density (LD) cartridge explosives. 30-40 t capacity dumper/ tipper with matching capacity hydraulic excavators/ loaders for loading and transportation of ore to sale plots and transportation of waste/ sub grade materials to their respective dumps/ stock yards have been envisaged in this scheme of mining.

In general the stratum is very soft however, occasional drilling & blasting is being carried out in the ore patches only for improved fragmentation. For the purpose of carrying out drilling, 115-150 mm diameter down the hole (DTH) blast-hole drills are deployed. The drilling pattern for 115-150 mm diameter holes is at a burden of 2m and spacing of 3m. The bench height has been kept at 6 m. Therefore keeping into account the factor for sub grade drilling & extra drilling to take care of hole collapse, the depth of the hole is around 6.5 m.

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

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(Qualified Person)

Around 2.5-4.5 cu.m bucket capacity hydraulic excavators (diesel powered) is being used in conjunction with 20-35 t capacity dumpers. The ROM is being segregated at the mining face itself as ore/ beneficiable ore/ sub-grade ore depending into the content of Cr_2O_3 in it. If the Cr_2O_3 content in the ore is more than 40% it is being considered into direct ore, if the Cr_2O_3 content in the ore is in between 10-40 % it is being considered as beneficiable ore /sub grade ore. Accordingly the ore is being stacked into their respective stacking plots. Waste & sub grade materials generated is being transported to their respective dumping/ stacking locations. Front end loader of around 1.5-3.0 cu.m bucket capacity is being deployed to load the ore/ subgrade grade ore from the respective stacking plots. Regular sampling of the ore at mine face itself is being carried out for on-face segregation of ore/ sub grade ore. As per the permission granted by DGMS under regulation 106(2)(b), the bench configurations adopted at South Kaliapani chromite mine is given below:-

Sl. No.	Parameters	D-quarry	F-quarry
1.	Quarry Size (L x W x D)	1366 m x 738 m x 120 m	570 m x 235 m x 128 m
2.	Top Bench RL	138 mRL	181.5 mRL
3.	Bottom Bench RL	18 mRL	53.5 mRL
4.	Maximum Bench Height	6 m	1.5 m
5.	Minimum Bench Width	11 m	2.5
6.	No. of benches in ore	9	12
7.	No. of benches in waste	11	15
8.	Ultimate pit slope angle	< 25 deg.	< 25 deg.
9.	UPL RL	-50 mRL	58mRL

In order to accommodate the huge labourers which were required earlier in the mines of OMC, Qry. F is still worked by manual means. However, at the ultimate stage the benches will be merged to form a single bench of 6m height.

e) **Describe briefly 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. A reference to the plans and sections may be given. UPL or ultimate size of the pit is to be shown for identification of the suitable dumping site..**

The year wise pit development plan & section for the years 2017-18, 2018-19, 2019-20 period on yearly basis have been shown in PLATE NO.-6A to PLATE NO.-6C. The surface plan of the mine is shown as PLATE NO.-3.

The development of mining operations in this mining plan period is envisaged in the in three quarries located at the northern and southern end of the mining lease viz., band-1, band 2 and band 4 respectively. The quarry on band-1 will be mined for three years for ore production whereas quarry on band 2 and band 4 will only be developed in the first year. Ore Production in band-2 and band -4 will commence from 2nd year.

Quarry in band-1 will be deepened further and benches to be developed properly to ensure systematic mining in subsequent years and quarry in band 2 and band 4 will advance from south to north direction.

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

The height & width of benches in ore/ OB will be 6 m x 11 m respectively both on the hang wall & foot wall side. The RL of the benches of every year is given in the following table. The location co-ordinates of mine advancement in each year along with the area proposed to be degraded in each year of ensuing five year period is also given in the following table:

Year	Pit No.	Excavation Planning	
		Location Co-ordinates	Bench/ RL
2017-18	Band-1	2600N – 1800N; 00E- 1420E	112 mrl to -2 mRL
	Band-2	1750N – 2100N; 1020 E- 1850E	178 mrl to 160 mRL
	Band-4	140N-400N; -300E -1150E	190 mrl to 232 mRL
2018-19	Band-1	2600N – 1800N; 00E- 1420E	124 mrl to -26 mRL
	Band-2	1750N – 2060N; 1020 E- 1850E	178 mrl to 142 mRL
	Band-4	700N-100N; -300E-1300E	232 mrl to 148 mRL
2019-20	Band-1	2600N – 1800N; 00E- 1420E	130 mrl to -38 mRL
	Band-2	1700N-2220N; 1000E-1950E	160 mrl to 130 mRL
	Band-4	750N-150N; -250E-1350E	232 mrl to 136 mRL

The excavated ore will be loaded to rear discharge trucks for its onward dispatch. And the sub-grade ore will be stacked separately in sub-grade yard and, the waste removed will also be stacked in the external waste dump having retaining wall with garland drain constructed at its periphery.

The waste generated due to mining operation will be kept in wd1 and wd2. wd1 will mature at the end of 2018-19 whereas wd2 will mature after 2019-20. Plantation to stabilize wd1 and wd2 will be done from 2018-19 onwards.

f) Conceptual Mine planning upto the end of lease period taking into consideration the present available reserves and resources describing the excavation, recovery of ROM, Disposal of waste, backfilling of voids, reclamation and rehabilitation showing on a plan with few relevant sections.

The South Kaliapani chromite mine comes under Category-A (Fully mechanized category) as per the IBM guidelines. The conceptual plan of South Kaliapani lease has been prepared on the basis of the life of deposit. Conceptual Plan has been prepared following the guidelines of IBM, keeping in view the present knowledge of the deposit, topography of the area, surface drainage pattern, mineable reserves available, mining technology and selection of the sites for waste disposal within the lease area etc.

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

From the six bands of chromite encountered in the Sukinda Valley the South Kaliapani area consists of three sub parallel lodes. They are 5 Nos. of chromite bands occupying different stratigraphic level. They are dipping sub – vertically towards N – W with pinch and swell structure.

(i) Band No – I
Chromite band No. I, of South Kaliapani lease is the northern-most band. The insitu ore body exposed in the quarries, within this band is brown, friable and medium grained. Presently, quarry No. D exists over this ore band.

(ii) Band – II/ III/ V
No mining has been carried out recently over these bands.

(iii) Band – IV
The in-situ ore body exposed in the quarries, within this band is brown, friable and medium grained. Presently, quarry No. F exists over this ore band.

As per the geological ore body model prepared in the 'ore body modeling' software, the extent of band No. 1 exits to much deeper levels. The bench configuration parameters considered for finalizing the ultimate pit limit in line to the permission granted by DGMS under regulation 106 (2)(b) of the Metalliferous Mines Regulations 1961 for deep hole drilling & blasting with deployment of HEMM are given below:-

Bench height	: 6m	Bench width	: 11m
Bank slope angle	: 60 degrees	Overall pit slope angle	:25 degrees.

After exhausting the ore by opencast method, the left out ore will be mined by u/g mining method, in due course after carrying out the required studies to assess the strata competency.

Life of Mine: The mine life of South Kaliapani lease is around 6 years at the proposed exploitation rate of 1.4 Mt of ROM ore per year w.e.f 2017-18 and considering proved ore reserves only.

Disposal of Sub grade mineral: The sub-grade material generated will be in the range of 10-30%Cr_2O_3 and will be stacked as external dumps at the ear marked places. A total of 1.81 Million tonnes of sub grade material @ 21.99% Cr_2O_3 will be generated up to the conceptual stage. The details of generation of sub grade materials is given in the table below.

(Sub grade generation upto Conceptual period)

Sub grade	
Qty., tonnes	Grade, % Cr_2O_3
1819708	21.99

The sub grade materials will be stacked at their respective demarcated places as shown in the plans. The stacks will be created in the form of terraces with its individual terrace height as 20 m.

Waste Disposal: The waste generated during the course of mining operations will be stacked as external dumps. All the lodes continue to exist almost vertically at deeper levels. The ultimate pit for band No. 1, 2 has been designed at -50 mRL & the ultimate pit for band 3, 4 has been designed at 58 mRL. The selection of the dump sites for external dumping is on the basis of following criteria.

- All dump sites have been located outside the mineralized zone beyond ultimate pit limit.
- Topography features have been taken into account, particularly in the context of water drainage.
- The DGMS permission under regulation 106(2)(b) of the Metalliferous Mines Regulations 1961.

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

The sequence of generation of waste materials is given in the table below.

(Waste generation upto Conceptual period)

Period	Qty., cu.m
Total	100880864

The total waste generated from the South Kaliapani lease is to the tune of 100.9 million cum, out of the above around 35.17 million cu.m of waste can be accommodated inside the South Kaliapani lease during the present plan period.

In future, either the mine has to resort back to underground method of mining or amalgamation of the lease with the adjoining leases belonging to the same owner will be done. On completion of the necessary prior formalities, necessary modification in the mining plan will be done subsequently.

The height & width of individual terrace will be 20 m with bank slope angle of 37° of individual lift for a total number of 3 lifts. The dumps will be compacted and afforested on the terraces as well as along the slopes after spreading a layer of top soil over it before rehabilitation. The location of these dumps is marked on conceptual plan. Afforestation proposed to be carried out over the dumps at the end of conceptual period. Dumps will be afforested to check against wash off and guarded with retaining walls at their toes along the lower contours. Following the retaining wall a garland drain will be developed for carrying water to the natural drainage system ultimately leading into the natural drainage pattern of the area. All the waste dumps will be rehabilitated on conceptual period by adequate plantation at the rate of 300 trees per hectare along the slopes as well as terraces so as to avoid any wash off. A total of 302500 saplings will be planted over the refuse dumps for their stabilization.

A summarized table indicating the details like waste generation & waste dumping location during the scheme period are given in table below.

Summary of material movement

Year	Band	Waste Dump Destination	Waste Dump Location
2017-18	I	WD1	West of existing Dump
	II & IV	WD2	East of existing Dump
2018-19	I	WD1	West of existing Dump
	II & IV	WD2	East of existing Dump
2019-20	I	WD2	West of existing Dump
	II & IV	WD2	East and West of existing Dump

A total of 1074450 m^3 of topsoil will be generated from the freshly broken area which will be utilized for concurrent afforestation over the dumps & also for avenue plantation due to very low shelf life of the lateritic soils. The phase-wise generation of topsoil is given in table below.

Top soil generation

Period	Top Soil Generation, In cu. m
Total	1074450

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

Exploration: There is proposal to drill 48 Nos. of boreholes with a drilling meterage of 10500 during this plan period. The details of the proposed boreholes is given in para 3.5.

Environmental monitoring: Noise, air, water and other environmental parameters will be monitored periodically to have a close check on the environmental pollution. Spraying of water on haul roads, dust arrester on drills, prevention of vibration by utilization of minimum quantity of explosive per delay, massive plantation along road and other areas will be taken up to restrict the nuisance caused by mining activities. At the end of conceptual period the area will have mined out voids surrounded from all the sides by plantation, afforested dumps and dense avenue plantation. A total of 46650 saplings will be planted over an area of 174.99 Ha. The land use pattern at the end of conceptual period on the basis of current level of exploration data with proposed exploitation by opencast method only is given below in Table. The conceptual plan is shown in Plate No.-7 and the conceptual sections are shown in Plate No.-7A

Land use in stages upto conceptual stage

S.No	Heads	Area, (Ha.)		
		Existing land use	Land use at the end of 2019-20	Conceptual land use
1	Area under mining	106.00	205.18	315.74
2	Overburden/ dump	95.31	157.10	174.99
3	Mineral storage/sub grade ore	53.31	60.09	13.196
4	Infrastructure (Workshop, admn. Building ETP & COBP)	13.69	22.13	15.86
5	Roads	8.65	8.67	0.577
6	Tailing pond	0.00	20	20
7	Safety Zone	(5.578) *	(5.578) *	5.578
8	Untouched tenant land	(6.516) *	(6.516) *	6.516
		276.96	473.17	552.457

*Note: Excluding * as shown in the above table.*

As per the permission letter from DGMS under rule 106(2)(b) (copy enclosed as Annexure-21) the mine slopes are to kept at 25 degrees. Moreover, the minimum distance of the waste dumps from the edge of the mine workings is 100m and accordingly all future proposals have been made. All the dumps have also to be designed at an overall slope of below 27 degrees. Therefore the land usage is a bit more.

