STEEL AUTHORITY OF INDIA LIMITED

ROWGHAT IRON ORE MINING PROJECT
located in MATLA RESERVE FORESTS
DISTT: NARAYANPUR AND KANKER, CHHATTISGARH

1. PRE-FEASIBILITY REPORT

2. REPORT ON

- TRAFFIC CARRYING CAPACITY STUDY to assess feasible increase in existing road traffic for transportation of iron ore that can be evacuated through road from Rowghat mine upto railway siding near Keonti and

- ENVIRONMENTAL IMPACT FOR PROPOSED MINERAL EVACUATION road corridor from Rowghat mine upto railway siding near Keonti (as Annexure-1 of the Pre Feasibility Report)

MECON LIMITED
RANCHI – 834002
INDIA

MEC/11/16/C38G/SR/2285/R0 **December, 2016**

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1.0 EXECUTIVE SUMMARY

Steel Authority of India Limited (SAIL) is a public sector undertaking, largely owned by Government of India and functions like an operating company. SAIL, by virtue of its Maharatna status, enjoys significant operational and financial autonomy. Bhilai Steel Plant is a manufacturing unit of SAIL. SAIL – the largest steel producer in country, has embarked upon a massive modernization and expansion plan to retain its position as the 'leader of the Indian Steel industry' w.r.t. market share by enhancing its production capacity to 23.46 MTPA from the installed production capacity of 13.8 MTPA of hot metal. SAIL sources its entire requirement of iron ore and part of its requirement of limestone, dolomite and coking coal from its captive mines located in the states of Jharkhand, Odisha and Chhattisgarh.

Bhilai Steel Plant (referred to as BSP here-in-after), the proud winner of the prestigious Prime Minister's Trophy for 11 times, came into being during the 2nd Five year plan as a part of Hindustan Steel Ltd (Later on known as Steel Authority of India Ltd - SAIL) in collaboration with erstwhile USSR. It is one of the five integrated steel plants under SAIL and is located strategically in the mineral rich central region of India. BSP has always been a major contributor to the bottom line of Maharatna Company- SAIL and hence is admired as its flagship unit. BSP's inbound supply chain has the strategic advantage of having captive mines. BSP is undergoing expansion to increase hot metal production to 7.6 MTPA. Under expansion, BSP is setting up a large Blast Furnace (BF-8) of useful volume 4060 m^3. Post expansion, the iron ore requirement for BSP will be about 12 MTPA.
Development of Rowghat Mine has been envisaged to meet the future iron ore requirement of BSP. But, since it is a green field project located in Reserve Forest, it has a long gestation period.

The Ministry of Mines, Govt. of India, vide letter dated 04.01.2007 has accorded approval under section 5(1) and relaxation under section 6(1)(b) of MM(D&R) Act, 1957, for grant of Mining Lease over an area of 2028.797 hectares (ha) in Deposit-F of Rowghat, comprising of 7 blocks namely Raodongri, Block-A, Tarhur, Anjarel, Korgaon, Kharkagaon and Takrel in favour of M/s. SAIL. Accordingly, terms & conditions for grant of the above mentioned ML was accorded to SAIL by the State Govt. vide letter dated 09.01.2007. The mining plan of Rowghat was approved by IBM vide letter No. dated 22.03.2007. MoEFCC, GoI has granted Environmental Clearance for the Rowghat Iron ore Mining Project vide letter No. J-11015/331/2006–IA.II (M) dated 4th June, 2009 and 15th March, 2010 for an annual production capacity of 14 Mt/yr of iron ore. The forest clearance has been accorded for over an area of 883.22 ha vide letter no. F.No.8-44/2005-FC(Pt), dated 03.08.2009.

The concept was to develop Rowghat deposit in phases (Phase – 1 & 2) to meet the partial requirement of iron ore of BSP. It is proposed to initially develop 3 blocks viz. Block-A, Tarhur and Anjarel for excavation of total ROM of 14 MTPA in phase-1.

As per the original plan, it was envisaged that the ROM ore will be transported through internal haul roads by 120 ton rear discharge dumpers to the primary & secondary crushing units to be set up at the hilltop. The secondary crushed product will be transported to the loading bay at foothill through flat bed/pipe conveyors where it will be screened to separate the Lump & Fines size fraction which will be directly dispatched to BSP. While the ore which requires beneficiation will be dispatched to Dalli-Rajhara mines (existing ML of BSP, SAIL at a distance of 95 km

from Rowghat) for beneficiation through rail only. The crux of the plan was that the entire quantity shall be evacuated through Rail.

However mining, development and production from Rowghat ML could not be commenced due to "Naxal" disturbance in the area.The progress of construction of Rail line between Dalli-Rajhara & Rowghat also got hampered due to "Naxal" problem.

The issue of "Naxal" problem, was brought to the knowledge of ministry of Steel & ministry of Home affairs. After series of meetings, MHA approved 2 battalions of BSF & CRPF/ SSB for protection of mining & railway line respectively. However responsibility for developing Infrastructures i.e. barracks & campus was entrusted to BSP. BSP till date developed six nos of BSF camps at mining area & eleven nos. of camps between Dalli-Rajhara for CRPF/SSB, at a whopping cost of 90 Crores.

As a result mining area is fully secure. Railway line up to 17 km (Gudum) is functional & up to 42 km i.e. "Keonti" is expected to be completed by Nov '2017. The Rail line up to 95 km (Rowghat) will be completed by 2021.

An alternate plan for evacuation of iron ore by road till the year 2021:

With the present limited life of the existing reserves of iron ore at Dalli-Rajhara of BSP mine and the increased iron ore requirement for the proposed hot metal production of BSP, development of Rowghat Deposit has become essential and urgent. Therefore an interim plan for evacuation of Iron Ore by Road has been prepared for this a traffic study of the existing road for the purpose was carried out along with base line air quality (one month) monitoring along the road evacuation corridor up to "Keonti". During the study it was also revealed that with the existing road only 0.3 Mt/yr., can be safely evacuated. No other changes have been proposed in the approved EIA/EMP by MoEFCC, GoI.

Hence we request that:

As the proposed change in scope of work is marginal and only for limited period up to 2021 and does not involve increase in annual production capacity, we seek **Amendment/ modification for evacuation of iron ore by road**, in the Environment Clearance already granted for Rowghat Iron ore Mining Project of M/s Steel Authority of India Limited, dated 4th June, 2009.

The salient features of the project include:

<table>
<tr><td>Proposal</td><td>The project was granted Environmental Clearance for 14 Mt/y iron ore by MoEFCC vide letter no. J-11015/331/2006–IA.II (M) dated 4th June, 2009 and 15th March, 2010. The present proposal is for seeking amendment in the Environmental Clearance as per the details given below:
<table>
<tr><th>Sr. No</th><th>As per EC granted</th><th>Amendment sought in EC condition</th></tr>
<tr><td>1.</td><td>From Rowghat ML to Dalli-Rajhara/Bhilai the iron ore (14Mt/yr.) was envisaged to be transported through rail mode.</td><td>Transportation of (0.3 Mt/y) iron ore through road from Rowghat ML to Keotitill the rail linereaches upto Rowghat by 2021.</td></tr>
</table>
(Mt/yr – million tonnes per year)
Note:
1. The above stated amendment in EC condition is being proposed temporarily for a period of about 5 years (i.e. upto 2021) to meet the immediate requirement of iron ore of the SAIL, BSP. During the intervening period of 5 years, the originally envisaged and approved infrastructure such as Crushing/ Screening plant with downhill</td></tr>
</table>

<table>
<tr><td></td><td>conveying & loading facilities at Rowghat ML are expected to be established and commissioned. Thereafter, the project will operate as per the originally approved EC condition.</td></tr>
<tr><td>Location of Mine</td><td>Matla Reserve Forest, Kanker & Narayanpur Districts, Chhattisgarh</td></tr>
<tr><td>Latitude</td><td>19°45′ 20.16″N to 19°51′ 20.00″N</td></tr>
<tr><td>Longitude</td><td>81°08′ 22.56″E to 81°12′ 30.00″E</td></tr>
<tr><td>Land Use</td><td>Entire ML area falls under Matla R.F. The details of the landuse (in ha) is given below:-
<table>
<tr><th>Partculars</th><th>Inside ML</th><th>Outside ML</th></tr>
<tr><td>Mining</td><td>678.63</td><td>0</td></tr>
<tr><td>Dumping</td><td>52.48</td><td>0</td></tr>
<tr><td>Hill top infrastructure complex</td><td>19.80</td><td>0</td></tr>
<tr><td>Roads</td><td>8.65</td><td>31.35</td></tr>
<tr><td>Explosive magazine</td><td>0.85</td><td>0</td></tr>
<tr><td>Power coridor</td><td>1.00</td><td>2.30</td></tr>
<tr><td>Conveyor gallery</td><td>0</td><td>9.45</td></tr>
<tr><td>Loading yard</td><td>0</td><td>62.00</td></tr>
<tr><td>Foothill complex</td><td>0</td><td>16.71</td></tr>
<tr><td>Sub total</td><td>761.41</td><td>121.81</td></tr>
<tr><td>Undisturbed</td><td>1267.387</td><td>-</td></tr>
<tr><td>Total</td><td>2028.797</td><td>121.81</td></tr>
</table></td></tr>
<tr><td>Total Mineable Reserves</td><td>511.043 million tonnes</td></tr>
<tr><td>Life of Mine</td><td>Approx. 40 years.</td></tr>
<tr><td>Method of Mining</td><td>Mechanized open cast mining by conventional shovel dumper combination</td></tr>
<tr><td>Quarries</td><td>Three blocks namely Block-A/ Tarhur & Anjarel will be covered in Phase-1 as a single quarry.</td></tr>
<tr><td>Waste disposal</td><td>External dumping for initial years. Backfilling of exhausted quarriessubsequently including re-handling of external dumps.</td></tr>
<tr><td>Mineral Processing</td><td>Only Crushing & screening.</td></tr>
<tr><td>Mineral Transport</td><td><u>Approved proposal</u>: Transportation of ore from by covered conveyors from Hilltop to loading yard/ railway siding at foothill complex. Thereafter, dispatch from the railway siding to Dalli Rajhara/ Bhilai through rail mode.

<u>Amendment sought in EC</u>: Transportation of ore from Rowghat ML to Keonti siding by road @0.3 Mt/yr. and from Keonti to Dalli-Rajhara/ Bhilai through Rail till 2021 (i.e. till the above approved proposal is completely operational)</td></tr>
<tr><td>Number of working days</td><td>300 days, 3 shifts per day (conceptual stage)</td></tr>
<tr><td>Water Demand</td><td>6850 m^3/day (conceptual stage)</td></tr>
<tr><td>Source of water</td><td>Mendki river & Nibra nallah.</td></tr>
<tr><td>Man Power</td><td>1018 Nos. @ mine rated capacity (conceptual stage)</td></tr>
<tr><td>Infrastructure</td><td>Plant & workshops, railhead, offices and other amenities</td></tr>
<tr><td>Proposed Investment</td><td>Rs.2,50,000Lakhs (Approx.)</td></tr>
<tr><td>Production Cost</td><td>Rs.609 per tonne at rated capacity</td></tr>
<tr><td>CSR Budget</td><td>Total Rs. 150 lakhs per year</td></tr>
</table>

The proposed change in mode of transportation is likely to impact the local road infrastructure and also the air quality of the area. Considering this, specific studies viz. Adequacy of road infrastructure and Air Quality Impact Predication Study have been carried out and incorporated in this report. It has been observed that the existing road capacity of the evacuation corridor (Rowghat to Keonti) is available to undertake the additional traffic load due to enhanced truck movement for transportation of 0.3 Mt/yr ore. Further, the air quality impact predication considering proposed change in the mode of transportation also shows the quality of air within the permissible limit.

The proposed mode of ore transport will facilitate initiating mining activities at Rowghat project with some supply of iron ore to Bhilai Steel Plant. This project will also generate much needed employment to the local people. Economy of the area will get a boost and there will be overall growth of the region interms of education, health, training, transport etc. The local people's standard of living is also expected to improve.

2.0 INTRODUCTION OF THE PROJECT / BACKGROUND INFORMATION

2.1 IDENTIFICATION OF PROJECT AND PROJECT PROPONENT

The Ministry of Mines, Govt. of India, vide letter dated 04.01.07 has accorded approval under section 5(1) and relaxation under section 6(1)(b) of MM(D&R) Act, 1957, for grant of Mining Lease over an area of 2028.797 hectares in Deposit-F of Rowghat, comprising of 7 blocks namely Raodongri, Block-A, Tarhur, Anjarel, Korgaon, Kharkagaon and Takrel in favour of M/s. Steel Authority of India Limited. Accordingly, terms & conditions for grant of the above mentioned ML was accorded to SAIL by the State Govt. vide letter dated 9.1.2007. The mining plan of Rowghat was approved by IBM vide letter dated 22.3.2007. The environment clearance for the ML area was accorded by MoEFCC vide letter dated 4.6.2009. The forest clearance has been accorded for an area of 883.22 Ha. vide letter dated 3.8.2009.

The concept was to develop Rowghat deposit in phases (Phase – 1 & 2) to meet the partial requirement of iron ore of Bhilai Steel Plant (BSP). It is proposed to initially develop 3 blocks viz. Block-A, Tarhur and Anjarel for excavation of total ROM of 14 MTPA in phase-1.

The ROM Ore will be transported through internal haul roads by 120 ton rear discharge dumpers to the primary & secondary crushing units to be set up at the hilltop. The secondary crushed product will be transported to the loading bay at foothill through flat bed/pipe conveyors where it will be screened to separate the lump size fraction which will be directly dispatched to BSP through rail while the fines will be dispatched to Dalli-Rajhara mines (existing ML of BSP, SAIL at a distance of 95 km from Rowghat) for beneficiation through rail only.

The rail line from Dalli Rajhara to Jagdalpur is in progress enroute the Rowghat project. The distance from Dalli Rajhara to Rowghat in the proposed rail route is

about 95 km. As of now, the construction work of rail line has been completed upto Gudum (17 km from Dalli Rajhara) and the rail head is expected to reach Keonti (42 km from Dalli Rajhara and almost half way to Rowghat) by the end of year 2017. Further, it is expected that the rail line will reach Rowghat by the end of year 2021.

With the present limited life of the existing reserves of iron ore at Dalli-Rajhara mine and the increased iron ore requirement for the proposed hot metal production of BSP, development of Rowghat Deposit has become essential and urgent. Due to the present limitation of transportation of ore through rail mode, it has been thought whether mining activities at Rowghat can be initiated and supply of limited quantity of iron ore from the ML can be assured through the existing road to Keonti so that further transportation from Keonti to BSP via. Dalli Rajhara can be done through rail mode for the time being till the rail head reaches Rowghat.

A traffic study of the existing road for the purpose was carried out along with base line air quality (one month) monitoring along the road evacuation corridor upto Keonti. Keeping into consideration the existing traffic and road condition a maximum figure of 0.3 MTPA only has been considered that can be effectively evacuated through road.

Steel Authority of India Limited (SAIL), a Maharatna public sector undertaking under Ministry of Steel, Government of India, is the leading steel maker in the country and is having integrated steel plants at Bokaro, Durgapur, Rourkela, Bhilai, Burnpur, alloys steel plant at Durgapur and special steel plant at Bhadrawati and Chandrapur. Also, SAIL has the second largest mining outfit in the country after Coal India Limited. SAIL's mines are spread over the states of Jharkhand, Orissa and Chhattisgarh. These mines commenced their operations as captive sources of raw materials for its integrated steel plants.

2.2 BRIEF INFORMATION ONNATURE OF THE PROJECT

The Ministry of Mines, Govt. of India, vide letter dated 04.01.07 has accorded approval under section 5(1) and relaxation under section 6(1)(b) of MM(D&R) Act, 1957, for grant of Mining Lease over an area of 2028.797 hectares in Deposit-F of Rowghat, comprising of 7 blocks namely Raodongri, Block-A, Tarhur, Anjarel, Korgaon, Kharkagaon and Takrel in favour of M/s. Steel Authority of India Limited. Accordingly, terms & conditions for grant of the above mentioned ML was accorded to SAIL by the State Govt. vide letter dated 9.1.2007. The mining plan of Rowghat was approved by IBM vide letter dated 22.3.2007. The environment clearance for the ML area was accorded by MoEFCC vide letter dated 4.6.2009. The forest clearance has been accorded for an area of 883.22 Ha. vide letter dated 3.8.2009.

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The rail line from Dalli Rajhara to Jagdalpur is in progress enroute the Rowghat project. The distance from Dalli Rajhara to Rowghat in the proposed rail route is about 95 km. As of now, the construction work of rail line has been completed upto Gudum (17 km from Dalli Rajhara) and the rail head is expected to reach Keonti (42 km from Dalli Rajhara and almost half way to Rowghat) by the end of year 2017. Further, it is expected that the rail line will reach Rowghat by the end of year 2021.

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A traffic study of the existing road for the purpose was carried out along with base line air quality (one month) monitoring along the road evacuation corridor upto Keonti. Keeping into consideration the existing traffic and road condition a maximum figure of 0.3 MTPA only has been considered that can be effectively evacuated through road.

Amendment in EC condition is accordingly requested for transportation of 0.3 MTPA of iron ore from the ML to Keonti through road till the railhead reaches Rowghat by the end of year 2021.

The salient features of the project include:

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<tr><td>Proposal</td><td>The project was granted Environmental Clearance for 14 Mt/y iron ore by MoEFCC vide letter no. J-11015/331/2006–IA.II (M) dated 4th June, 2009 and 15th March, 2010. The present proposal is for seeking amendment in the Environmental Clearance as per the details given below:
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(Mt/yr – million tonnes per year)
Note:
The above stated amendment in EC condition is being proposed temporarily for a period of about 5 years (i.e. upto 2021) to meet the immediate requirement of iron ore of the SAIL, BSP. During the intervening period of 5 years, the originally envisaged and approved infrastructure such as Crushing/ Screening plant with downhill conveying & loading facilities at Rowghat ML are expected to be established and commissioned. Thereafter, the project will operate as per the originally approved EC condition.</td></tr>
</table>

The total mineable reserves available are 511.043million tonnes of iron ore. The average expected life of the lease is approx. 40 years.

2.3 NEED FOR THE PROJECT AND ITS IMPORTANCE TO THE COUNTRY OR REGION :

SAIL's expansion & modernization program has increased hot metal production capacity to 23.2Mt/yr. Further, SAIL is also working on long term strategic plan "**VISION 2025**", which will steer the company towards a target of 50 Mt/yr hot metal productionin line with the Prime Minister's vision of enhancing India's steel-making capacity to 300 Mt/yr by 2025. Iron ore is one of the key inputs for hot metal production, therefore continuous supply of quality iron ore from mines is a pre-requisite for the success of expansion & modernization programme.

Entire iron ore requirement of SAIL (BSP) is being met from Dalli Rajhara group of iron ore mines, which is going to exhaust very soon (in a time period of around 9 years). Accordingly BSP, SAIL has planned augmentation of production & infrastructure facilities at its Rowghat mine to commensurate with SAIL'sexpansion plan. Iron ore from Rowghat mines will be supplied to BSP. The project will not only help in supply of iron ore demand to BSP but also help in the overall growth of the region.

2.4 DEMAND AND SUPPLY GAP

The major application of iron ore in India is for manufacture of iron and steel. India is one of the major producers and exporters of high grade iron ore. The iron ore production in India was 152.43 Mt for the year 2013-14. Out of total production of 152.43 Mt, domestic iron ore consumption was estimated to be 110.50 Mt for the same year which means the entire domestic demand is satisfied by domestic supplies of iron ore.The major iron ore producing states are Odisha, Jharkhand, Chhattisgarh, Karnataka and Goa. India is world's 4th largest iron ore producer and 3rdexporter after Australia and Brazil. India iron ore export during 2013-14 was 16.30 Mt showing decline in export from previous years.

SAIL is implementing its growth plan to enhance hot metal production capacity to 23.46 Mt/yr by 2015-16 with an investment of about Rs 72,000 crore. The iron ore requirement for the current expansion will increase to about 43 Mt/yr. In order to meet enhanced requirement of iron ore, production capacity of existing mines at Gua, Bolani, Kiriburu, Meghahatuburu, Barsua and Kalta is being expanded to its maximum potential and new mines are planned to be developed at Rowghat, Chiria and Taldih.

Iron ore produced from SAIL's captive mines are used up in the company's steel plants. SAIL's steel plants are being modernized and expanded. The proposed iron ore production from the Rowghat mine will help SAIL to meet its iron ore requirementof BSP.

2.5 IMPORT VS INDIGENOUS PRODUCTION

Although the production of iron ore in India was about 152.43 Mt during 2013-14, the domestic production of iron ore has seen a decline in the past few years due to regional shortages in some States like Karnataka due to legal and regulatory issues. However, during 2013-14 there has been an increase in the production of iron ore as compared to the previous year. About 33% of the total production was shared by Public Sector Companies like SAIL, NMDC, OMC etc. The share of Private Sector was 67%. Almost entire production of iron ore (99%) was accrued from Odisha, Goa, Chhattisgarh, Jharkhand and Karnataka during the year. The remaining production was reported from Andhra Pradesh, Chhattisgarh, Maharashtra and Rajasthan.Although import of iron ore was 3.05 MT in 2012-13, it has seen a fall in 2013-14 to 0.37 Mt. Import of Steel has also declined in the year 2013-14 as compared to imports during previous years.

2.6 EXPORT POSSIBILITIES

Iron ore produced from this project will be entirely consumed in SAIL's plants. There is no proposal for export of iron ore from this project.

2.7 DOMESTIC / EXPORT MARKET

Iron ore is used in the iron & steel industry as the basic raw material required for manufacture of various grades ofiron and steel. India is a net exporter of iron ore.

2.8 EMPLOYMENT GENERATION

The Rowghat mine will be headed by aMine Manager who will be responsible for the supervision, control and management of the block. The Mine Managershall report to the Mines Agent, all of whom shall be provided residential accommodation at its township planned near Narayanpur. The senior most executive of BSP mines will normally be the Mines Agent for the entire complex. Director (Raw Material & Logistics)will be the nominated owner of Rowghat iron ore mines.

All statutory supervision i.e. Mines Foreman, Mining Mate etc.are being employed as specified in the Metalliferous Mines Regulation, 1961. A total of 1018 Nos. of employees will be employed at Rowghat mines. Most of the unskilled, semi-skilled and skilled workers will be local persons.