Studies will be conducted for underground development of the ore deposit. All necessary studies required for developing an underground mine in soft strata will be carried out followed with acquisition of permissions from the concerned statutory agencies for opening the mine by underground method. The quantum of underground drilling required may also be modified as per the requirement.

The proposed Chrome Ore Beneficiation Plant (COBP) plant has to be in operational state till the end of life of Mine. As per the proposed amendment in EC, the proposed tailing pond is an integral extension of the COBP. The conceptual plan has been prepared on the basis of present level of ore body of Band-4. The same will be revised with deeper level of exploration of Band-4 and subsequently the re-handling of tailing will be proposed in future proposals, with revision of conceptual plan.

B. **UNDERGROUND MINING**

Not applicable

[Sunil Kr. Kar, Mining Engineer]
(Qualified Person)

[Abinash Kr. Sahu, Geologist]
(Qualified Person)

C. Extent of Mechanization

The summary of all the existing fleet of machinery is given below:-

S.No.	Nos.	Size / capacity	Machinery type	Purpose
1	3 Nos.	2.5 - 3.5 cu.m	Excavators	For loading of Ore & OB.
2	1 No.	150 mm	Drills	For drilling
3	50 Nos.	40t	Dumpers, 40t	For transportation of ore to Ore & sub-grade to respective stack yards, OB to dumps
4	1 no.	1.5-2.5 cu.m	Front end loader	For loading of blasted ore from stack yard to dumpers & rejects back to OB dump
5	6 nos.	375 hp	Dozer	For maintaining the working faces, drill faces, dumping areas etc.
6	2 nos.	234 hp	Grader	
7	4 nos.	12 kL	Water tanker	For suppression of dust over the haul roads
8	3 no.	12 kL	Diesel browser	For filling of diesel into track mounted equipment.
9	2 no.	-	Maintenance Van	For maintenance of the track mounted equipment at working faces itself.
10	3 no.	-	Transport van	
11	1 no.	14 t	Mobile crane	For maintenance of the HEMM viz. lifting up of the dump body, engines etc whenever required during maintenance.
12	1 no.	600cfm	Compressor	
13	1 no.		Ambulance	

It has been planned to operate the South Kaliapani chromite mines with the proposed fleet of mining machineries as given in table below.

Proposed Fleet of Major HEMM & Auxilliary Mining Equipment

HEMM	Proposed Fleet, Nos.
Hydraulic Excavator, 2.5-4.5 cu.m	13
Loader, 1.5 - 3 cu.m	5
Dumper, upto 30-50t	72
Drill, 115-150 mm	7
Compressor, 450cfm	12
Dozer, D-155 Equivalent (for mine/ dump/ stockpiles)	9
Explosive van, 1t	1
Water tanker, 12 KL	9
Ambulance	1

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

Dumper fleet calculation

distance, Km	2.5
Time per swing (cycle time) of shovel, sec	35
Loading time , sec	210
hauling time , sec	600
unloading time , sec	90
returning time , sec	450
spotting time , sec	60
dumper cycle time ,sec	1410
no. of dumpers	5.2
no. of dumpers per excavator	6
Total dumpers	60+12 (stand by) = 72

Loader Fleet Calculation

S.No.	Parameters	Ore
1	Purpose	For loading of ore (dispatch)
2	Annual running hours	3000
3	Productivity, tph	150
4	Production per m/c per year, Mt (2x3)	0.45
5	Max. handling, Mt	1.40
6	Loaders required to operate, Nos. (5/4)	3 Nos.

The comparison between existing fleet of machineries and proposed fleet is furnished in the table below

Requirement of machinery proposed for the period 2017-18 (01.01.2018 to 31.03.2018)

Machinery type	Proposed capacity
Hydraulic Excavator, 2.5-4.5 cu.m	28 Nos
Drill, 115-150 mm	13 Nos
Dumper, upto 30-50t	168 Nos.
Loader, 1.5 - 3 cu.m	5 Nos.
Dozer, Equivalent (for mine/ dump/ stockpiles)	9 Nos.
Water tanker, 12 KL	9 Nos.
Compressor, 600cfm	13 Nos.

Requirement of machinery proposed for the period 2018-19 to 2019-20

S.No.	Existing capacity			Proposed capacity	
	Machinery type	Size / capacity	Nos.	Machinery type	Nos.
1	Excavators	2.5 - 3.5 cu.m	3 Nos.	Hydraulic Excavator, 2.5-4.5 cu.m	13
2	Drills	150 mm	1 No.	Drill, 115-150 mm	7
3	Dumpers,	40t	50 Nos.	Dumper, upto 30-50t	72
4	Front end loader	1.5-2.5 cu.m	1 no.	Loader, 1.5 - 3 cu.m	5
5	Dozer	375 hp	6 nos.	Dozer	9
6.	Water tanker,	12 KL	1	Water tanker, 12 KL	9
7.	Compressor,	600cfm	1	Compressor, 600cfm	7

D. Blasting

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

The details of the calculations for major HEMM are given in tables below:-

Drilling Fleet Calculation

Drill diameter, mm	150
Height of bench , m	6
sub grade drilling @10%	0.6
Length of hole , m	6.6
burden, m	3.5
spacing , m	4
Volume of ore to be broken / hole, m3	92.4
volume of maximum excavation , m3	13,000,000
30% of exacation to be drilled	3900000
No. of holes to be drilled	42208
Meterage of drilling to be required, m	278571.4286
Speed of drill , m/hr	15
No. of working days	300
efficiency	80%
no. of shift	3
meterage of drilling per year	64800
No. of drills required	4.3
Total	**5+2 (stand by) =7**

Excavator calculation

Bucket capacity (m^3)	2.5-4.5
Time per swing (cycle time), sec	35
Fill factor	0.9
Swell factor	0.7
Production efficiency	0.9
Output/shovel/hour	262.44
Output/shovel/day	4723.92
Volume of maximum excavation , m3	13,000,000
Volume of maximum excavation/day, m3	43333.33
No. of excavators required	9.2
Total	**10+3 (stand by) =13**

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

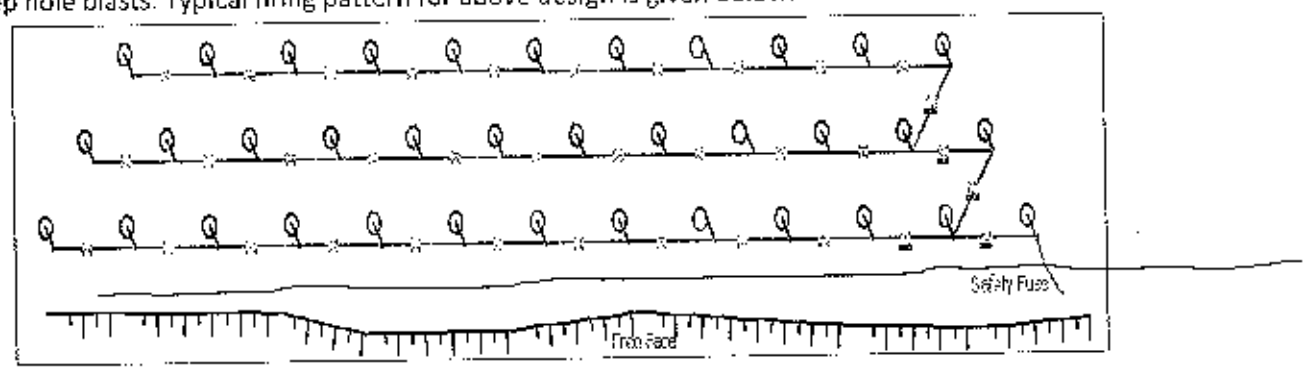
(Abinash Kr. Sahu, Geologist)
(Qualified Person)

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

The blast design configuration for South Kaliapani mines is given below:-

Broad parameters	Ore	Waste
Total excavation, tonnes	1400000	26000000
30% of the rock requires blasting	0.3	0.2
total excavation requiring blasting	420000	5200000
Drill diameter, mm	150	150
burden, m	3.5	3.5
spacing , m	4	4
Height of bench , m	6	6
Sub grade drilling @10%	0.6	0.6
Length of hole , m	6.6	6.6
Volume of ore to be broken / hole, m3	92.4	92.4
stemming	3	3
charge length	3.6	3.6
explosive density , gm/cc	1.1	1.1
loading density, kg/m	6	6
total explosive charge /hole	21.6	21.6
density ,tonnes/m3	3	2
yield/hole, tonne	277.2	184.8
total holes/year	1515	28138.52814
total no of holes blasted per day	13	234.4877345
amount of explosive blasted per day,kg	273	5064.935065
quantity of material blasted per day, tonnes	2917	36111.11111
powder factor , ton/kg	**10.7**	**7.1**
drilling pattern	staggered	
initiation system	electric detonator/DF/nonel/	
firing pattern	wide v-cut	
Delay interval	25/ 50 ms	

As the charge per delay is limited therefore there won't be any impact of vibrations induced due to deep hole blasts. Typical firing pattern for above design is given below.



NONEL is also being us ! occasionally in the mines in place of cord relays.

(Sunil Kr. Ka ining Engineer)
(Qua Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

b) Storage of explosives (like capacity and type of explosive magazine)

The magazine is located within Kalarangi lease and is valid upto 31.3.2020 and is licensed to store the following quantities:-

(i) Explosives	: 3 t
(ii) Detonating fuse	: 10000 m
(iii) Safety fuse	: 40000 m
(iv) Detonator	: 44000 Nos.

Apart from the above there is a provision of tripartite agreement with third party (named as Agency) for supply of explosive from his outside magazine to mines site by his approved type explosive van for blasting at Mines. The Magazine license in respect of the same is attached at Annexure 23

3.0 MINE DRAINAGE

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

Ground water table as monitoring in open dug wells monitored during the baseline data generation is around 6.1 m bgl during summer season & 2.11 m bgl during post monsoon season. The minimum level of water table is 122 mRL and maximum level of water table is 126 mRL as mentioned in approved EIA/EMP

b) Indicate maximum and minimum depth of Workings.

Maximum and minimum depth of workings of existing quarry, at the end of proposed scheme period is given below.

Depth	Existing Quarries	At the end of plan period i.e. 31.03.2020
Bottommost Bench RL	18.00 mRL	-38 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

The mine has a catchment area of 100 Ha. and the annual rainfall is around 1475mm average. Therefore the accumulation of water in the mine catchment areas will be around 147.5 thousand KL. Taking 10% loss of surface run offs and 10% ground precipitation, the net water accumulated within the mined out voids is around 118 thousand cu.m. In order to dewater the above accumulated water a total of 4 Nos. of centrifugal pumps have been installed with an average de-watering rate of 400 cu.m/ hr. depending upon an average availability of 3 pumps for around 15 hrs./ day.