3.0 PROJECT DESCRIPTION

The Ministry of Mines, Govt. of India, vide letter dated 04.01.07 has accorded approval under section 5(1) and relaxation under section 6(1)(b) of MM(D&R) Act, 1957, for grant of Mining Lease over an area of 2028.797 hectares in Deposit-F of Rowghat, comprising of 7 blocks namely Raodongri, Block-A, Tarhur, Anjarel, Korgaon, Kharkagaon and Takrel in favour of M/s. Steel Authority of India Limited. Accordingly, terms & conditions for grant of the above mentioned ML was accorded to SAIL by the State Govt. vide letter dated 9.1.2007. The mining plan of Rowghat was approved by IBM vide letter dated 22.3.2007. The environment clearance for the ML area was accorded by MoEFCC vide letter dated 4.6.2009. The forest clearance has been accorded for an area of 883.22 Ha. vide letter dated 3.8.2009.

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With the present limited life of the existing reserves of iron ore at Dalli-Rajhara mine and the increased iron ore requirement for the proposed hot metal production of BSP, development of Rowghat Deposit has become essential and urgent. Due to the present limitation of transportation of ore through rail mode, it has been thought whether mining activities at Rowghat can be initiated and supply of limited quantity of iron ore from the ML can be assured through the existing road to Keonti so that further transportation from Keonti to BSP via. Dalli Rajhara can be done through rail mode for the time being till the rail head reaches Rowghat.

A traffic study of the existing road for the purpose was carried out along with base line air quality (one month) monitoring along the road evacuation corridor upto Keonti. Keeping into consideration the existing traffic and road condition a maximum figure of 0.3 MTPA only has been considered that can be effectively evacuated through road.

3.1 TYPE OF PROJECT INCLUDING INTERLINKED & INTER DEPENDED PROJECT

The proposed project falls under Category "A", as per EIA notification – 2006, Amendment in Dec '2009, April '2011, Dec. '2012, March '2013, Sept. '2013, June '2014, October '2014 & April '2015 of the Ministry of Environment, Forest& Climate Change, New Delhi. This is a self dependent project. The mine is captive source of iron ore for BSP (SAIL).

3.2 LOCATION

Rowghat ML is located in Narayanpur & Kanker Distt. in Chhattisgarh state. The area is located between latitudes 19°45′ 20.16″N to 19°51′ 20.00″N and longitudes 81°08′ 22.56″E to 81°12′ 30.00″E. The ML is located in SOI Toposheet No. 65E/1 and a key plan showing the project location is shown in **Drg. No. MEC/11/16/C38G/1.**

3.3 DETAILS OF ALTERNATE SITE

Since the proposed project envisages iron ore mining within the leasehold, possibility of alternate site is out of question.

3.4 SIZE AND MAGNITUDE OF OPERATION

Rowghat ML measures ML-130 leasehold area measures 2028.797 hectares, comprising of 7 blocks namely Raodongri, Block-A, Tarhur, Anjarel, Korgaon, Kharkagaon and Takrel. The mine is proposed to work at a rated capacity of 14 Mt/yr. However, as the rail link upto Rowghat has not yet been commissioned and is expected to reach by 2021, a quantity of 0.3 Mt/yr. is expected to be transported through road to a nearest rail head (proposed Keonti siding) and further onwards to Dalli Rajhara/ Bhilai through Rail. The details have already been described in 3.2 above.

3.5 MINE DESCRIPTION

3.5.1 Geology

Geological Survey of India had for the first time started systematic regional exploration of Rowghat iron ore deposits-'A', 'B', 'C', 'D', 'E', and 'F' in 1971-72 and continued till June 1979. In addition to the geological work done by GSI in the 1970s, BSP carried out detail exploration in Block-A of Deposit-F during 1989-91 to firm up the reserves and facilitate investment decision. BSP incurred an expenditure of about Rs. 110 Lakhs on account of the above exploration of Block-A. BSP also carried out a number of ecological studies as per the requirement of various statutory authorities by engaging consultants.

Deposit-F is an elongated ridge trending NE-SW and forming the eastern limb of Rowghat syncline. General strike of the deposit is NNE-SSW and dip of the ore body varies from 300-700 due E and even to 900 at places. Approximate strike length of deposit-F is 13 km and average width is 9 km.

The ML area has 7 blocks namely Raodongri, Block-A, Anjarel, Tarhur, Korgaon, Kharkagaon & Takrel. Raodongri block has 4 cross-sections, serially numbered as RD 0, 4, 8, and 12 from north to south based on the interpretation of surface geological data and sub-surface borehole data. Majority of the cross sections are aligned in NW-SE direction, which is nearly perpendicular to the general elongation of the ore body.

In Block A, a total of 19 cross-sections, serially numbered from A to S from north to south have been prepared based on the interpretation of surface geological data and sub-surface borehole data. Majority of the cross sections are aligned in NW-SE direction, which is nearly perpendicular to the general elongation of the ore body. The number of boreholes on each cross-section line has been given in the geological section and ranges from 1-6. Besides, the data of pits wherever available have also been considered.

Tarhur block has 5 cross-sections, serially numbered as CS 0, 4, 8, 12 and 16 from north to south based on the interpretation of surface geological data and sub-surface borehole data. Majority of the cross sections are aligned in NW-SE

direction, which is nearly perpendicular to the general elongation of the ore body.

Anjarel block has 4 cross-sections, serially numbered as CS A8, A, I and Q from north to south. These sections have been prepared based on the interpretation of surface geological data and sub-surface borehole data. Majority of the cross sections are aligned in NNW-SSE direction, which is nearly perpendicular to the general elongation of the ore body.

Korgaon block has 6 cross-sections, serially numbered as KN 8, KS 0, 8, 16, 24 and 32 from north to south. These sections have been prepared based on the interpretation of surface geological data and sub-surface borehole data. Majority of the cross sections are aligned in W-E direction, which is nearly perpendicular to the general elongation of the ore body.

Kharkagaon block has 6 cross-sections, serially numbered as KH 0, 4, 8, 12, 16 and 20 from north to south. These sections have been prepared based on the interpretation of surface geological data and sub-surface borehole data. Majority of the cross sections are aligned in NW-SE direction, which is nearly perpendicular to the general elongation of the ore body.

Takrel block has 4 cross-sections, serially numbered as CS A8, A, I and Q from north to south. These sections have been prepared based on the interpretation of surface geological data and sub-surface borehole data. Majority of the cross sections are aligned in W-E direction, which is nearly perpendicular to the general elongation of the ore body.

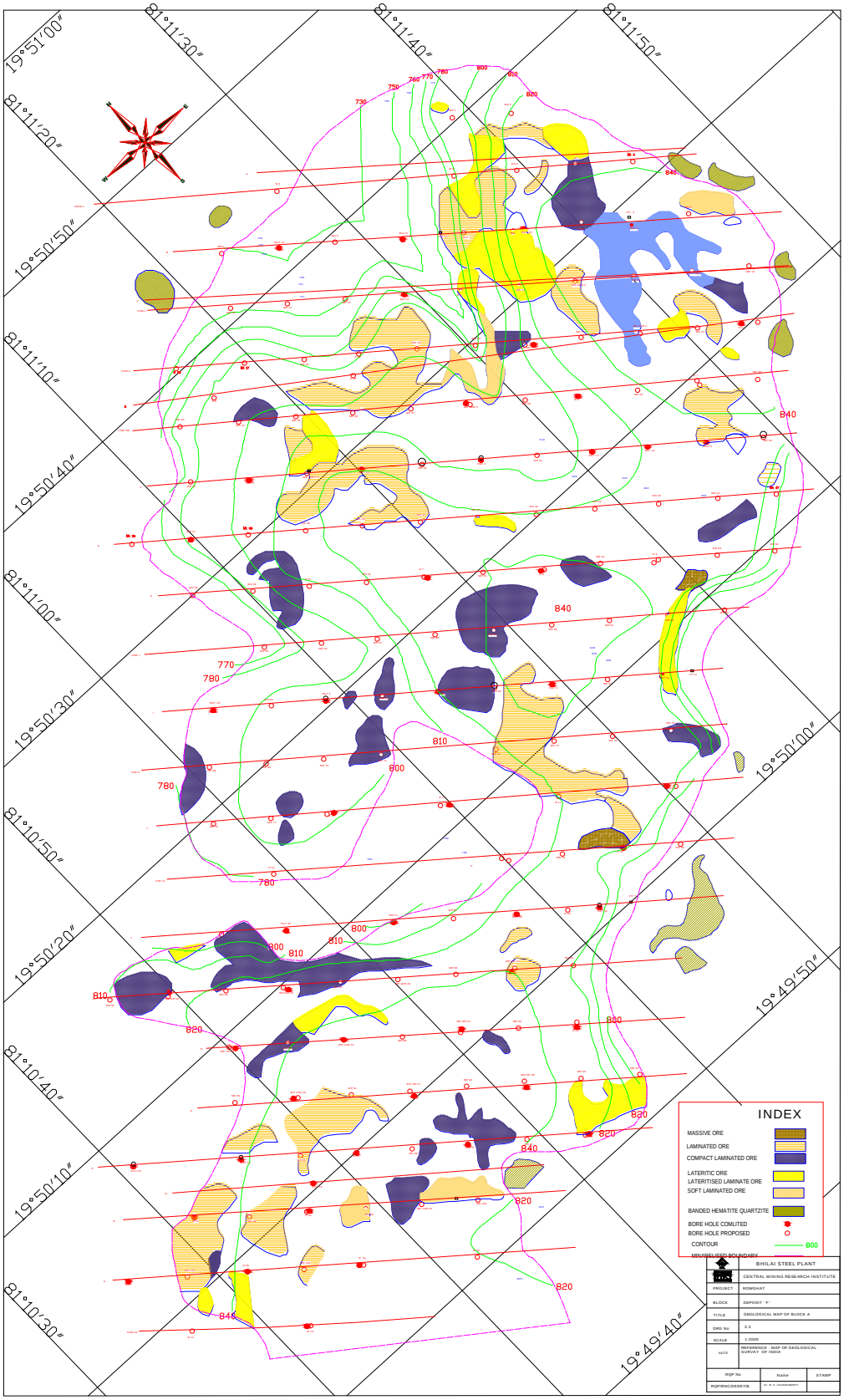

Fig 1: Geological Map of Block-A

3.5.2 Mineral Reserves

Considering the problem of cut-off both from the point of view of average grade and homogeneity, a cut-off of 55% Fe is adopted for this purpose. Apart from the non-ore bands in the ore-body, viz. ferruginous shale and BHQ, laterite and lateritic ore cover the upper portion of the ore body up to certain depth. Considering the cut-off of 55% Fe, the laterite with certain part of lateritic ore in it with less than 55% Fe for all practical purposes, has been considered as laterite and forms the overburden.

Table 1: Cross section wise iron ore reserves and grades of all the blocks

Block	Reserves, Mt	Grade, % Fe
Raodongri	47.420	61.62
Block-A	254.593	62.87
Tarhur	49.3	63.74
Anjarel	80.5	64.32
Korgaon	41.39	62.82
Kharkagaon	25.38	61.59
Takrel	12.46	59.62
Total	511.043	62.92

3.5.3 Mining

It is proposed to exploit 14 million tones / year of iron ore from the deposit. As the mineral area falls in reserve forest, therefore it is proposed to exploit three blocks viz. Block A, Tarhur and Anjarel in first phase and remaining three blocks in the second phase to have a smaller opened up area at any one time.
Out of the total land requirement, mineralized area required is 322.78 ha in first phase and 355.85 ha in the second phase.

Initially it is proposed to develop Block-A, Tarhur and Anjarel together in order to excavate the total R.O.M. of 14 MTPA of the desired quality. In order to get the desired quality of the dry screened +15-30 mm fraction the richer Anjarel block (+64% Fe) has to be opened up along with Block-A and Tarhur to act as sweetener. The mine will be opened from the northern end of Block A, nearest to the state highway. Excavation will be started at +840 mRL at 3 locations in Block-A. In Tarhur excavation will start in benches along the strike at +850 mRL. Similarly mining will be carried out in the +870 mRL at Anjarel.

Due to the heterogeneity of the iron ore deposit, particularly along depth and the general phenomenon that the top slices are usually of lower grade, a number of benches have to be opened and worked simultaneously to supply average grade input to the crushing units. It is proposed to work the mine by Shovel-Dumper combination.
The ROM Ore will be transported through internal haul roads by 120 ton dumper to the primary & secondary crushing units to be set up at the hilltop. The secondary crushed product (-80mm) will be transported to the loading bay through flat bed/pipe conveyors where it will be screened to separate the lump size fraction, to railway siding located at

foot hill for direct dispatch to Bhilai, rest of the material will be dispatched to Dalli-Rajhara for beneficiation.

It is proposed to mine ore by 10 cu m shovel and 120 T dumpers. A 3.5 cubic meter hydraulic backhoe has additionally been proposed for selective mining particularly near contact zone. It is proposed to work the benches of 10 m height. On the basis of geo-engineering characteristic of the deposit, mining system parameters like width, height and slope of the working benches have been decided.

Table 2: Mine system parameters

Particular	Unit	System Parameters
Maximum Bench HeightOre/ OB	Meter	10
Working bench width	Meter	20
Non working bench width	Meter	10
Bench slope	Degree	70
Pit slope	Degree	45
Blast hole dia.	mm	150
Inclination of blast hole	Vertical	

Designing of the mining system has been done in the light of technical parameters of HEMM. Safety guidelines of Director General of Mine Safety (DGMS) have also been considered in designing the mine. However for overburden removal of 15000 tones per day where the bench height of 3.28 meter, it is proposed to deploy 5 cubic meter hydraulic shovel along with 50 tones dumper.

Gradient of haul road will be maintained at 1 in 16. Only in pit temporary ramps of 1 in 10 will be provided. In this shovel dumper mining system, the slope of each bench will be kept 70° but overall slope of working benches will be kept 45°.

The overburden will be dumped in valley portion outside the mineral boundary adjacent to Block A and Tarhur initially and after 10 years the overburden will be backfilled in Tarhur block. Overburden will be dumped layer by layer and height of each layer will not exceed 30m.

The proposed three blocks in Phase I can be approached from two sides but it is proposed to approach Block-A from the existing PWD metal road on the NE side and other two block will be connected internally.

3.5.4 Mineral Processing:

No beneficiation of ore will be carried out at Rowghat. The ROM ore will be basically sized by a series of crusher i.e primary/ secondary crusher and further screened to form the lump/ fines fraction. As the strike length of the deposit is very high, 2 Nos. of primary crushing plants have been planned for the purpose of reducing the lead

distance of dumpers to feed the crusher. In order to blend the varying quality of iron ore from different blocks and to feed reasonably consistent average quality iron ore to the Crushing Plants, provision of pre-crusher stockpiles has been envisaged.

The major equipment, including the **Primary and Secondary Crushing Plant**, are:

i. Large capacity Hopper
ii. Dumping platform
iii. Feeders
iv. Overhead Crane
v. Screens, and a number of inter-connecting conveyors

These facilities will be housed in large covered buildings on hilltop/ slope of the hill ranges.

Down-hill Conveying System

The secondary crushed product from these units is proposed to be taken to the screening plant through down-hill conveyors of adequate capacity. Pipe conveyors will be used in steeper portions whereas open conveyors will be used in areas with gentler gradients. The total length of such downhill conveyor system will be about 11-12 km.

Dry Screening Plant

As it is proposed to separate the lumps fraction for direct dispatch to Bhilai, a 14 MTPA dry screening plant is envisaged to be built before the loading siding. The plant will consist of a series of circular motion double deck screens. The lumps produced will be dispatched to Bhilai for use as BF grade ore. The remaining fines fraction will be loaded into wagons and transported to Dalli-Rajhara for beneficiation.

Loading Siding at foothill

In order to handle such huge requirement of dispatches, an extensive railway yard with facilities for stockpiling of ore, handling of incoming empty wagons, a number of loading and shunting lines etc. will be required. The loading yard required will cover about 62.00 ha area which completely covers forest land.

Foothill Complex

All buildings and facilities such as Main Administrative Building and Site Office, Security Barrack, Time Office, Canteen, Vocational Training, Medical Post, Water Storage and Distribution Centres, etc, will require about 10 ha area at the foothill.

3.5.5 Mineral Transport

The ROM Ore will be transported through internal haul roads by 120 ton rear discharge dumpers to the primary & secondary crushing units to be set up at the hilltop. The secondary crushed product will be transported to the loading bay at foothill through flat bed/pipe conveyors where it will be screened to separate the lump size fraction which will be directly dispatched to BSP through rail while the fines will be dispatched to Dalli-Rajhara mines (existing ML of BSP, SAIL at a distance of 95 km from Rowghat) for beneficiation through rail only.

The rail line from Dalli Rajhara to Jagdalpur is in progress enroute the Rowghat project. The distance from Dalli Rajhara to Rowghat in the proposed rail route is about 95 km. As of now, the construction work of rail line has been completed upto Gudum (17 km from Dalli Rajhara) and the rail head is expected to reach Keonti (42 km from Dalli Rajhara and almost half way to Rowghat) by the end of year 2017. Further, it is expected that the rail line will reach Rowghat by the end of year 2021.

With the present limited life of the existing reserves of iron ore at Dalli-Rajhara mine and the increased iron ore requirement for the proposed hot metal production of BSP, development of Rowghat Deposit has become essential and urgent. Due to the present limitation of transportation of ore through rail mode, it has been thought whether mining activities at Rowghat can be initiated and supply of limited quantity of iron ore from the ML can be assured through the existing road to Keonti so that further transportation from Keonti to BSP via. Dalli Rajhara can be done through rail mode for the time being till the rail head reaches Rowghat.

A traffic study of the existing road for the purpose was carried out along with base line air quality (one month) monitoring along the road evacuation corridor upto Keonti. Keeping into consideration the existing traffic and road condition a maximum figure of 0.3 MTPA only has been considered that can be effectively evacuated through road.

Traffic carrying capacity study to assess feasible increase in existing road traffic for transportation of iron ore that can be evacuated through road from Rowghat mine upto railway siding near keonti and **Environmental impact w.r.t Air quality and Noise levels due to proposed mineral evacuation** through the above mentioned road corridor is enclosed as **Annexure – 1.** The road evacuation corridor along with AAQ, Noise monitoring stations and traffic survey locations are shown in **Drg. No. MEC/C38G/11/16/2.0.**

Amendment in EC condition is accordingly requested for transportation of 0.3 MTPA of iron ore from the ML to Keonti through road till the railhead reaches Rowghat by the end of year 2021.

3.6 RAW MATERIALS

The project is for mining & processing of iron ore from the leasehold. Therefore, major resources / materials required for the project are fuels & explosives. One explosive magazine of 300t capacity has been planned for Rowghat ML. In order to supply of fuel to the Dumpers, Shovels and other mining machinery deployed in the Mines, aHSD storage and distribution has been provided at Barsua. The

requirement of fuel and explosive at the Rowghat ML for mining and associated activities are given in **Table 3 below:**

Type	Daily requirement (Max.)
HSD	30 kld (Approx.)
Explosives	7.5 tpd (Approx.)

3.7 RESOURCE OPTIMIZATION / RECYCLING AND RESOURCE

No tails will be generated at Rowghat ML. The entire ROM will be sized and the lumps will be sent to BSP and the fines will be sent to Dalli-Rajhara beneficiation plant.

3.8 SITE SERVICES

3.8.1 WaterRequirement:

Water requirement for Rowghat ML is 6850 cu.m/ day. The water requirement will be met from Mendki river & Nibra nallah.

3.8.2 Power Requirement

Power will be required for some of the mining equipment, beneficiation plant, conveyors, pellet plant, illumination and water supply. Chhattisgarh State Electricity Board (CSEB) has given its consent to provide required power to the project. It is presumed that CSEB will provide power at the Main Receiving Station in the Foothill Complex. Accordingly the HT line has been laid up to the Hilltop Complex.

3.8.3 Amenities

The leasehold area will hosts statutory facilities *viz.* crèche, canteen, first – aid centre, vocational training centre etc. and also Administration block, servicing and repairing shops, fuel pump station and a medical unit. Residential accommodations for staffs and executives will be provided near Narayanpur.

3.9 WASTES

The overburden will be dumped in valley portion outside the mineral boundary adjacent to Block A and Tarhur initially and after 10 years the overburden will be backfilled in Tarhur block. Overburden will be dumped layer by layer and height of each layer will not exceed 30m.

3.10 EMPLOYMENT

The proposed manpower for Rowghat will be 1018 Nos.

4.0 SITE ANALYSIS

4.1 CONNECTIVITY

The nearest villages are Bhaisagaon (forest village) and Aturbeda. Rowghat can be approached by Rajnandgaon - Kondagaon State Highway (SH-5) via Dalli-Rajhara. Dalli-Rajhara is the nearest railhead on South East Central Railway and is about 95 km from Bhaisagaon. The area is also connected to National Highway no. 43 (NH-43) (Raipur -

Vishakhapatnam) through Narayanpur and Kondagaon, which is 70 km from Rowghat via Narayanpur on SH-5. The Bailadila iron ore mine of National Mineral Development Corporation (NMDC) is about 230 km south of Rowghat by road via Jagdalpur.

Deposit-F is an elongated ridge trending NE-SW and forming the eastern limb of Rowghat syncline. General strike of the deposit is NNE-SSW and dip of the ore body varies from 300-700 due E and even to 900 at places. Approximate strike length of deposit-F is 13 km and average width is 9 km.

4.2 LAND FORM, LAND USE, OWNERSHIP

The entire ML area comprising of 2028.797 ha comes under Matla RF.

4.3 TOPOGRAPHY

The iron ore bearing rocks constitutes a predominant 'M' shaped ridge at Rowghat, surrounded by almost flat and undulating plains. The average elevation of the plains varies between 300 & 400 meters above M.S.L. and the ridges upto 891.43 m above M.S.L.

There are four prominent ridges in the area viz. Eastern, Middle-1, Middle-2 and Western ridge. The Eastern ridge comprising Deposit-F starts from about 2 km WSW of Kharkagaon and continues northeasterly to about a km west of Aturbeda, covering a distance of about 14 km. The important peak i.e. 886 m (2938') is located in the northern part of the deposit. The top portion of the ridge is almost flat and presents a plateau like topography with occasional mounds.

The Mendki River situated to the NE of the ridge along with its tributaries constitutes the main drainage system. It flows roughly in a northwesterly direction till it joins the southwesterly flowing Tadoki River. After the confluence, it flows along westerly direction.

4.4 LAND USE

Entire ML area falls under Matla R.F.

Table 4: The details of the landuse (in ha)

Partculars	*Inside ML*	*Outside ML*
Mining	678.63	0
Dumping	52.48	0
Hill top infrastructure complex	19.80	0
Roads	8.65	31.35
Explosive magazine	0.85	0
Power coridor	1.00	2.30
Conveyor gallery	0	9.45
Loading yard	0	62.00
Foothill complex	0	16.71
Sub total	761.41	121.81
Undisturbed	1267.387	-
Total	**2028.797**	**121.81**

4.5 EXISTING INFRASTRUCTURE

The area is almost virgin and approach roads to the hill top are under process of construction.