At the end of this plan period, the mine will have a catchment area of 200 Ha. Considering the annual rainfall is around 1475mm average. Therefore the accumulation of water in the mine catchment areas will be around 295 thousand KL. Taking 10% loss of surface run offs and 10% ground precipitation, the net water accumulated within the mined out voids will be around 236 thousand cu.m. In order to dewater the above accumulated water a total of 8 Nos. (additional 4 nos) of centrifugal pumps will be required with an average de-watering rate of 400 cu.m/ hr. depending upon an average availability of 3 pumps for around 15 hrs./ day.

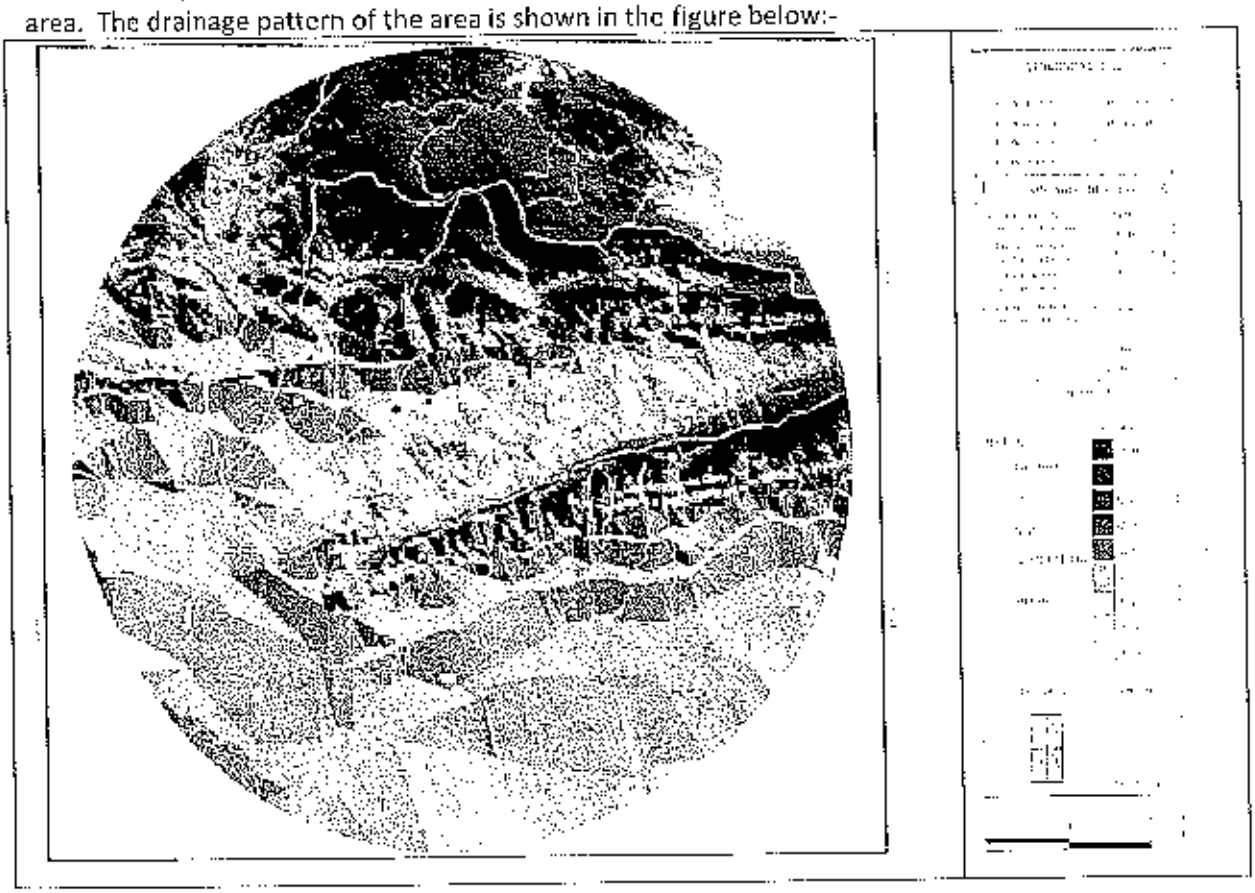
The accumulated mine water at D-quarry is being pumped out through a series of centrifugal pumps. The removed mine water is allowed to pass through an ETP. Similarly the mine water dewatered from the F-quarry is also allowed to pass through another ETP. However, garland drains have been provided to avert movement of water into the pit. Garland drains have also been provided around the dump. In the present setup ferrous sulphate and alum solution is blended in the ratio of 5: 1 and the mixed solution is then allowed to fall over the incoming mine water. Thereafter the mine water

is allowed to pass through a series of settling tanks in order to increase the retention time and ultimately discharged to the natural run off course. Approx. consumption of ferrous sulphate & alum per shift comes to around 150kg and 30kg respectively. The feasibility study completed by IIT, Kharagpur, in this regard is enclosed as Annexure -37. The same shall be established soon after we get the feasibility report as per the guide line of SPCB, Odisha Bhubaneswar. There is a contract with M/s Ramky for disposal of the generated sludge at CHSWS, Mangalpur.

The mine drainage plan has been shown in Plate-9 Environment Plan.

d) Describe regional and local drainage pattern. Also indicate annual rain fall, catchments area, and likely quantity of rain water to flow through the lease area, arrangement for arresting solid wash off etc.

The mine lease is located in southern part of funnel shaped Sukinda Valley which extends from east to west with the open end facing west. The northern part of the Sukinda Valley is marked by Daitari hill range which rises sharply from about 140 m above mean sea level to more than 600 mRL. There are peaks exceeding 800 mRL in Daitari hill range. At places Hills are marked by very steep slopes including bare rocky cliffs. The southern part of the valley is bounded by Mahagiri hill range, which also is very steep and rises to more than 600 mRL. In Mahagiri hill range also there are a few bare rocky cliffs. The hills are densely forested. The mine lease is between 132 m RL in the north and 217 m RL in the south-west and slopes from north to south. The principal drainage channel of the Sukinda valley is Damsal nala which flows from east to west and traverses towards north of the lease area. The drainage pattern of the area is shown in the figure below:-



The details of the rainfall, catchment area, pumping arrangements etc are given in para. 3.0 (c) above.

(Sunil Kr. Kar, Mining Engineer)
[Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

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

a) Indicate briefly the nature and quantity of top soil, overburden / waste and Mineral Reject to be disposed off.

The strata encounterd in the lease area is soft in nature. The topsoil is of lateritic nature and the waste/overburden is mainly limonitic in nature.

The mine waste and sub grade mineral generated during the course of mining operations will be handled separately. These materials will be dumped at their respective ear marked places inside South Kaliapani lease only. The dumps shall be formed by retreating method of dumping so as to facilitate early reclamation. The top soil generated will be reused for afforetation and preparation mine road.

The year-wise quantity of top soil, overburden/wastes proposed to be generated during the proposed plan period is given below.

Year	Top Soil (cu. m)		Waste (OB/SB/IB)		Mineral reject	
	Reuse/ Spreading	Storage	Backfilling	Storage	Blending	Beneficiation
2017-18	762390	Nil	Nil	10328625	24617	Nil
2018-19	566147	Nil	Nil	11967194	380702	Nil
2019-20	571230	Nil	Nil	12871763	72453	Nil

b) The proposed dumping ground within the lease area be proved for presence or absence of mineral and be outside the UPL unless simultaneous backfilling is proposed or purely temporary dumping for a short period is proposed in mineralized area with technical constraints & justification.

Two numbers of external dumps are proposed in the present plan period. The summary of material movement and the location and extent of the dumps are given in the table below

Year	Band	Waste Dump Destination	Waste Dump Location	Extent (Local Grid)
2017-18	I	WD1	West of existing Dump	950N-1600N/-100E-1200E
	II & IV	WD2	East of existing Dump	1100N-2350N/1350E-2050E
2018-19	I	WD1	West of existing Dump	950N-1600N/-100E-1200E
	II & IV	WD2	East of existing Dump	1100N-2350N/1350E-2050E
2019-20	I	WD2	West of existing Dump	1100N-2350N/1350E-2050E
	II & IV	WD2	East and West of existing Dump	1100N-2350N/1350E-2050E

The details of existing overburden dump is given in the table below

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

Dump	Extent (Local grid)	Top /bottom (mRL)	Designated capacity (cu m)	Present capacity (cu m)	Remaining quantity (cu m)
WD1	-100E to 1400E/900N TO 1750N	136.19/273.481	57938592	45523169	12415423

The details of existing sub grade dump is given in the table below

Dump	Extent (Local grid)	Top /bottom (mRL)	Designated capacity (cu m)	Present capacity (cu m)	Remaining quantity (cum)
SGD1	500E to 915E/1630N TO 1835N	162.84/199.8	890499.69	890499.69	
SGD2	1382E to 1555E/727N TO 848N	170.3/172.4	12070	1000.085	11069

The location of proposed dumps have been designed outside the ultimate pit limit.

The generated waste will be disposed off at its ear marked place and the same has been shown in Plate No.-8. The area will be first explored for the underneath ore band, if any. Proposal for the same has already been made on the chapter of exploration. If the area is falling over tenant/ revenue land, surface right permission of the said area will be taken. A parapet wall & garland drain will be constructed all around the periphery. The dump will extend to its periphery first and then retreat backwards in order to facilitate early reclamation of atleast its slopes.

The location of dumps are outside the ultimate pit limit. Two numbers of external dumps are proposed in the present plan period. The summary of material movement and the location and extent of the dumps are given in the table below

Year	Band	Waste Dump Destination	Waste Dump Location	Extent (Local Grid)
2017-18	I	WD1	West of existing Dump	950N-1600N/-100E-1200E
	II & IV	WD2	East of existing Dump	1100N-2350N/1350E-2050E
2018-19	I	WD1	West of existing Dump	950N-1600N/-100E-1200E
	II & IV	WD2	East of existing Dump	1100N-2350N/1350E-2050E
2019-20	I	WD2	West of existing Dump	1100N-2350N/1350E-2050E
	II & IV	WD2	East and West of existing Dump	1100N-2350N/1350E-2050E

c) **Attach a note indicating the manner of disposal of waste, configuration and sequence of year wise build up of dumps along with the proposals for protective measures.**

All the dumps will be formed be retreating method of dumping, so as to facilitate early reclamation. The height of the individual terrace will be 20 m. The bank slope angle considered for designing the dump is 37 degrees and the overall slope angle of the dumps are below 25 degrees. The capacity of the individual dumps & quantity proposed to be dumped are given below:-

[Sunil Kr. Kar, Mining Engineer]
[Qualified Person]

(Abinash Kr. Sahu, Geologist)
[Qualified Person]

Year	Waste Dump No.	Qty. to be dumped in m^3	Dump Bottom RL	Dump Top RL	Total height	Terrace height
2017-18	WD1	5560250	130-140 (varying)	190	50m	1st terrace: 20m 2nd terrace: 20m 3rd terrace: 10m
	WD2	4768375	130-165 (varying)	174	40m	1st terrace: 20m 2nd terrace: 20m
2018-19	WD1	6855173	190	310	120m	3rd terrace: 20m 4th terrace: 20m 5th terrace: 20m 6th terrace: 20m 7th terrace: 20m 8th terrace: 20m
	WD2	5112021	174	194	40m	3rd terrace: 20m
2019-20	WD2	12871763	194	270	76m	4th terrace: 20m 5th terrace: 20m 6th terrace: 16m

A systematic study will be undertaken from a institute of repute for slope stability for dumping of OB up to the proposed height. The recommendation of the study will be implemented for safe and scientific manner of waste dumping.