4.6 SOIL CLASSIFICATION

The soil is lateritic, typical of the area. The thickness of the top soil varies from nil (due to outcropping of iron ore to maximum of 60 cm.

4.7 CLIMATE

The period from July to September is characterized by heavy downpour and incessant rains, the average annual rainfall being 1530 mm. October and November are the pleasant months, while the peak winter months are December to February when the temperature falls down to 4.40C. The summer months of March to June are quite hot and dry. The temperature rises to 45.50C during these months.

4.8 SOCIAL INFRASTRUCTURE AVAILABLE:

SAIL, has been providing social amenities for local villagers, most of whom are tribals. SAIL has made arrangements for supply of clean drinking water to nearby villages. The company has built roads, community halls, bus shelters in villages. Village schools have been provided financial and material assistance. Financial grants have been given to village events / festivals. SAIL's doctors hold free medical camps twice in a week, where medicines are also provide free of charge. SAIL has also been distributing good quality saplings of fruit bearing trees to local villagers free of charge.

5.0 PLANNING BRIEF :

5.1 PLANNING CONCEPT:

The Ministry of Mines, Govt. of India, vide letter dated 04.01.07 has accorded approval under section 5(1) and relaxation under section 6(1)(b) of MM(D&R) Act, 1957, for grant of Mining Lease over an area of 2028.797 hectares in Deposit-F of Rowghat, comprising of 7 blocks namely Raodongri, Block-A, Tarhur, Anjarel, Korgaon, Kharkagaon and Takrel in favour of M/s. Steel Authority of India Limited. Accordingly, terms & conditions for grant of the above mentioned ML was accorded to SAIL by the State Govt. vide letter dated 9.1.2007. The mining plan of Rowghat was approved by IBM vide letter dated 22.3.2007. The environment clearance for the ML area was accorded by MoEFCC vide letter dated 4.6.2009. The forest clearance has been accorded for an area of 883.22 Ha. vide letter dated 3.8.2009.

The concept was to develop Rowghat deposit in phases (Phase – 1 & 2) to meet the partial requirement of iron ore of Bhilai Steel Plant (BSP). It is proposed to initially develop 3 blocks viz. Block-A, Tarhur and Anjarel for excavation of total ROM of 14 MTPA in phase-1.

The ROM Ore will be transported through internal haul roads by 120 ton rear discharge dumpers to the primary & secondary crushing units to be set up at

the hilltop. The secondary crushed product will be transported to the loading bay at foothill through flat bed/pipe conveyors where it will be screened to separate the lump size fraction which will be directly dispatched to BSP through rail while the fines will be dispatched to Dalli-Rajhara mines (existing ML of BSP, SAIL at a distance of 95 km from Rowghat) for beneficiation through rail only.

The rail line from Dalli Rajhara to Jagdalpur is in progress enroute the Rowghat project. The distance from Dalli Rajhara to Rowghat in the proposed rail route is about 95 km. As of now, the construction work of rail line has been completed upto Guru (17 km from Dalli Rajhara) and the rail head is expected to reach Keonti (42 km from Dalli Rajhara and almost half way to Rowghat) by the end of year 2017. Further, it is expected that the rail line will reach Rowghat by the end of year 2021.

With the present limited life of the existing reserves of iron ore at Dalli-Rajhara mine and the increased iron ore requirement for the proposed hot metal production of BSP, development of Rowghat Deposit has become essential and urgent. Due to the present limitation of transportation of ore through rail mode, it has been thought whether mining activities at Rowghat can be initiated and supply of limited quantity of iron ore from the ML can be assured through the existing road to Keonti so that further transportation from Keonti to BSP via. Dalli Rajhara can be done through rail mode for the time being till the rail head reaches Rowghat.

A traffic study of the existing road for the purpose was carried out along with base line air quality (one month) monitoring along the road evacuation corridor upto Keonti. Keeping into consideration the existing traffic and road condition a maximum figure of 0.3 MTPA only has been considered that can be effectively evacuated through road.

Amendment in EC condition is accordingly requested for transportation of 0.3 MTPA of iron ore from the ML to Keonti through road till the railhead reaches Rowghat by the end of year 2021.

5.2 LAND USE PLANNING:

Entire ML area falls under Matla R.F. is given below:-

Table 5: The details of the landuse (in ha)

Partculars	*Inside ML*	*Outside ML*
Mining	678.63	0
Dumping	52.48	0
Hill top infrastructure complex	19.80	0
Roads	8.65	33.55
Explosive magazine	0.85	0
Power coridor	1.00	2.30
Conveyor gallery	0	9.45
Loading yard	0	62.00
Foothill complex	0	15.36
Sub total	761.41	122.66
Undisturbed	1267.387	-
Total	**2028.797**	**122.66**

5.3 ASSESSMENT OF INFRASTRUCTURE DEMAND

The area is almost virgin and approach roads to the hill top are under process of construction. In the last decade SAIL (BSP) has spent more than Rs. 33/- crores in the CSR activities in and around Rowghat Mines. The leasehold area will hosts statutory facilities *viz.* crèche, canteen, first – aid centre, vocational training centre etc. and also administration block, servicing and repairing shops, fuel pump station and a medical unit. Residential accommodations for staffs and executives will be provided near Narayanpur.

5.4 AMENITIES / FACILITIES

The area is almost virgin and approach roads to the hill top is under process of construction.

6.0 PROPOSED INFRASTRUCTURE:

The leasehold area will hosts statutory facilities *viz.* crèche, canteen, first – aid centre, vocational training centre etc. and also administration block, servicing and repairing shops, fuel pump station and a medical unit. Residential accommodations for staffs and executives will be provided near Narayanpur.

CSR Activities: SAIL has formulated CSR policy for showing its commitments towards economic as well as social development. The company's CSR policy recognizes that its business activities have direct and indirect impact on the society. The policy also aims improving the quality of life of the workforce and their families as well as of the local community and society at large.

In line with CSR policy of SAIL, Bhilai Steel Plant (BSP) has also contributed for social up-liftments of regions in and around its mining complexes. The major CSR activities of SAIL, BSP can be grouped as following:

- Free Medical Camp with medicine
- Solar light
- Distribution of School bags and stationary
- Construction of Community Hall
- Approach Road
- Drinking Water supply
- Digging of Tank in villages
- Self employment / Income generation programme

SAIL-BSP has already started peripheral development of the area under CSR activities even before commencement of mining at Rowghat mines. The expenditure made under CSR activities for Rowghat mines during the last 11 years area as follows:

Table 6: CSR Expenditure done under Rowghat Mines (Rs. Lakh)

Year	Expenditure in ₹, Lakhs
2007-08	28.08
2008-09	57.26
2009-10	792.43
2010-11	126.18

Year	Expenditure in ₹, Lakhs
2011-12	229.24
2012-13	180.17
2013-14	210.72
2014-15	887.70
2015-16	299.83
2016-17 (till Nov. 2016	524.60
Total	**3336.21**

7.0 REHABILITATION & RESETTLEMENT (R&R) PLAN :

The project does envisage any leasing or acquisition of private land. Hence there would not be any land oustees who have to be resettled our rehabilitated.

8.0 PROJECT SCHEDULE & COST ESTIMATE

8.1 LIKELY DATE OF START OF CONSTRUCTION AND LIKELY DATE OF COMPLETION:

The rail line from Dalli Rajhara to Jagdalpur is in progress enroute the Rowghat project. The distance from Dalli Rajhara to Rowghat in the proposed rail route is about 95 km. As of now, the construction work of rail line has been completed upto Gudum (17 km from Dalli Rajhara) and the rail head is expected to reach Keonti (42 km from Dalli Rajhara and almost half way to Rowghat) by the end of year 2017. Further, it is expected that the rail line will reach Rowghat by the end of year 2021.

With the present limited life of the existing reserves of iron ore at Dalli-Rajhara mine and the increased iron ore requirement for the proposed hot metal production of BSP, development of Rowghat Deposit has become essential and urgent. Due to the present limitation of transportation of ore through rail mode, it has been thought whether mining activities at Rowghat can be initiated and supply of limited quantity of iron ore from the ML can be assured through the existing road to Keonti so that further transportation from Keonti to BSP via. Dalli Rajhara can be done through rail mode for the time being till the rail head reaches Rowghat.

A traffic study of the existing road for the purpose was carried out along with base line air quality (one month) monitoring along the road evacuation corridor upto Keonti. Keeping into consideration the existing traffic and road condition a maximum figure of 0.3 MTPA only has been considered that can be effectively evacuated through road.

Amendment in EC condition is accordingly requested for transportation of 0.3 MTPA of iron ore from the ML to Keonti through road till the railhead reaches Rowghat by the end of year 2021.

8.2 ESTIMATED PROJECT COST AND ECONOMIC VIABILITY OF THE PROJECT

The total estimated project cost involving facilities at Rowghat is Rs. 250000lakhs (Approx.). The project is economically viable. Further, the project is very much essential and technical necessity to ensure adequate & uninterrupted supply of iron ore to the modernized / expanded steel plants of BSP.

8.2.1 Cost of Mining & Cost of Mineral :

The entire production of iron ore from Rowghat Mines will be consumed in SAIL's own steel plants. Cost of Production of iron ore will claim on transfer price Rs. 609 per tonne at rated capacity.

9.0 ANALYSIS OF PROPOSAL (FINAL RECOMMENDATION)

The project was granted Environmental Clearance for 14 Mt/y iron ore by MoEFCC vide letter no. J-11015/331/2006–IA.II (M) dated 4th June, 2009 and 15th March, 2010. The present proposal is for seeking amendment in the Environmental Clearance as per the details given below**:**

Sr. No.	As per EC granted	Amendment sought in EC condition
1.	From Rowghat ML to Dalli-Rajhara/Bhilai the iron ore (14Mt/yr.) was envisaged to be transported through rail mode.	Transportation of (0.3 Mt/y) iron ore through road from Rowghat ML to Keoti till the rail line reaches upto Rowghat by 2021.

(Mt/yr – million tonnes per year)

Note:

The above stated amendment in EC condition is being proposed temporarily for a period of about 5 years (i.e. upto 2021) to meet the immediate requirement of iron ore of the SAIL, BSP. During the intervening period of 5 years, the originally envisaged and approved infrastructure such as Crushing/ Screening plant with downhill conveying & loading facilities at Rowghat ML are expected to be established and commissioned. Thereafter, the project will operate as per the originally approved EC condition.

The project will have the following benefits:

- The project will provide increased requirement of iron ore for the SAIL steel plants, which have already been expanded.
- In addition, it will add to revenue generation of the District / State.
- There will be social benefits from the mining operation in the region. The underlying benefits through the proposed project are :
    - Additional direct / indirect employment to the local population of the area.
    - Fulfillment of social sustainable responsibility through promoting and maintaining permanent structure as follows :

- Facility for village school including classroom, toilet construction, ceiling fan/coolers or books for school library.
- Vocational training to be provided to the persons for improving their skills in income generation techniques like stitching, Hatchery. Plumber, carpenter, blacksmith etc.
- Formation of self-help groups to develop the saving and helping each other with financial resources instead of going for heavy interest debts.

Considering the above points, the proposed modification in scope of work of the Rowghat ML has become necessary.