The details of the protective measures envisaged for the dump with year wise proposed reclamation/ rehabilitation measures are given below:-

Year	Waste Dump No.	Length of garland drain, m	Length of retaining wall, m	No. of settling pits
2017-18	WD1	800	800	1
	WD2	800	800	1
2018-19	WD1	800	800	1
	WD2	800	800	1
2019-20	WD1	900	900	1
	WD2	1000	1000	1
Total	WD1	2500	2500	3
	WD2	2600	2600	3

Depending upon the drainage pattern of the area where the dump is located, retaining walls, garland drain with settling tanks will be provided in all the dumps. The year wise plans & sections of all the dumps are given in drawings No. PLATE NO.-8A & 8B. The garland drains will be dug around 1 m beneath the adjoining contour level at the lower peripheral areas of the dump. The width of the drains shall be around 1.5 m. The settling tanks will be located at the outlet of the garland drains. It will of around 3m length with three compartments of around 1m width to arrest the suspended solids followed with the chamber to arrest any oil particles. The last chamber shall contain the clean water which will be ultimately discharged. The retaining walls will be of 1m height and 1m width at the top and around 1.2m at the base. The retaining wall shall be made of RCC/ crated bounder wall as per requirement. The design detail of the retaining wall and settling tank is enclosed as Annexure-39.

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

The protective measures constructed for the waste dump shall be periodically subjected to repair work for maintenance of the same in good condition.

Besides, it is also proposed to stabilize the existing dead waste dumps with bio-degradable coir geo textile made of coconut fibre or husk. It facilitates new vegetation by absorbing water and preventing topsoil from drying out. Seeding or plantation is done after blanketing the coir matting on the dump slope. They provide dump soil good support allowing natural vegetation to become established. The Figure 3.1 shows the typical coir matting in dump slopes. The Figure 3.2 shows the process of coir matt blanketing on the dump slopes. First the dump soil slopes are maintained properly. The seeding is done next. After that the coir matt are placed on the dump with proper anchor. Then the seedling will soon cover the dump with vegetation which stabilizes the dump mats and sowing seeds.

Figure 3.1 : Typical coir matting in dump slopes

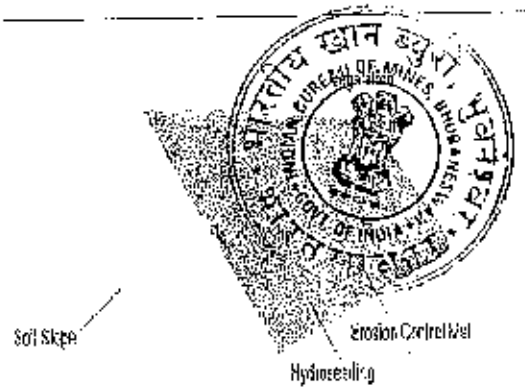


Figure 3.2 : process of coir matt blanketing on the dump slopes

Figure 3.2a : Vegetation on the dump slopes

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

5.0 USE OF MINERAL AND MINERAL REJECT

a) Describe briefly the requirement of end-use industry specifically in terms of physical and chemical composition.

The ore mined will be supplied in the open market to the manufacturers of ferro chrome. The physical & chemical specifications required by the buyers are given below:-

Fines (-10mm), Chips (+10-25mm) & Lumpy (+25-100mm)
Grade- +40%cr2o3

b) Give brief requirement of intermediate industries involved in up-gradation of mineral before its end-use.

No intermediate industry involved for up-gradation of mineral.

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

The ore mined will be supplied in the open market to the manufacturers of ferro chrome. The physical & chemical specifications required by the buyers are given below:-

Fines (-10mm), Chips(+10-25mm) & Lumps (+25-100mm)
Grade- +40 cr_2o_3

d) Indicate precise physical and chemical specification stipulated by buyers

The physical & chemical specifications required by the buyers are given below:-

Fines (-10mm), Chips (+10-25mm) & Lumps (+25-100mm)
Grade-+ 40 % Cr_2O_3

d) Give detail of processes adopted to upgrade the ROM to suit the user requirements.

The ROM recovered are configured into three parts, direct ore (+40% cr_2o_3), sub grade ore (+10- 40 % cr_2o_3) and rejects (below 10% cr_2o_3). The process adopted to upgrade the subgrade ore is by beneficiation process at COBP.

e) The useable mineral recovered from ROM may not be directly used in any industry and may need intermediate process to suit the user industry in terms of physical and chemical compositions.

The ROM recovered are configured into three parts, direct ore (+40% cr_2o_3), sub grade ore (+10-40% cr_2o_3) and rejects (below 10% cr_2o_3). The direct ore is directly sold in market. The subgrade ore is upgraded in the Chrome ore beneficiation plant(COBP) and the concentrates produced are sold in the market, the subgrade ore will be stacked and the rejects will be disposed in external dumps.

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

6.0 PROCESSING OF ROM AND MINERAL REJECT

a) If processing / beneficiation of the ROM or Mineral Reject is planned to be conducted, briefly describe nature of processing / beneficiation. This may indicate size and grade of feed material and concentrate (finished marketable product), recovery etc.

The existing Chrome Ore Beneficiation (COB) Plant of Odisha Mining Corporation Limited at South Kaliapani, Jajpur district, Odisha, was commissioned in April 1995 to produce saleable concentrates by upgrading the beneficiable sub- grade ore. The plant was designed to treat annually 150,000 tons (dry basis) of ore analyzing about 33% Cr_2O_3 and produce coarse and fine concentrates with 50-52% and 51-53% Cr_2O_3 content respectively. The design parameters were developed based on beneficiation study carried out at the mineral processing laboratory of Bhaba Atomic Research Centre (BARC), Hyderabad.

In the plant, the feed material crushed to 18mm, is wet screened at 1mm. The screen oversize is ground to D80 150µm/d100 300µm in close circuit operation with a hydro-cyclone. The composite product comprising cyclone underflow and screen undersize material is de-slimed at about 20-30µm in a cluster of hydro-cyclones. The de-slimed product obtained as hydro-cyclone underflow is treated in hydro-sizer, a multi-compartment teeter-bed separator (TBS). The top size of +300µm from the first compartment of the hydro-sizer is recycled to the grinding mill. The coarse fraction obtained from the 2nd to 5th compartment is the final product of 46-48% Cr_2O_3. The fines obtained from 6th to 9th compartment product of the hydro-sizer and analyzing about 38-40% Cr_2O_3 was to be treated in Bartles Mosley Separator (BMS) for production of fine concentrate. However, the BMS could not be made to work properly and hence, for some recovery of the fines material, OMC provided hydro-cyclones in its place. Both sand and fine concentrates are dewatered in pan filters and stacked in ground stockpile. The original flow sheet is shown in the next page to follow:-

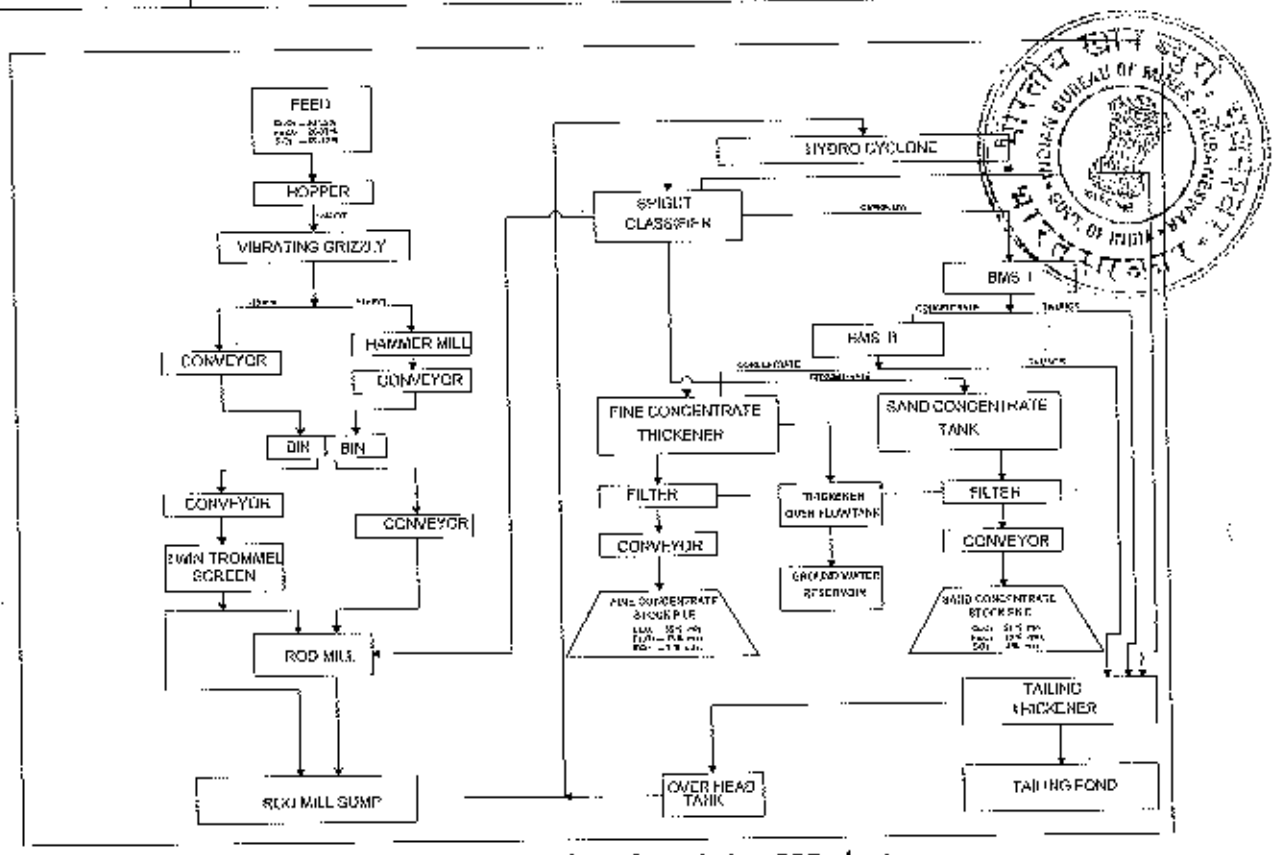
Modification work was required in this COB plant to enable attainment of desired grade of product (50-52 % Cr_2O_3) with optimum recovery in coarse and fine concentrates. For this purpose, open circuit operation of the rod mill is planned to be converted to close circuit operation, as per the original flow-sheet, by replacing the existing cyclone with a suitable cyclone. This step is envisaged to obtain the ground product in a controlled size of d80 150µm required for a reasonable degree of liberation. In addition, the coarse product from 2nd to 5th compartment of the Hydro-sizer, which is collected in the coarse product sump, will be pumped to a bank of twin-start coarse spirals. The concentrate from these spirals will be collected in a new sump, from where it will be pumped to the existing coarse concentrate filter to obtain the desired coarse concentrate product. The tailings from these spirals will be collected in the existing tailings sump. The flow sheet indicating the material & water balance of the COBP alongwith the modifications proposed in the existing COBP is enclosed as Annexure – 32.

Description of the New Chrome Ore Beneficiation (COB) Plant:

The new COBP is proposed to come in the future. The run of mine chrome ore will be treated in the beneficiation plant to produce concentrates. The beneficiation plant tailings will be discharged into a tailings pond. The friable ferruginous type sub grade ore received from nearby South Kaliapani and Sukrangi mines will be used as feed for the proposed beneficiation plant to produce composite concentrate of 72,000 tons (annually on dry basis) with 52% Cr_2O_3.