STEEL AUTHORITY OF INDIA LIMITED

Pre-Feasibility Report **Annexure - 1**

- TRAFFIC CARRYING CAPACITY STUDY to assess feasible increase in existing road traffic for transportation of iron ore that can be evacuated through road from Rowghat mine upto railway siding near Keonti and

- ENVIRONMENTAL IMPACT FOR PROPOSED MINERAL EVACUATION road corridor from Rowghat mine upto railway siding near Keonti (as Annexure-1 of the Pre Feasibility Report)

MECON LIMITED
RANCHI – 834002
INDIA

MEC/11/16/C38G/SR/2285/R0 **December, 2016**

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1.0 BACKGROUND

Steel Authority of India Limited (SAIL), a public sector undertaking under Ministry of Steel, Government of India, is the leading steel maker in the country and is having integrated steel plants at Bokaro, Durgapur, Rourkela, Bhilai, Burnpur, Bhadrawati and Chandrapur. Also, SAIL has the second largest mining outfit in the country after Coal India Limited. Spread over the states of Jharkhand, Orissa and Chhattisgarh, the mines of SAIL commenced their operations as captive sources of raw materials for its integrated steel plants.

The Ministry of Mines, Govt. of India has accorded approval under section 5(1) and relaxation under section 6(1)(b) of MM(D&R) Act, 1957, for grant of Mining Lease over an area of 2028.797 hectares in Deposit-F of Rowghat, comprising of 7 blocks namely Raodongri, Block-A, Tarhur, Anjarel, Korgaon, Kharkagaon and Takrel in favour of M/s. Steel Authority of India Limited. The mining plan of Rowghat has already been approved by IBM vide letter dated 22.3.2007. The environment clearance for the ML area was accorded by MoEFCC vide letter dated 4.6.2009. The forest clearance has been accorded for an area of 883.22 Ha. vide letter dated 3.8.2009.

As conceptualized, the Rowghat deposit is to be developed in two phases, namely, Phase–1 & 2 to meet the partial requirement of iron ore demand of Bhilai Steel Plant (BSP). It is proposed to initially develop 3 blocks viz. Block-A, Tarhur and Anjrel for excavation of total ROM of 14 MTPA in phase-1.

The ROM Ore from the Rowghat Iron Ore Mine will be transported through internal haul roads by 120 ton rear discharge dumpers to the primary & secondary crushing units to be set up at the hilltop. The secondary crushed product will be transported to the loading bay at foothill through flat bed/pipe conveyors where it will be screened to separate the lump size fraction which will be directly dispatched to BSP through rail while the fines will be dispatched to Dalli-Rajhara mines (existing ML of BSP, SAIL at a distance of 95km from Rowghat) for beneficiation through rail only.

The rail line from Dalli Rajhara to Jagdalpur is in progress enroute the Rowghat project. The distance from Dalli Rajhara to Rowghat in the proposed rail route is about 95 km. As of now, the construction work of rail line has been completed upto Gudum (17 km from Dalli Rajhara) and the rail head is expected to reach Keonti (42 km from Dalli Rajhara and almost half way to Rowghat) by the end of year 2017. Further, it is expected that the rail line will reach Rowghat by the end of year 2021.

With the continuously depleting existing iron ore reserves at Dalli-Rajhara mine and the increased demand of iron ore for the proposed hot metal production of BSP, development of Rowghat Deposit has become essential and imperative.

Hence, as the construction of railway line between Keonti to Rowghat mine segment is yet to be completed and will take some more time to complete, SAIL-BSP is planning to transport iron ore from Rowghat Mining Lease (ML) to its railway siding near Keonti by road along the State Highway (SH-5), for its further onward transportation through rail to Bhilai Steel Plant (BSP), until the construction of rail head reaches Rowghat.

Sr. No	Scope of Work as per EC granted	Modified present proposal
Transportation		
1.	Proposed railway siding near foothill of Rowghat Iron Ore Mine to Railway siding near keonti	Rowghat ML to railway siding near keonti (~0.30 MT/yr) for onward transporatation to BSP, SAIL

A traffic study of the existing road for the purpose was carried out along with base line air quality (one month) monitoring along the road evacuation corridor upto Keonti. Keeping into consideration the existing traffic and road condition a maximum figure of 0.3 MTPA only has been considered that can be effectively evacuated through the road.

Thus, giving due recognition to the safety and ecosystem of the proposed evacuation corridor amendment in EC condition is requested for transportation of 0.3 MTPA of iron ore from the Rowghat ML to Keonti through road till the construction of railhead reaches Rowghat expectedly by the end of year 2021.

As the above proposed change of EC condition likely to impact the local road infrastructure as also the air quality of the area, specific environmental studies viz., Traffic Density Study, Air Quality Impact Predication Study and Noise level have been carried out and presented in the report.

2.0 LOCATION

The iron ore Deposits A to E at Rowghat are located in the Matla Reserved Forest area of Kanker & Narayanpur Districts of Chhattisgarh. Deposit-F lies at the boundary of two forest divisions, i.e. Narayanpur in Bastar District and Bhanupratappur-(East) in Kanker District. It is about 20 km NNW of Narayanpur Town, a Tehsil under Narayanpur District. The portion of Deposit-F reserved for SAIL is spread between latitudes 19°45'15" & 19°50'50" and longitudes

81°08'30 and 81°12'16" in Survey of India Toposheet no. 65 E/1. Locations of ML is shown in Drawing No. MEC/C38G/11/16/1.0.

The nearest villages are Bhaisagaon (forest village) and Aturbeda. Rowghat can be approached by Rajnandgaon - Kondagaon State Highway (SH-5) via Dalli-Rajhara. Dalli-Rajhara is the nearest railhead on South East Central Railway and is about 90 km from Bhaisagaon. The area is also connected to National Highway no. 43 (NH-43) (Raipur - Vishakhapatnam) through Narayanpur and Kondagaon, which is 70 km from Rowghat via Narayanpur on SH-5. The Bailadila iron ore mine of National Mineral Development Corporation (NMDC) is about 230 km south of Rowghat by road via Jagdalpur.

The road evacuation corridor along with AAQ, Noise monitoring stations and traffic survey locations are shown in Drg. No. MEC/C38G/11/16/2.0.

3.0 PHYSIOGRAPHY

The iron ore bearing rocks constitutes a predominant 'M' shaped ridge at Rowghat, surrounded by almost flat and undulating plains. The average elevation of the plains varies between 300 & 400 meters above M.S.L. and the ridges upto 891.43 m above M.S.L.

There are four prominent ridges in the area viz. Eastern, Middle-1, Middle-2 and Western ridge. The Eastern ridge comprising Deposit-F starts from about 2 km WSW of Kharkagaon and continues northeasterly to about a km west of Aturbeda, covering a distance of about 14 km. The important peak i.e. 886 m (2938') is located in the northern part of the deposit. The top portion of the ridge is almost flat and presents a plateau like topography with occasional mounds.

The Mendki River situated to the NE of the ridge along with its tributaries constitutes the main drainage system. It flows roughly in a northwesterly direction till it joins the southwesterly flowing Tadoki River. After the confluence, it flows along westernly direction.

4.0 CLIMATE

The area lies in tropical region where climate is characterized by very hot summers and cool winters. The period from July to September is characterized by heavy downpour and incessant rains, the average annual rainfall being 1530 mm with 60-70 rainy days. October and November are the pleasant months, while the peak winter months are December to February when the temperature falls down to 4.4^0C. The summer months of March to June are quite hot and dry. The temperature rises to 45.5^0C during these months.

The meteorological station was set up at BSP Hospital, Antagarh. Wind frequency distribution was monitored during (Oct. - Nov. 2016). Overall including day and night the predominant wind direction is from SSW (2.48%), followed by S (2.07%), SW (1.66%) and N (1.66%). The calm conditions prevailed for 88.02% of the time. During day time predominant wind direction was SSW (4.64%) followed by NNW (4.10%), S (3.83%) and N (3.01%); calm conditions prevailed for 78.69% of the time. During night time the predominant wind is SSE (0.83%) followed by N, NNE, ESE, SE, S and SSW (0.28%) and calm condition prevailed for 97.28% of the time

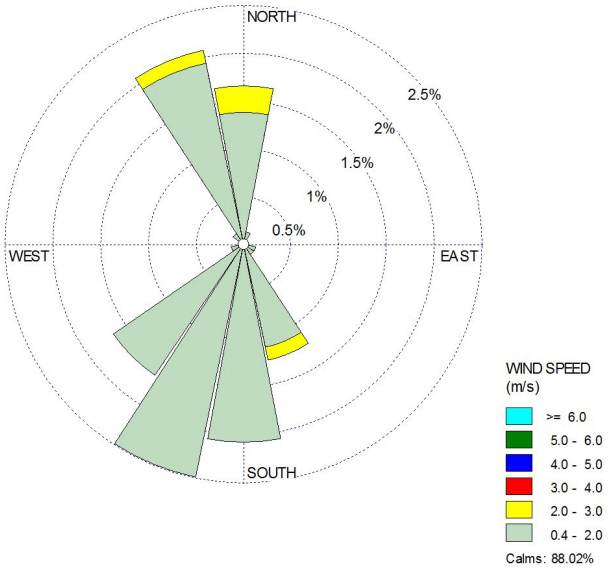


Fig.1: Wind Rose at BSP Hospital, Antagarh (24 hours overall)

5.0 TRAFFIC SURVEY

5.1 TRAFFIC ARRANGEMENTS AS PER EARLIER EC CONDITION

The ROM Ore will be transported through internal haul roads by 120 ton rear discharge dumpers to the primary & secondary crushing units to be set up at the hilltop. The secondary crushed product will be transported to the loading bay at foothill through flat bed/pipe conveyors where it will be screened to separate the lump size fraction which will be directly dispatched to BSP through rail while the fines will be dispatched to Dalli-Rajhara mines (existing ML of BSP, SAIL at a distance of 95 km from Rowghat) for beneficiation through rail only.

5.2 PROPOSED TRAFFIC ARRANGEMENTS

The rail line from Dalli Rajhara to Jagdalpur is in progress enroute the Rowghat project. The distance from Dalli Rajhara to Rowghat in the proposed rail route is about 95 km. As of now, the construction work of rail line has been completed

upto Gudum (17 km from Dalli Rajhara) and the rail head is expected to reach Keonti (42 km from Dalli Rajhara and almost half way to Rowghat) by the end of year 2017. Further, it is expected that the rail line will reach Rowghat by the end of year 2021.

With the present limited life of the existing reserves of iron ore at Dalli-Rajhara mine and the increased iron ore requirement for the proposed hot metal production of BSP, development of Rowghat Deposit has become essential and urgent. Due to the present limitation of transportation of ore through rail mode, it has been thought whether mining activities at Rowghat can be initiated and supply of limited quantity of iron ore from the ML can be assured through the existing road to Keonti so that further transportation from Keonti to BSP via. Dalli Rajhara can be done through rail mode for the time being till the rail head reaches Rowghat.

A traffic study of the existing road for the purpose was carried out along with base line air quality (one month) monitoring along the road evacuation corridor upto Keonti. Keeping into consideration the existing traffic and road condition a maximum figure of 0.3 MTPA only has been considered that can be effectively evacuated through road.

5.3 PREVAILING ROAD CONDITION

Data of existing road conditions, traffic survey report etc. has been collected from the PWD Dept. of Chhattisgarh state and also through primary traffic survey data collected during the study period (October' 2016) by team of MECON assisted by SAIL officials. The approximate length of road from Rowghat ML upto proposed railway siding near Keonti is about 60 Km. The details of road width, type, length etc. are given below in Table 1:

Table 1: details of road width, type, length

Sl.No	Stretch	Length in Km (Approx)	Type of Road	Existing Carriageway Width, m	Existing Shoulder Width (approx),m
1	Proposed Railway siding near Keonti to Antagarh	23.0	Bituminous	7.0	1.0-1.5
2	Antagarh to junction on SH-5	30.0	Bituminous	3.75	1.0-1.5
3	Junction on SH-5 to Rowghat mine	7.0	WBM / Moorum	3.75	-
	Total Length	60.0			

Moorum shoulders are present on the road stretches mentioned at Sl. No. 1, 2 & 3 of the above table. In case of road stretch, mentioned at Sl. No. 4 of the above table, either

there is no shoulder or is covered with vegetation. The road formation width ranges from 10 – 12 m.