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)



Process Flow sheet for existing COB plant

The beneficiation plant will be located at a right angle orientation to the existing plant building and will consist of four major sections – (a) Crushing & storage section (b) Washing & grinding section (c) Concentration section and (d) Dewatering & stockpiling section. The chrome ore of -300mm size will be directly dumped into a hopper. The ore will be drawn out from the hopper to feed a vibrating grizzly to scalp out the -18mm fraction. The grizzly oversize will be fed to a hammer mill and the crushed and scalped product will be collected in a crushed ore Storage Bin.

The crushed ore will then be scrubbed in a drum scrubber and will be fed to a wet vibrating screen of 1mm aperture. The -1mm screen undersize will be cleaned in a spiral classifier and the rake classifier sand along with +1mm fraction obtained as screen oversize will be fed to a rod mill, in close circuit with a classifying hydro-cyclone for reducing feed ore to d80 size 150µm. Underflow from the classifying hydro-cyclone will be recycled to the rod mill. The ground product obtained as overflow of close circuit hydro-cyclone will be further treated in a de-sliming cyclones. Underflow of de-sliming hydro-cyclone will be fed to a hydro-sizer and overflow will be collected in the tailings sump. Overflow of spiral classifier will be fed to a set of hydro-cyclones followed by tabling for further processing.

Underflow of the de-sliming hydro-cyclones will be fed to a two (2) stage hydro-sizer and will be classified for obtaining coarse, medium and fine fractions. The stray plus 300 µm fraction obtained from this equipment will be re-circulated to rod mill by gravity for size reduction. The coarse product from hydro-sizer will be processed in spiral concentrator to obtain concentrate and tails. The concentrate will be collected in concentrate sump and tails from the same will be directly sent to tailings sump.

The medium fraction will be treated in spiral concentrators for further up-gradation. Concentrate thus produced will be collected in composite concentrate sump and the tails will be discharged. Middling from spiral concentrators will be reground for further liberation in a regrinding mill and, then treated in a pair of wet tables to obtain concentrate, middling and tailings fractions.

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(Qualified Person)

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(Qualified Person)

Concentrate and middling fractions will be collected in the composite concentrate sump, when the ore from South Kaliapani mine is being treated. While treating the ore from Sukrangi mine, only concentrate will be discharged to composite concentrate sump and the middling fraction will be diverted to the tailings sump.

After de-sliming with hydro-cyclones, fine fraction and overflow of hydro-sizer will be treated in a spiral concentrator. While treating the ore form Sukrangi mine, the concentrate will be transported to the composite concentrate sump and the middling fraction with tailings will be sent to the tailings sump. During, the processing of South Kaliapani ore, the concentrate and middling fraction will be collected in the composite concentrate sump and the tailings will be collected in the tailing sump. The overflow of the spiral classifier will be treated in de-sliming hydro-cyclones. The overflow of the hydro-cyclones will be directly fed to the tailing sump and the underflow of the same will be treated in a pair of wet vibrating tables. The concentrate and tailings will be collected in the concentrate sump and tailings sump respectively. Composite concentrate and tailing from the respective sump will be processed for dewatering.

Concentrate will be pumped from concentrate sump to a concentrate thickener and thickened concentrate slurry containing about 50 per cent solid will be fed by thickener underflow pumps to a horizontal pan filter. The filter cake obtained from the filter will be delivered to ground stockpiles through belt conveyor. The filtrate will be collected in a RCC tank located adjacent to the thickener, along with thickener overflow water. Water from this tank will be pumped to a ground water storage tank to recycle to the system.

Tails from tailings sump will be pumped to a tailings thickener. Water recovered from tailings thickener will be recycled to the plant and thickened tailings will be pumped to tailings pond.

The flow sheet indicating the material & water balance for the proposed process is enclosed as Annexure – 33 & 34

b) Give a material balance chart with a flow sheet or schematic diagram of the processing procedure indicating feed, product, recovery, and its grade at each stage of processing.

The existing Chrome ore Beneficiation (COB) Plan of Odisha Mining Corporation Limited at South Kaliapani, Jajpur district, Odisha, was commissioned in April 1995 to produce saleable concentrates by upgrading the low-grade ore. The plant was designed to treat annually 150,000 tons (dry basis) of ore analyzing about 33% Cr_2O_3 and produce coarse and fine concentrate with 50-52% and 51-53% Cr_2O_3 content respectively. The design parameters were developed based on beneficiation study carried out at the mineral processing laboratory of Bhaba Atomic Research Centre (BARC), Hyderabad. In the plant, the feed material crushed to 18mm, is wet screened at 1mm. The screen oversize is ground to D80 210pm/d100 300pm in close circuit operation with a hydrocyclone.

The composite product comprising cyclone underflow and screen undersize material is de-slimed at about 10pm in a cluster of hydro-cyclones. The de-slimed product obtained as hydro-cyclone underflow is treated in hydro -sizer, a multi-compartment teeter-bed separator (TBS). The top size of +300pm from the first compartment of the hydro-sizer is recycled to the grinding mill. The coarse fraction obtained from the 2nd to 5th compartment is the final product of 46-48% Cr_2O_3. The fines obtained from 6th to 9th compartment product of the hydro-sizer and analyzing about 38-40% Cr_2O_3 was to be treated in Bartles Mosley Separtor (BMS)for production of fine concentrate. However, the BMS could not be made to work properly and hence, for some recovery of the fines material, OMC provided hydro-cyclones in its place. Both sand and fine concentrates are dewatered in pan filters and stacked in ground stockpile. The circuit of the plant could produce concentrate at about 68% recovery.

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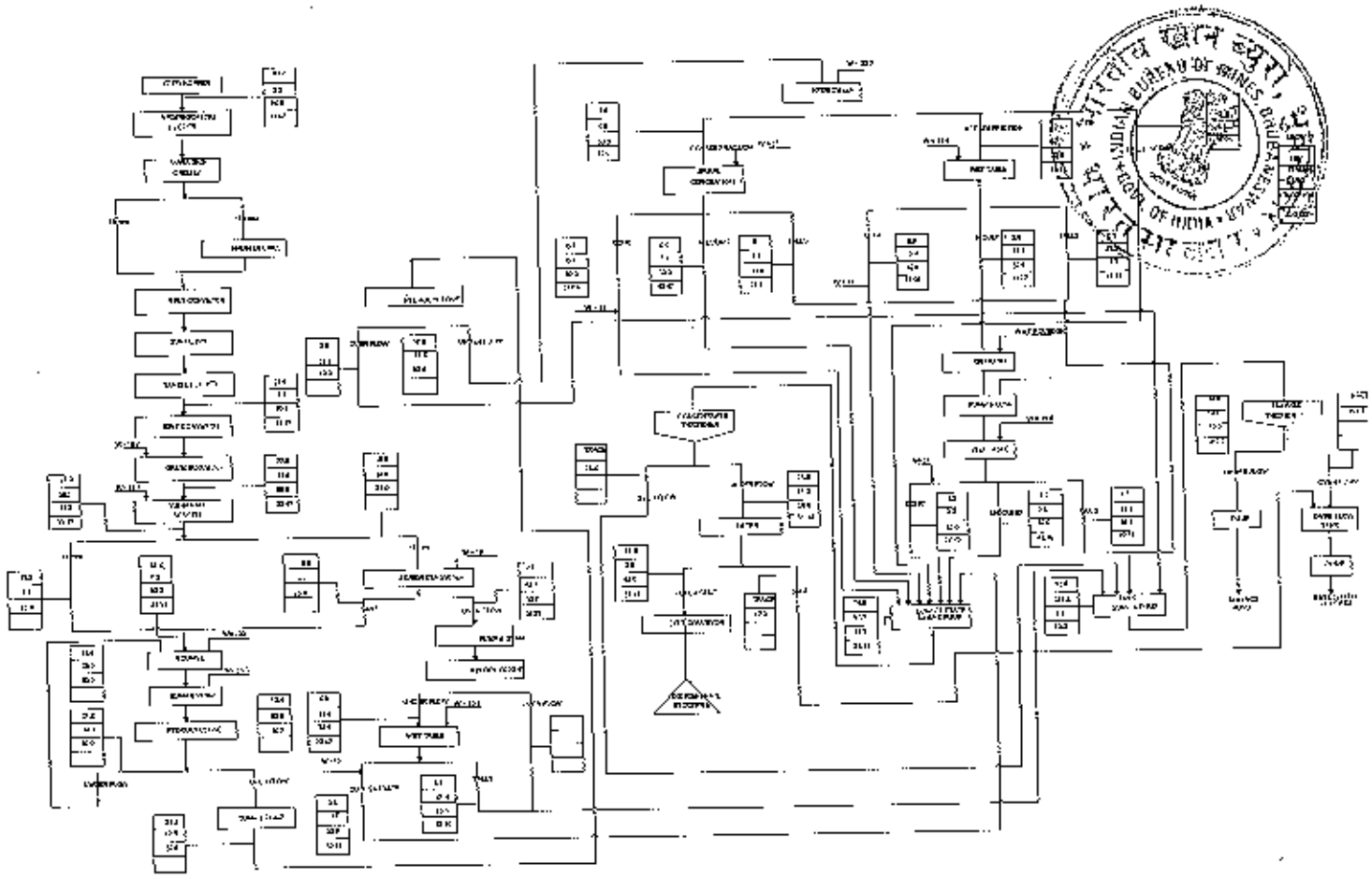
(Qualified Person)



Water/Material balance chart of existing COBP

Modification work was required in this COB plant to enable attainment of desired grade of product (50-52% Cr_2O_3) with optimum recovery in coarse fine concentrates. For this purpose , open circuit operation of the rod mill is planned to be converted to close circuit operation , as per the original flow-sheet, by replacing the existing cyclone overflow will be directed to sump pump and cyclone underflow will be discharged in to the hydrosizer by gravity. The close circuit hydrosizer underflow will be discharged in to the mill for further size reduction. The sizer overflow will be directed to same sump pump where hydrocyclone overflow is collected.From the sump slurry with-150pm will be pumped to existing dorrocione for disliming the underflow of dorrocione will be fed to the jet sizer (existing hydrosizer) and the coarse product of the sizer will be fed to the coarse spiral concentrator, the medium fraction will be fed to fine spiral concentrate from the rougher spiral will be fed to cleaned spiral and the concentrate from the cleaner will be collected in fines spiral sump. Coarse spiral product will be collected in a separate sump. The overflow from the dorrocione, the tailing from coarse spiral, rougher spiral and the tailing from the cleaner will be directed to existing tailing thickener and will be discharged in to tailing dam. The coarse concentrate and fine concentrate thus obtained will be filtered in the existing coarse and fine concentrate filters respectively.The modified circuit has been designed by M/s MBE-CMT, Kolkata to process ROM of 30-35% Cr_2O_3 at 28TPH to produce about 15 TPH of concentrate of about 52% Cr2O3. The flow sheet indicating the material & water balance of the COBP alongwith the modifications proposed in the existing COBP is enclosed as Annexure – 32.

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(Qualified Person)

c) Explain the disposal method for tailings or reject from the processing plant.

The tailings were being discharged through a pipeline and the same has been shown in the surface plan.

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.

As per the earlier concept, the basic engg. document prepared proposed for disposal of tailings partly as wet tails & dry tails. The same was incorporated in the environment clearance accorded to the lessee by MoEF. But while implementation of the same it was arrived that the engineering design is not commercially feasible. Accordingly, the concept was modified and the same was incorporated in the last approved SOM. In the new tailing pond, proposed to be constructed within the south kaliapani lease, a HDPE lining will be provided to avoid infiltration of water below ground. On the basis of all the above, steps are being taken by OMC to amend the EC conditions from MoEF & CC,GoI.

OMC has already taken action for treatment of tailings generated from the existing COB Plant along with the tailings from the proposed new COB plant under construction. Accordingly a site, adjacent to the F-Quarry of south Kaliapani mines of size about 1000m x 200m has been identified for construction of a tailing pond along with ETP. The site survey and soil investigation works have been completed under the technical guidance of MECON, Ranchi the technical consultant for this work. The basic engineering work of this proposed tailing pond construction work has been completed by MECON. The pond will be designed with HDPE liner all along the pond bottom and U/S slopes to prevent contamination of harmful slurry with ground water. It will also be designed to meet the statutory norm specifying the limit of total chromium and hexavalent chromium content of effluent water when discharged into surface water along with other parameters. It has been envisaged that the proposed pond will be of two compartment design, each having a life cycle of 3.8 yrs having facility for reclamation. The location of the proposed tailing pond has been finalized on the basis of the following assumptions:-

- Beyond the ultimate pit limit of Quarry – F (Band – IV).
- Topography of the area
- Minimal risk to the local community / inhabitants

Application submitted by OMC for amendment of EC in respect of South Kaliapani Mines regarding shifting of tailing pond has been discussed at the expert appraisal committee. The matter is being pursued with MoEF & CC,GoI.The information sought by MoEF & CC,GoI has been submitted by Chief Wild life Warden & ERO,Bhubaneswar. It is expected the amendment of EC will be obtained very soon. The forest clearance over the entire forest area has been obtained from MoEF & CC,GoI & the same has been handed over by the Forest dept.,GoO for mining & allied activites. The Agency for construction of tailing pond along with ETP and slurry handling has been finalized through open tender system. The work will be awarded after obtaining amendment of EC with time period for completion of work as 12 months. The existing COB plant is non-operational due to non-availability of tailing pond & after completion of tailing pond the COB plant will be operated.

Generation of tailings:

The throughput capacity of the existing COBP is 3,24,000 MT and that of the proposed COBP adjoining to the existing one is 1,50,000 MT. Therefore a total 4,74,000 MT of throughput will generate 2,40,000 MT of tailings per annum. The details are as follows:

Sl.No.	Type of material	Existing (MT)	Proposed (MT)	Total (MT)
1	Throughput (30-35%Cr2O3)	3,24,000	1,50,000	4,74,000
2	Concentrate (+48-50% Cr2O3)	1,64,000	70,000	2,34,000
3	Tailing (18-20% Cr2O3)	1,60,000	80,000	2,40,000

- Rate of Tailing Generation: 2,40,000 MT
- Thickened slurry disposal (TSD) having 60% solid and 40% water will be adopted.
- Saturated unit weight of tailings: 1.8 gm/cc
- Volume of the settled sediment: 1, 78,475 m3/yr
- Specific Gravity of the tailing slurry: 2.72

Tailing Pond:

- There will be a two pond system separated by an embankment.
- 1 mm HDPE liner will be provided all along pond bottom and u/s slopes.
- Total tailing generation : 1,60,000 ton/ year.
- Total area of tailing pond is 1000m X 200m = 2,00,000 m2 (i.e. 20 ha)
- Rainfall intensity : 82.37 mm/hr.
- Specific Gravity -- Slurry : 1.3 to 1.4 ; Solids : 2.7
- Topography: Max: 206 mRL and Min: 172 mRL
- Levels:
- Pond-1 : Top RL : 189.5 m; Bottom RL : 179 m
- Pond-2 : Top RL : 183.5 m; Bottom RM : 173 m
- Free board : 1.5 m
- Overflow of tailing pond will go to Effluent Treatment Plant (ETP) by gravity
- Treated water from ETP will be collected and will be pumped back to COBP.

e) Specify quantity and type of chemicals if any to be used in the processing plant.

The accumulated mine water at D-quarry is being pumped out through a series of centrifugal pumps. The removed mine water is allowed to pass through an ETP. Similarly the mine water dewatered from the F-quarry is also allowed to pass through another ETP. However, garland drains have been provided to avert movement of water into the pit. Garland drains have also been provided around the dump. In the present setup ferrous sulphate and alum solution is blended in the ratio of 5:1 and the mixed solution is then allowed to fall over the incoming mine water. Thereafter the mine water is allowed to pass through a series of settling tanks in order to increase the retention time and ultimately discharged to the natural run off course. The feasibility study completed by IIT, Kharagpur, in this regard is enclosed as Annexure -37. The same shall be established soon after we get the feasibility report as per the guide line of SPCB, Odisha Bhubaneswar.

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

Approx. consumption of ferrous sulphate & alum per shift comes to around 150kg and 30kg respectively.

g) Indicate quantity (cum per day) of water required for mining and processing and sources of supply of water, disposal of water and extent of recycling. Water balance chart may be given.

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

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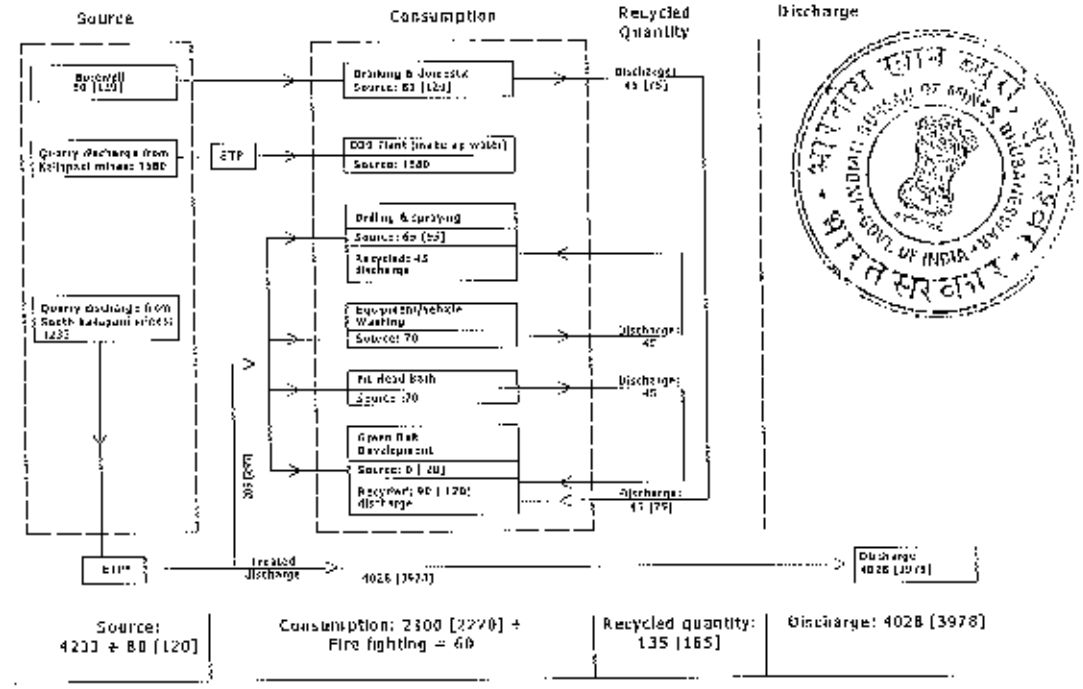
(Qualified Person)

Water requirement for the project in expansion phase is given the following table

Activities	Avg. demand (m^3/d)	Peak demand (m^3/d)
Mining operation		
Drilling & spraying	50	65
Dust suppression	60	75
Equipment / vehicle washing	70	70
Pit head bath	70	70
Plant operation		
Make up water requirement	1680	1680
Common facilities		
Green belt	90	140
Drinking water requirement at mine site and Colony	80	120
Total	2100	2220

The water balance chart is given below

* Part of mine discharge water from South Kaliapani mine will be treated in adjacent Kaliapani lease of OMCL



1. Figures are in m^3/d
2. Figures outside [ ] corresponds to average daily water demand.
3. Figures within [ ] corresponds to daily demand in peak season. [ ] values are indicated only when peak demand is different than average demand; Otherwise daily demand in peak season and average daily demand should be taken as equal.

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

7.0 OTHER

a) Site Services

Basic infrastructure is available in the mine to facilitate the workings. They are mine offices, workshop, garage, explosives magazine, rest shelter, first aid station, site store, V.T. centre, Time office, Canteen, laboratory, etc.

Electric Supply

The power requirement for the proposed expansion of the plant has been estimated as 2.76 x 106 kWH.

Magazine

The magazine is located within Kalarangi lease and is valid upto 31.3.2020 and is licensed to store the following quantities:-

(i) Explosives : 3 t
(ii) Detonating fuse : 10000 m
(iii) Safety fuse : 40000 m
(iv) Detonator : 44000 Nos.

Apart from the above there is a provision of tripartite agreement with third party (named as Agency) for supply of explosive from his outside magazine to mines site by his approved type explosive van for blasting at Mines.

b) Employment Potential:

Considering the statutory requirement and requirement of various operational departments the estimated manpower requirement is given in table below.

Manpower requirement

S. No.	Position	Numbers
1	Graduate Mining Engineer	2
2	Mines Manager	1
3	Asst. Manager	4
4	Geologist	1
5	Mines Foreman	10
6	Mining Mate	15
7	Blaster	3
8	Blasting Crew	8
9	Surveyor	1
10	Doctor	2
11	Magazine Keeper	1
12	Register Keeper	5
13	Clerical and supervisory	29
14	Attendant	40
15	Workers in workshop, plant etc	665
16	Security	13
17	Others	128
18	Staff Strength of COBP	50

Already one graduate mining engineer & one geologist has been appointed for the South Kaliapani mines as Mining Engr. & Geologist under rule 55 of MCDR 2017 meeting the prescribed qualifications i.e. Graduation in Mining Engg. with 5 years of experience in supervisory capacity & Post graduation in Geology with 5 years of professional experience respectively.

(Sunil Kr. Kar, Mining Engineer)
(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

8.0 PROGRESSIVE MINE CLOSURE PLAN UNDER RULE 23 OF MCDR 2017

8.1 Environment Base line information:

The present landuse, at the end of scheme period & conceptual stage is given in the table below:

S.No	Heads	Area, (Ha.)		
		Existing land use	Land use at the end of 2019-20	Conceptual land use
1	Area under mining	106.00	205.18	315.74
2	Overburden/ dump	95.31	157.10	174.99
3	Mineral storage/sub grade ore	53.31	60.09	13.196
4	Infrastructure (Workshop, admn. Building ETP & COBP)	13.69	22.13	15.86
5	Roads	8.65	8.67	0.577
6	Tailing pond	0.00	20	20
7	Safety Zone	(5.578) *	(5.578) *	5.578
8	Untouched tenant land	(6.516) *	(6.516) *	(6.516)
		276.96	473.17	552.457

*Note: Excluding * as shown in the above table.*

Water regime

As discussed under 3.2 the leaschold area being in the open mouth of funnel shaped valley (Gukinda Valley), several seasonal and perennial channels flow down from the Daitari hill range and Mahagiri Hill range to join the Damsal Nala. A few of the drainage channels emerging from Mahagiri hill range flow north and north-west through the South Kaliapani Mine Lease to join the Damsal Nala

Quality of air, water and ambient noise level

The summarized environmental monitoring report for half year ending 31.12.2017 has been enclosed as Annexure-20. The month wise environmental monitoring reports for last one year has been enclosed as Annexure-20. The location details and schedule of environmental monitoring are given below

Air Monitoring

Monitoring was carried out for Particulate Matter (PM2.5), Particulate Matter (PM10), Sulphur Dioxide (SO2), Oxides of Nitrogen (NOX) and Carbon Monoxide (CO). The PM10 &PM2.5 was monitored for 24 hourly, while SO2 and NOX were monitored on 4 hourly bases for 24 hours at each sampling location and CO was monitored using the CO Monitor for 1 hr. in a day in each monitoring station twice in a week, for a month. The sampling and analysis of ambient air quality was carried out as per the approved procedures by CPCB.