On the project road there are more than 80 culverts and few bridges. The width of the culverts & bridges ranges from 8.5m to 12m. Some of the culverts need repair.

The following photographs show the prevailing condition of road & shoulder width in different stretches.

Road between Rowghat to SH-5 (showing the road)

Road between Rowghat to SH-5 (showing the road)

Road between Junction on SH-5 to Antagarh (showing road & shoulder)

Road between Junction on SH-5 to Antagarh (showing damaged shoulder)

Road between Junction on SH-5 to Antagarh (showing existing 2 lane bridge)

Road between Junction on SH-5 to Antagarh (showing existing 2 lane bridge)

Road between Junction on SH-5 to Antagarh (showing damaged edges)

Road between Junction on SH-5 to Antagarh (showing damaged road)

Road between Antagarh to Keonti (showing existing road & culvert)

Road between Antagarh to Keonti (showing damaged road edges)

Road between Antagarh to Keonti
(showing existing road)

Road between Antagarh to Keonti
(showing damaged road)

Road between Keonti to Prop. Rly. Siding
(showing existing road)

Road between Keonti to Prop. Rly. Siding
(showing existing road)

5.4 EXISTING ROAD CAPACITY (AS PER IRC)

The road carrying capacity values have been determined as per the guidelines of IRC: 64-1990. As per "IRC: 64.1990: Guidelines for Capacity of Roads in Rural Areas", the carrying capacity for different road widths are given below:

Table 2: IRC: 64.1990: The Carrying Capacity of Roads in Rural Areas

Sl. No	Type of road (Carriageway width)	Suggested Design Service Volume in PCU/Day		
		Plain	Rolling	Hilly
1	Single lane road (3.75m)	2000	1800	1600
2	Intermediate lane(5.5m)	6000	5700	5200
3	Two Lane road (7.0m)	15000	10000	7000

The above values are subject to reduction/ increment based on the type of pavement, shoulder condition & width. In case of 2-lane roads, when the shoulder width is less than 1.8m, various reduction factors of IRC: 64 are to be considered to arrive at design service volumes.

5.5 PROPOSED CARRYING CAPACITY OF THE PROJECT ROAD STRETCH

The terrain condition considered for the project road stretch is generally plain terrain and accordingly the design service volumes have been considered. The existing traffic volume at Antagarh is 1728 PCU and this traffic volume has been considered for the entire project road stretch. Traffic survey at three points i.e Keonti, Antagarh and Dandak Van has been carried out. The PCU values at Antagarh is slightly less than the traffic survey conducted by PWD. Hence the PWD traffic survey data has been considered for assessing the residual carrying capacity of the project road. The road between Antagarh to Rowghat mine is the critical stretch as the width of the road is only 3.75m and all the vehicles will be passing through this stretch to ply between Rowghat mines and the railway siding near Keonti.

Table 3: Design service volume in PCU/day & carrying caopacity available

Sl. No	Project Road Stretch	Existing Carriageway Width	Design service volume in PCU/day (as per IRC 64)	Existing PCU (based on Traffic survey data)	Capacity available (PCU)
1	Proposed Railway siding near Keonti to Antagarh	7.0	15000*0.92=13800	1728	12072
2	Antagarh to Junction on SH-5	3.75	2000	1728	272
3	Junction on SH-5 to Rowghat mine	3.75	2000	1728	272

Note: For Sl.No. 1 of the table a reduction factor of 0.92 has been considered due to shoulder width less than 1.8m as per IRC-64.

Thus analyzing the stretch between Antagarh to Rowghat mine from the above table it can be seen that this stretch can have spare capacity of only 272 PCU/day (both directions).

So, no. of PCUs in one direction = 272/2

= 136 PCU/day

No of Trucks = 136/3 Nos (considering 1Truck= 3 PCU)

= 45.3 Nos or 4 trucks per hour

Quantity of Iron ore transported/day	=	45*20	(considering 20T payload per truck)
	=	900 T	
Quantity of Iron ore transported/year	=	900*330	(No. of working days =330/year)
	=	2,97,000	T or say 3 lakh tons

Hence it can be seen that about 0.3 (Million tonnes per annum, Mtpa) can be transported through this stretch. Thus it can be concluded that in the present condition about 0.3 Mtpa can be transported through the proposed road keeping into consideration the safety and ecosystem of the area.

5.6 TRAFFIC DENSITY SURVEY RESULT

In order the assess the existing traffic on various ore transporting roads, traffic survey on 24 hourly basis was conducted at the following 3 locations:

1. Near Keonti
2. Antagarh
3. Dandak Van

The above Monitoring locations showing road evacuation corridor are marked in Drawing No. MEC/C38G/11/16/2.0.

At each of the above locations number of two wheelers (motor-cycles & scooters), light vehicles (cars, jeeps / SUVs) and heavy vehicles (buses and trucks) were passing either way were counted hourly continuously for 24 hours.

The results of the traffic density survey near keonti, Antagarh and Dandak van are given in Tables 4, 5 and 6 respectively.

Table 4: Results of Traffic Density Survey on near keonti on 29-10-2016

Time	Two Wheeler		LMV		HMV	
	To Narainpur	To Bhanupratapur	To Narainpur	To Bhanupratapur	To Narainpur	To Bhanupratapur
00:00 - 01:00	2	0	1	1	1	0
01:00 - 02:00	1	0	0	0	0	0
02:00 - 03:00	0	1	0	0	0	0

Table 4: Results of Traffic Density Survey on near keonti on 29-10-2016

03:00 - 04:00	0	0	0	0	0	0
04:00 - 05:00	8	3	2	4	0	0
05:00 - 06:00	9	10	6	7	4	1
06:00 - 07:00	12	13	12	10	2	3
07.00 - 08.00	19	16	8	12	8	4
08.00 - 09.00	23	20	13	17	10	6
09.00 - 10.00	30	23	20	22	7	6
10.00 - 11.00	32	37	27	35	6	5
11.00 - 12.00	44	40	36	30	9	7
12.00 - 13.00	33	36	18	24	6	7
13.00 - 14.00	21	45	23	29	11	8
14.00 - 15.00	13	30	16	21	10	4
15.00 - 16.00	20	22	21	34	6	5
16.00 - 17.00	18	16	14	18	4	8
17.00 - 18.00	11	19	9	14	3	9
18.00 - 19.00	14	13	13	7	2	4
19.00 - 20.00	10	12	11	11	2	5
20.00 - 21.00	7	8	8	6	3	1
21.00 - 22.00	4	6	10	10	4	2
22.00 - 23.00	6	3	4	7	1	0
23.00 - 00.00	3	4	1	2	0	1
Total Vehicles	340	377	273	321	99	86
PCU's (1509)	170	189	273	321	297	258

Table 5: Traffic Density Survey near Antagarh on 29-10-16

Date:29.10.16	Place:	Antagarh				
Time	Two Wheeler		LMV		HMV	
	To Narainpur	To Bhanupratapur	To Narainpur	To Bhanupratapur	To Narainpur	To Bhanupratapur
00:00 - 01:00	0	2	0	2	0	1
01:00 - 02:00	0	0	0	0	0	0
02:00 - 03:00	0	0	0	0	0	0
03:00 - 04:00	0	0	0	0	0	0
04:00 - 05:00	4	6	1	1	2	1
05:00 - 06:00	11	12	7	3	1	4
06:00 - 07:00	17	9	11	9	3	6
07.00 - 08.00	23	13	14	12	6	7
08.00 - 09.00	18	18	16	33	6	8
09.00 - 10.00	22	27	28	25	8	8
10.00 - 11.00	31	35	30	31	11	7
11.00 - 12.00	47	44	36	37	10	4
12.00 - 13.00	36	40	17	26	10	13
13.00 - 14.00	27	43	15	20	11	8
14.00 - 15.00	39	26	22	30	7	9
15.00 - 16.00	20	19	30	17	5	10
16.00 - 17.00	16	28	14	21	9	6
17.00 - 18.00	11	37	19	16	8	6
18.00 - 19.00	14	20	11	8	6	4
19.00 - 20.00	11	16	8	3	4	3
20.00 - 21.00	6	12	6	6	4	1
21.00 - 22.00	4	10	2	4	2	2
22.00 - 23.00	8	6	1	4	1	2
23.00 - 00.00	2	7	1	3	1	3
Total Vehicles	367	430	289	311	115	113
PCU's (1682)	183.5	215	289	311	345	339

Table 6: Traffic Density Survey on Dandhak Van on 29-10-16

Date:29.10.16	Place:	Dandak Van				
Time	Two Wheeler		LMV		HMV	
	To Narainpur	To Bhanupratapur	To Narainpur	To Bhanupratapur	To Narainpur	To Bhanupratapur
00:00 - 01:00	1	0	0	0	0	1
01:00 - 02:00	1	0	0	0	0	0
02:00 - 03:00	0	0	0	0	0	0
03:00 - 04:00	0	0	0	0	0	0
04:00 - 05:00	2	3	2	1	2	1
05:00 - 06:00	4	1	6	4	1	3
06:00 - 07:00	8	6	11	6	3	6
07.00 - 08.00	11	7	13	10	5	6
08.00 - 09.00	17	17	12	11	6	5
09.00 - 10.00	28	20	20	17	7	4
10.00 - 11.00	30	21	26	21	10	5
11.00 - 12.00	37	23	31	24	8	6
12.00 - 13.00	18	24	19	30	9	11
13.00 - 14.00	14	25	13	27	7	7
14.00 - 15.00	20	31	25	21	7	8
15.00 - 16.00	31	21	18	29	5	10
16.00 - 17.00	13	32	19	23	8	6
17.00 - 18.00	11	16	11	19	8	4
18.00 - 19.00	8	11	7	12	6	3
19.00 - 20.00	6	6	3	7	3	1
20.00 - 21.00	4	7	2	3	3	2
21.00 - 22.00	5	2	2	6	2	1
22.00 - 23.00	3	3	1	2	1	1
23.00 - 00.00	1	0	1	0	0	2
Total Vehicles	273	276	242	273	101	93
PCU's (1372)	136.5	138	242	273	303	279

5.7 POSSIBLITY OF INCREASING TRUCK TRAFFIC FROM SAIL'S MINES

The terrain condition considered for the project road stretch is generally plain terrain and accordingly the design service volumes have been considered. The existing traffic volume at Antagarh is 1728 PCU (reference PWD survey data) and this traffic volume has been considered for the entire project road stretch.

The road between Antagarh to Rowghat mine is the critical stretch as the width of the road is only 3.75m and all the vehicles will be passing through this stretch to ply between Rowghat mines and the railway siding near Keonti.

As per IRC:64 "Guidelines for Capacity of Roads in Rural Areas, the recommended design service volume for single lane roads (3.75 m) on plain terrain (Rowghat Mine to Antagarh) is 2000 Passenger Car Units (PCUs) per day.

The existing traffic density on SH-5 (near Antagarh) has been found to be 1728 PSU/day. Hence, the total carrying capacity available is 272 PCU/day for the Rowghat to Keonti Siding stretch.