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(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

Ambient Air Quality Monitoring Stations

Sl. No.	Location	Station Code	Coordinates	
			Latitude	Longitude
1	Near Chirigunia Colony	A1	21°02'28.68"N	85°45'28.62" E
2	Near OMC Office	A2	21°02'1.09" N	85°45'5.46"E
3	Near COB Plant (Administrative Block)	A3	21°02'34.74"N	85°47'32.09"E
4	Near KaliapaniVillage	A4	21°02'53.66" N	85°47'19.42"E
5	Near Pump house	A5	21°02'15.06" N	85°46'4.58"E
6	Near Office & RS	A6	21°02'31.35" N	85°45'4.02"E

Fugitive Emissions Monitoring Stations

Sl. No.	Location	Station Code	Coordinates	
			Latitude	Longitude
1	Near F Quarry Haul Road	FE1	21°02'23.26" N	85°45'3.07" E
2	Near F Quarry Pump House	FE2	21°02'24.15" N	85°45'4.97" E
3	Near D Quarry Haul Road	FE3	21°02'41.82" N	85°46'46.28" E
4	D quarry near Welsh bridge	FE4	21°02'50.22" N	85°46'48.26" E
5	COB plant near Crusher	FE5	21°02'35.1" N	85°47'[illegible] E
6	COB plant near Storage Bin	FE6	21°02'35.16" N	[illegible]

Noise Monitoring

The monitoring of noise level was carried out at specified locations. Ambient Noise Levels were recorded at hourly intervals for 24 hours. And in case of Work zone, noise monitoring was carried out at hourly intervals for 08 hours.

Ambient Noise Monitoring Locations

Sl. No.	Location	Station Code	Coordinates	
			Latitude	Longitude
1	Near Chirigunia Colony	N1	21°02'28.68"N	85°45'28.62" E
2	Near OMC Office	N2	21°02'1.09" N	85°45'5.46"E
3	Near COB Plant (Administrative Block)	N3	21°02'34.74"N	85°47'32.09"E
4	Near Kaliapani Village	N4	21°02'53.66" N	85°47'19.42"E
5	Near Pump house	N5	21°02'15.06" N	85°46'4.58"E
6	Near Office & RS	N6	21°02'31.35" N	85°45'4.02"E
	Work zone Noise Level			
7	Quarry – D (within 30 mtrs.)	N7	21°02'15.9" N	85°46'49.44"E
8	Quarry – F (within 30 mtrs.)	N8	21°02'25.02" N	85°45'5.19"E
9	COB Plant (within 30 mtrs.)	N9	21°02'36.12" N	85°47'49.8"E

Surface Water Monitoring

For assessing the water quality, surface water samples were collected. Eight (8) water samples from four locations (04) were taken in sterilized plastic cans twice a month. The samples were analyzed for essential physical, chemical and bacteriological parameters as per the list enclosed in the work order.

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(Qualified Person)

(Abinash Kr. Sahu, Geologist)
(Qualified Person)

Surface Water Sampling Locations

Sl. No.	Location	Sample code	Coordinate Latitude	Coordinate Longitude
1.	Meeting point near upstream of Damsala Nala and D Quarry	SW1	21°03'5.16" N	85°46'28.94" E
2.	Meeting point near downstream of Damsala Nala and D quarry	SW2	21°02'41.1" N	85°45'39.84" E
3.	Meeting point near upstream of Damsala Nala near Gurujangpal School and F Quarry	SW3	21°03'22.02" N	85°47'28.74" E
4.	Meeting point of downstream of Damsala Nala near Gurujang OMC Haring and F Quarry	SW4	21°03'22.02" N	85°47'24.3" E

Flow of Water Measurement

The monitoring of flow of water was carried out monthly once of the springs and perennial streams present within and adjoining the mining lease area. The flow of water measurement was carried out at 4 specific locations (04) and is expressed in m^3/min.

Flow of Water Locations

Sl. No.	Location	Sample code	Coordinates Latitude	Coordinates Longitude
1.	Meeting point near upstream of Damsala Nala and D quarry	FW1	21°03'5.16" N	85°46'28.94" E
2.	Meeting point near downstream of Damsala Nala and D quarry	FW2	21°02'41.1" N	85°45'39.84" E
3.	Meeting point near upstream of Damsala Nala near Gurujangpal School and F quarry	FW3	21°03'22.02" N	85°47'28.74" E
4.	Meeting point of downstream of Damsala Nala near Gurujang OMC Haring and F quarry	FW4	21°03'22.02" N	85°47'24.3" E

Flora and Fauna

The list of Flora and Fauna found in the Forest range (Sukinda range of Cuttack Forest Division) was collected from the Working Scheme of the range available at the Divisional Forest Office for reference. The list of flora and fauna found in the region was prepared by conducting field survey and by discussions with concerned Forest Department personnel using the list available in the Working Plan as a basc. The phyto-sociology of the vegetation (covering frequency, density, abundance and species diversity) in the forest areas falling in core and buffer zone was determined by conducting field studies in selected areas (by laying suitable sizes of quadrat) falling under the respective zones.

In this part of the Mahagiri P.F., the forests consist of grasslands with widely spaced mature trees, of which, Sal (Shorea robusta), Asan (Terminalia tomentosa), Mahul (Madhuca indica), Mango (Mangifera indica), Bahada (Terminalia bellirica) and Tendu (Diospyros melanoxylon) are prominent.

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(Qualified Person)

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Species of Trees found in Different Areas in Mine Lease

Sal (*Shorea robusta*)
Plasal (*Pterocarpus marsupium*)
Simli (*Bombax ceiba*)
Asan (*Terminalia tomentosa*)
Kurum (*Adina cordifolia*)
Kasi (*Bridelia retusa*)
Sidha (*Lagerstroemia parviflora*)
Kangara (*Xylia xylocarpa*)
Harida (*Terminalia chebula*)
Baheda (*Terminalia bellirica*)

Jam (*Syzygium cuminii*)
Mahula (*Madhuca indica*)
Amba (*Mangifera indica*)
Kend (*Diospyros melanoxylon*)
Dhaura (*Anogeissus latifolia*)
Kumbi (*Careya arborea*)
Gambhari (*Gmelina arborea*)
Char (*Buchanania latifolia*)
Kusum (*Schleichera oleosa*)
Misc.

Climatic conditions

The study area lies in tropical region where climate is characterised by very hot summers and cool winters. Summer is typically from March to June when daily average maximum temperature ranges from a maximum of 39°C during daytime to a minimum of 22°C at night. Winter is from November to February when daily average maximum temperature during day goes up to 32°C and minimum temperature at night becomes as low as 15°C. The average annual rainfall as recorded at IMD observatory at Cuttack is 1475.3 mm. The Southwest monsoon lasts from mid June to mid September and the area gets more than 75% of the annual rainfall during this period.

Human settlements

The demography pattern is given below:-

Item	Study area, Buffer zone	Share in total population (%)
Population		
Total	52845	
Male	27392	51.83
Female	25453	48.17
Households	10436	19.75
SC	6252	11.83
ST	20318	38.45
Literates	26754	50.63
Working population	19949	37.75
Main workers	14740	27.89
Cultivators	4449	8.42
Agril laourers	3610	6.83
HH industry	929	1.76
Others	5752	10.88
Marginal workers	5209	9.86

Public buildings, places of worship and monuments

There is no place of archaeological or religious importance within 5 km of the lease.

Indicate any sanctuary is located in the vicinity of leasehold

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(Qualified Person)

No sanctuary is located in the vicinity of leasehold. The environment plan of the mine is shown in Plate No.-09

8.2 Impact Assessment: Attach an Environmental Impact Assessment Statement describing the impact of mining and beneficiation on environment on the following:

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

The land use pattern at the end of conceptual period for the total lease area of 552.457 Ha. is given below in Table. The conceptual plan is shown in Plate No.-7 and the conceptual section is shown in Plate No.-7A.

S.No	Heads	Area, (Ha.)		
		Existing land use	Land use at the end of 2019-20	Conceptual land use
1	Area under mining	106.00	205.18	315.74
2	Overburden/ dump	95.31	157.10	174.99
3	Mineral storage/sub grade ore	53.31	60.09	13.196
4	Infrastructure (Workshop, admn. Building ETP & COBP)	13.69	22.13	15.86
5	Roads	8.65	8.67	0.577
6	Tailing pond	0.00	20	20
7	Safety Zone	(5.578) *	(5.578) *	5.578
8	Untouched tenant land	(6.516) *	(6.516) *	6.516
		276.96	473.17	552.457

*Note: Excluding * as shown in the above table.*

ii) Air quality

Following measures were proposed for management of air quality:-

- Water sprinkling on haul roads.
- Dense plantation along the safety zone.
- No overloading of tippers/ Dumpers.
- Provision of wet drilling in the drill machine.
- Provisions of dust masks to the persons exposed to dust.

Apart from the above, regular monitoring of the ambient air quality as per the statutes will be strictly followed. . The results of the ambient air quality / noise quality monitoring reports as enclosed in Annexure – 20 indicates that the quality parameters are within the acceptable levels.

iii) Water quality

Depending upon the drainage pattern of the area where the dump is located, retaining walls, garland drain with settling tanks will be provided in all the dumps. The quantum of work envisaged for construction of drains, retaining walls and settling tanks are given in table below.

Steps for water quality management

Year	Waste Dump No.	Length of garland drain, m	Length of retaining wall, m
2017-18	WD1	800	800
	WD2	800	800
2018-19	WD1	800	800
	WD2	800	800
2019-20	WD1	900	900
	WD2	1000	1000
Total	WD1	2500	2500
	WD2	2600	2600

The measures as envisaged above will be strictly implemented alongwith continued monitoring of environmental parameter as per the statutes. . The results of the water quality monitoring reports as enclosed in Annexure- 20 indicates that the quality parameters are within the acceptable levels.

iv) Noise levels

Due to operation of the HEMM & plant, ambient noise levels is likely to increase but the same will be managed through proper maintenance of the plant & machineries & use of personal protective equipments.

v) Vibration levels (due to blasting)

The blast induced ground vibrations will be controlled through limiting the charge per delay and use of in-hole delay by NONEL means of initiation. The blasting frequency will be limited to 3 times per week. Ground vibration monitoring will be carried out on regular basis.

vi) Water regime

It is to be noted that the existing groundwater levels on the hill top are well below the ore-body floor, expectedly more than 130m bgl. These would therefore remain unaffected by mining operations.

vii) Acid mine drainage

Not applicable

viii) Surface subsidence

Not applicable

ix) Socio-economics

This mining employment has greatly increased the income levels of the natives. In addition, creation of comparatively well paid jobs in the area has generated not only sizeable trade in household supplies (including vegetables, milk, food, textile, etc) but also some household employment. It has also generated demand for tertiary services like transport and repair shops. The impact of mining operations in the area on socio-economic has been a positive one. The infrastructure of the area roads, public transport P&T facilities and electricity supply, has also improved after the advent of mining operation in the area.

x) Historical monuments etc.

There are no historical monuments or places of archeological interest within 5 km radius of the lease. The environment plan of the mine is shown in Plate No.-09

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8.3 Progressive Reclamation Plan :

8.3.1. Mined-Out Land: Describe the proposals to be implemented for reclamation and rehabilitation of mined-out land including the manner in which the actual site of the pit will be restored for future use. The proposals may be supported with yearly plans and sections depicting yearly progress in the activities for land restoration/ reclamation/rehabilitation, afforestation etc, called "Reclamation Plan".

As the mineralized chrome zone still continues below the pit created at the end of year 2019-20, the excavation won't be backfilled. However, the slopes of the proposed dump will be afforestated with massive plantation of 8500 saplings for 3 years of plan period.

8.3.2 Topsoil Management: The topsoil available at the site and its utilization may be described.

The top-soil generated while breaking virgin areas will be to the tune of around 517950 cu.m in a span of 3 years which will be used for concurrent afforestation over the dumps.

8.3.3 Tailings Dam Management: The steps to be taken for protection and stability of tailing dam, stabilization of tailing material and its utilization, periodic desilting measures to prevent water pollution from tailings etc, arrangement for surplus water overflow along with detail design, structural stability studies, the embankment seepage loss into the receiving environment and ground water contaminant if any may be described.

OMC has already taken action for treatment of tailings generated from the existing COB Plant along with the tailings from the proposed new COB plant under construction. Accordingly a site, adjacent to the F-Quarry of south Kaliapani mines of size about 1000m x 200m has been identified for construction of a tailing pond along with ETP. The site survey and soil investigation works have been completed under the technical guidance of MECON, Ranchi –the technical consultant for this work. The basic engineering work of this proposed tailing pond construction work has been completed by MECON. The pond will be designed with HDPE liner all along the pond bottom and U/S slopes to prevent contamination of harmful slurry with ground water. It will also be designed to meet the statutory norm specifying the limit of total chromium and hexavalent chromium content of effluent water when discharged into surface water along with other parameters. It has been envisaged that the proposed pond will be of two compartment design, each having a life cycle of 2.5 yrs having facility for reclamation. The location of the proposed tailing pond has been finalized on the basis of the following assumptions:-

- Beyond the ultimate pit limit of Quarry – F (Band – IV).
- Topography of the area
- Minimal risk to the local community / inhabitants

Application submitted by OMC for amendment of EC in respect of South Kaliapani Mines regarding shifting of tailing pond has been discussed at the expert appraisal committee. The matter is being pursued with MoEF & CC,GoI.The information sought by MoEF & CC,GoI has been submitted by Chief Wild life Warden & ERO,Bhubaneswar. It is expected the amendment of EC will be obtained very soon. The forest clearance over the entire forest area has been obtained from MoEF & CC,GoI & the same has been handed over by the Forest dept.,GoO for mining & allied activites. The Agency for construction of tailing pond along with ETP and slurry handling has been finalized through open tender system. The work will be awarded after obtaining amendment of EC with time period for completion of work as 12 months. The existing COB plant is non-operational due to non-availability of tailing pond & after completion of the tailing pond the COB plant will be operated.

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8.3.4 Acid mine drainage, if any and its mitigative measures.
Not applicable

8.3.5 Surface subsidence mitigation measures through backfilling of mine voids or by any other means and its monitoring mechanism. The information on protective measures for reclamation and rehabilitation works year wise may be provided as per the following table.

Summary of year-wise proposal for item no. 8.3 for the FY 2017-18 to 2019-2020

Items	Details	Cumulative actual carried out till date (upto 31.10.2017)	Prop. for 2017-18	Prop. for 2018-19	Prop. for 2019-20
Dump management	Area afforested (ha)	(Over the OB dumps in an area of 8.75 Ha.)	(Over the OB dumps in an area of 8.75 Ha)	36.46	90.19
	No of saplings planted	8000 Nos.	500 Nos.	20000 Nos.	30000 Nos.
	Cumulative no of plants	26000 Nos.	26500 Nos.	46500 Nos.	76500 Nos.
	Cost including watch and care during the year	1200000 INR	75000 INR	3000000 INR	4500000 INR
Management of worked out benches	Area available for rehabilitation (ha)	NIL	NIL	NIL	NIL
	Afforestation done(ha)	NIL	NIL	NIL	NIL
	No of saplings planted in the year	NIL	NIL	NIL	NIL
	Cumulative no of plants	NIL	NIL	NIL	NIL
	Any other method of rehabilitation (specify)	NIL	NIL	NIL	NIL
	Cost including watch and care during the year	NIL	NIL	NIL	NIL
Reclamation and Rehabilitation by backfilling	Void available for Backfilling (L x B x D) pit wise /stope wise	NIL	NIL	NIL	NIL
	Void filled by waste /tailings	NIL	NIL	NIL	NIL
	Afforestaion on the backfilled area	NIL	NIL	NIL	NIL
	Rehabilitation by making water reservoir	NIL	NIL	NIL	NIL
	Any other means (specify)	NIL	NIL	NIL	NIL
Rehabilitation of waste land within lease	Area available (ha)	NIL	NIL	NIL	NIL
	Plantation carried out (within present retained ML area)	NIL	NIL	NIL	NIL

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(Qualified Person)

Items	Details	Cumulative actual carried out till date (upto 31.10.2017)	Prop. for 2017-18	Prop. for 2018-19	Prop. for 2019-20
	Plantation carried out (within surrendered ML area)	NIL	NIL	NIL	NIL
	Check dams (within retained/ surrendered area)	NIL	NIL	NIL	NIL
	Method of rehabilitation	NIL	NIL	NIL	NIL
Others (specify)	Total no of saplings planted outside lease area	NIL	NIL	NIL	NIL
	Total cost including watch and care	NIL	NIL	NIL	NIL
	Total cost for monitoring of Ambient Air Quality, water quality etc.	25,00,000	5,00,000	5,00,000	5,00,000
	Cost towards construction of settling tank, garland drain & retaining wall around Dump-1 & 2	69,80,000	48,00,000	48,00,000	57,00,000

8.4 Disaster Management and Risk Assessment: This may deal with action plan for high risk accidents like landslides, subsidence flood, inundation in underground mines, fire, seismic activities, tailing dam failure etc. and emergency plan proposed for quick evacuation, ameliorative measures to be taken etc. The capability of lessee to meet such eventualities and the assistance to be required from the local authority may also be described.

The objective of on-site disaster management plan for the mine is to in a state of perpetual readiness through training and development to immediately control and arrest any emergency situation so as to avert a full fledged disaster and the consequence of human and property damage and in the event of a disaster still occurring, to manage the same so that the risk of the damage to life and property in minimized.

OMC have a demand procedure for Emergency Preparedness and Responses. The emergency situations arising out of the situations as defined in the clause shall be addressed in the document. The salient features are elaborated as below:

- Emergency Response Organization
- Communication System
- Action on the site
- Facilities available at site
- Medical treatment for injured personnel's
- Emergency Response Organization

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(Qualified Person)

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(Qualified Person)

Following officers of the mines will be responsible for co-ordination in case emergency situated in any sections of the mine.

Person	Responsibility	
Head of Department / Mine Agent	Site Controller	B K Behera, RM Mobile No. 9438501275
Mines Manager / Shift in-charge	Accident Controller / Communication Officer	AK Pradhan, Mgr., Mining Mobile No. 9437431943
Employee who gives the first information about the incident / accident	Primary Controller/Safety officer	SK Jena, Dy. Mgr., Mining Mobile No. 8280138317
P & A Department (HOD)	Liaison Officer	L Hansda, Dy. Mgr. Personnel Mobile No. 9437335927

Key Personnel and their responsibilities

Site Controller:

- The head of the department / mine agent shall have an overall responsibility for controlling the incident / accident and directing the personnel.
- To prepare a full proof plan for control of accident like, landsides, subsidence flood and other natural calamities.
- To inform statutory bodies of the State and Central Government.
- To inform communication officer about the emergency, control centre and assembly point.
- To provide all assistance and call for fire squad, security officer and other services required for removing / control of danger.
- To ensure that all necessary personnel assemble at assembly point.
- Make arrangement for medical treatment to the personnel injured seriously.

Accident Controller:

- Mines manager shall act as accident controller/ communication officer.
- Mock rehearsal of management plan prepared for accident.
- To withdraw men / machine from the affected area with priority for safety of personnel, minimize damage to the machines, environment and loss of material.
- To make a report based on the facts and figure and submit to the site controller.
- To communicate to the site in charge and make arrangement for first aid and transportation of the injured personnel.

Primary Controller:

- To inform the Accident Controller / shift in-charge from the nearest means of communication about the location and the nature of accident.
- To assist in clearing any obstruction in relief of accident.
- To carry out all instructions of accident controller.
- To provide first aid treatment and communicate to the shift in-charge.

Capability of Lessee:

Following facilities are available at mine site:

- Public address system

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(Qualified Person)

- Telephone / Mobile handsets
- Runners / Messenger
- Emergency alarm
- Fire fighting equipment and accessories with trained manpower
- Full fledge hospital at a distance of 4 km from the mine.
- Training centre
- Fire tender
- Ambulance van
- Jeeps

8.5 **Care and maintenance during temporary discontinuance: An emergency plan for the situation of temporary discontinuance due to court order or due to statutory requirements or any other unforeseen circumstances may indicate measures of care, maintenance and monitoring of status of discontinued mining operations expected to re-open in near future.**

When the mine is temporarily discontinued due to any unforeseen circumstances the following care and maintenance shall be carried out:

- Notice to be served to all the concerned authority.
- Temporary fencing shall cover the mine entries.
- All access roads/openings to the pit / face shall be closed by parapet wall as per rule.
- Warning shall be displayed on the 'Notice Board' at appropriate places.
- Security personnel shall be posted at every danger point.
- No unauthorized person shall be allowed to enter into the mine without prior permission of the management.
- Garland drain shall be made all around the mine and dumps to prevent water flow towards mine for prevention of landslide/side fall and siltation etc.
- All men and machinery shall be withdrawn from the mine and shall be kept in compound and safe place.

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8.6 **FINANCIAL ASSURANCE:**

The amount calculated for the purpose of Financial Assurance shown as below

S N	Type of land use	Area of land use (in Ha)			The area considered as fully reclaimed and rehabilitated	Net area considered for calculation of financial assurance
		Area put into use at the start of plan period i.e. 1.10.17	Addl Area required During scheme period upto 31.03.20	Total Area at the end of the plan period		
1	Excavated Area	106.00	99.18	205.18	0	205.18
2	Storage for top-soil	0	0.00	0.00	0	0.00
3	Overburden dump	95.31	61.79	157.10	0	157.10
4	Mineral storage/ sub grade ore	53.31	6.78	60.09	0	60.09
5	Infrastructure (Workshop, admn. Building ETP & COBP) & Others	13.69	8.44	22.13	0	22.13
6	Roads	8.65	0.02	8.67	0	8.67
7	Railways	0	0.00	0.00	0	0.00
8	Green belt	0	0.00	0.00	0	0.00
9	Talling pond	0	20.00	20.00	0	20.00
10	Mineral separation plant	0	0.00	0.00	0	0.00
11	Township area	0	0.00	0.00	0	0.00
Total		276.96	196.21	473.17	0	473.17

The total financial assurance upto 2019-20 will be Rs Rs. 14,19,51,000/-@ Rs.3,00,000/- per hectare.
The Financial Assurance Plan has been shown as Plate No.-11

अनुमोदित
APPROVED

02/11/2018
क्षेत्रीय खान नियंत्रक
REGIONAL CONTROLLER OF I
भारतीय खान ब्यूरो
INDIN BUREAU OF MINES
भुवनेश्वर/BHUBANESWAR

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भारतीय खान ब्यूरो, भुवनेश्वर
INDIAN BUREAU OF MINES, BHUBANESWAR
भारत सरकार
GOVT. OF INDIA