Further, for the two lane roads on plain terrain (Antagarh to Keonti stretch) is 15000 Passenger Car Units (PCUs) per day and the reduction factor for shoulder width of 1.2 m is 0.92. Accordingly, the recommended design service volume comes down to 13800 PCUs/day.

Considering existing traffic density on SH-5 (near Antagarh) to be 1728 PSU/day and the proposed additional traffic load from Antagarh to kentia stretch to be about 272 PCU/day, the total expected heavy vehicle traffic on Antagarh to keonti stretch shall be about 2000 nos./ day, which is very minimal compared to the traffic carrying capacity available.

6.0 ENVIRONMENTAL IMPLICATIONS OF CHANGED SCENARIO

The following environmental attributes may be affected due to changes in production planning:

1. Emmissions and air quality &
2. Noise level

6.1 Micro Meteorology

Prevailing micro-meteorological conditions regulates the dispersion and dilution of air pollutants in the atmosphere. In view of the above meteorological station was set up at BSP Hospital, Antagarh.

The following parameters were recorded at hourly intervals continuously during the monitoring period (Oct. - Nov. 2016).

- Wind speed
- Wind Direction
- Air Temperature
- Relative humidity

Whereas, rainfall was recorded on hourly basis.

Tables 7 gives the summary of monitored meteorological data (Oct.- Nov. 2016).

Table 7: Summarised Meteorological Data during monitoring period

Month	Wind speed (m/s)			Temperature (°C)			Relative humidity (%)			Rainfall (mm)		
	Mean	Max.	% of Calm	Mean	Highest	Lowest	Mean	Highest	Lowest	Total	24 hrs. highest	No. of rainy days
Oct-Nov 2016	0.16	2.38	88.01	26.82	36.3	18.0	69.25	93.6	8.3	2	1	03

Wind frequency distribution as monitored is given at Table 8. From the table it can be seen that during the monitoring period (Oct. - Nov. 2016). Overall including day and night the predominant wind direction is from SSW (2.48%), followed by S (2.07%), SW (1.66%) and N (1.66%). The calm conditions prevailed for 88.02% of the time. During day time predominant wind direction was SSW (4.64%) followed by NNW (4.10%), S (3.83%) and N (3.01%); calm conditions prevailed for 78.69% of the time. During night time the predominant wind is SSE (0.83%) followed by N, NNE, ESE, SE, S and SSW (0.28%) and calm condition prevailed for 97.28% of the time.

Table 8 : Wind Frequency Distribution at BSP Hospital, Antagarh

A. 24 hours Overall

Direction	Velocity Ranges (m/s)						Sum
	0.44 - 2.0	2.0 - 3.0	3.0 - 4.0	4.0 - 5.0	5.0 - 6.0	>= 6.0	%
N	1.38	0.28	0	0	0	0	1.65
NNE	0.14	0	0	0	0	0	0.14
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0.14	0	0	0	0	0	0.14
SE	0.14	0	0	0	0	0	0.14
SSE	1.1	0.14	0	0	0	0	1.24
S	2.07	0	0	0	0	0	2.07
SSW	2.48	0	0	0	0	0	2.48
SW	1.66	0	0	0	0	0	1.65
WSW	0.14	0	0	0	0	0	0.14
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0.14	0	0	0	0	0	0.14
NNW	1.93	0.14	0	0	0	0	2.07
SUM %	25.15	6.02	1.08	0.15	0.15	0.15	32.72
CALM % (V<0.44 m/s) = 88.02							

B. Day Time (0600 – 1800 Hrs.)

Direction	Velocity Ranges (m/s)						Sum
	0.44 - 2.0	2.0 - 3.0	3.0 - 4.0	4.0 - 5.0	5.0 - 6.0	>= 6.0	%
N	2.47	0.55	0	0	0	0	3.01
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	1.64	0	0	0	0	0	1.64
S	3.84	0	0	0	0	0	3.83
SSW	4.66	0	0	0	0	0	4.64
SW	3.29	0	0	0	0	0	3.28
WSW	0.27	0	0	0	0	0	0.27
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0.27	0	0	0	0	0	0.27
NNW	3.84	0.27	0	0	0	0	4.1
SUM %	20.22	0.82	0	0	0	0	21.04
CALM (V<0.44 m/s) = 78.69							

C. Night time (1800 – 0600 Hrs.)

Direction	Velocity Ranges (m/s)						Sum %
	0.44 - 2.0	2.0 - 3.0	3.0 - 4.0	4.0 - 5.0	5.0 - 6.0	>= 6.0	
N	0.28	0	0	0	0	0	0.28
NNE	0.28	0	0	0	0	0	0.28
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0.28	0	0	0	0	0	0.28
SE	0.28	0	0	0	0	0	0.28
SSE	0.56	0.28	0	0	0	0	0.83
S	0.28	0	0	0	0	0	0.28
SSW	0.28	0	0	0	0	0	0.28
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
SUM %	2.22	0.28	0	0	0	0	2.49
CALM (V<0.44 m/s) = 97.23							

The overall (day-night), day and night time wind-rose diagrams is given in Figs. 2.0, 3.0 and 4.0, respectively.

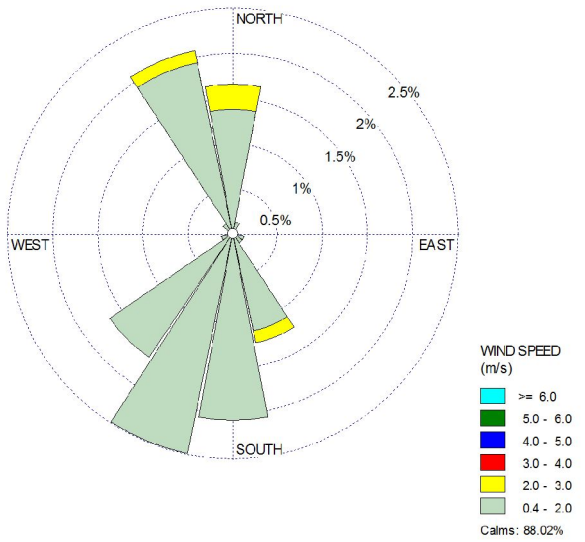


Fig. 2.0: Wind Rose at BSP Hospital, Antagarh (24 hours overall)

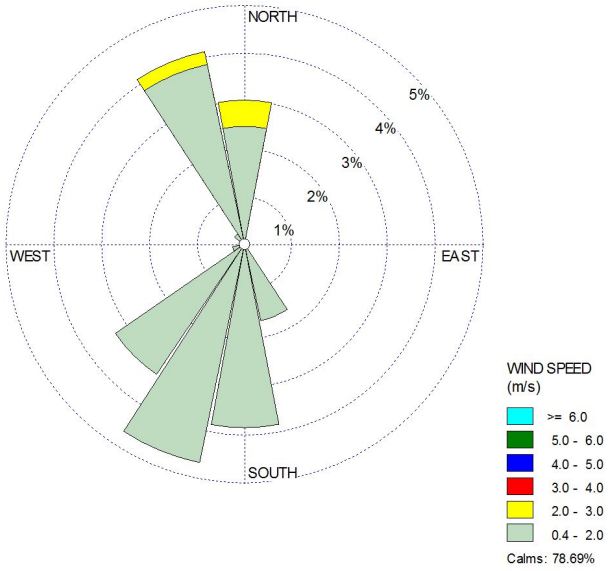


Fig. 3.0: Wind Rose at BSP Hospital, Antagarh (Day)

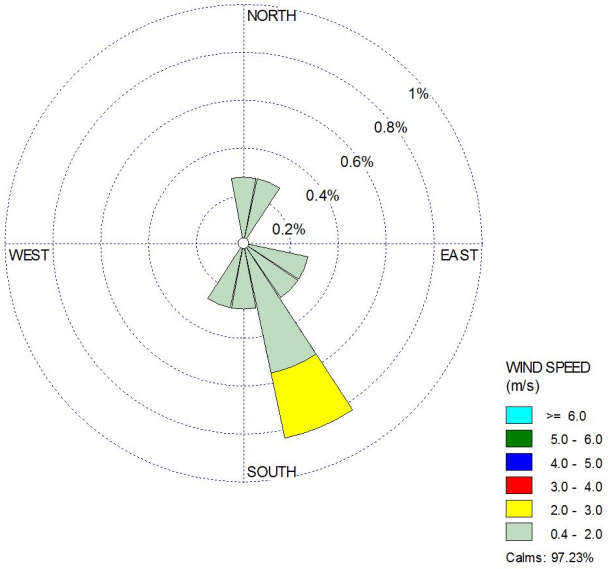


Fig. 4.0: Wind Rose at BSP Hospital, Antagarh (Night)

6.2 The present ambient air quality level:

The existing ambient air quality data monitored during Winter (October-November), 2016 along the proposed evacuation corridor due to existing traffic and other anthropogenic activities is shown below:

Six locations were selected for establishing Ambient Air Quality monitoring Network. The list of selected AAQ Stations is given in Table 9.

Table 9: Air quality data Monitoring Stations

Sl. No.	Location	Station Code	Latitude	Longitude	Remarks
1.	Bharanda	AN1	19°49'10.83"N	81°13'15.78"E	Represents control station
2.	Dandakvan	AN2	19°52'47.70"N	81°12'25.26"E	Within 500m of the ML in the predominant downwind direction.
3.	Talabera	AN3	19°55'37.21"N	81°10'43.50"E	On the evacuation corridor
4.	Antagarh	AN4	20° 5'51.51"N	81° 9'30.14"E	At the mid of the evacuation corridor.
5.	Masbaras	AN5	20° 8'49.87"N	81° 8'40.10"E	On the evacuation corridor
6.	Keonti	AN6	20°13'34.85"N	81° 5'5.21"E	End point on evacuation corridor

Table 10: Detail Ambient Air Quality results for Bharanda (AN1)

Sample No.	Date	Results in $\mu g/m^3$				
		$PM_{2.5}$	PM_{10}	SO_2	NOx	CO
1	03/04-10-2016	23	82	<4.0	13.3	435.11
2	07/08-10-2016	36	75	5.0	15.5	322.71
3	10/11-10-2016	27	63	5.6	12.2	424.92
4	13/14-10-2016	32	79	5.7	16.6	465.97
5	18/19-10-2016	41	62	5.7	11.2	563.91
6	21/22-10-2016	38	68	4.2	14.8	403.69
7	25/26-10-2016	29	59	4.8	17.1	423.90
8	29/30-10-2016	26	81	4.3	13.2	441.86

Table 11: Detail Ambient Air Quality results for Dandakvan (AN2)

Sample No.	Date	Results in $\mu g/m^3$				
		$PM_{2.5}$	PM_{10}	SO_2	NOx	CO
1	03/04-10-2016	20	77	<4.0	12.5	227.42
2	07/08-10-2016	23	65	4.8	15.7	320.29
3	10/11-10-2016	25	72	<4.0	11.8	533.39
4	13/14-10-2016	29	80	4.7	14.7	423.96
5	18/19-10-2016	31	67	4.3	16.5	385.08
6	21/22-10-2016	26	76	4.8	12.7	374.83
7	25/26-10-2016	29	81	4.9	15.6	411.60
8	29/30-10-2016	32	71	<4.0	11.6	445.99

Table 12: Detail Ambient Air Quality results for Talabera (AN3)

Sample No.	Date	Results in µg/m^3				
		$PM_{2.5}$	PM_{10}	SO_2	NOx	CO
1	03/04-10-2016	31	74	<4.0	14.0	249.54
2	07/08-10-2016	33	56	4.6	11.3	255.79
3	10/11-10-2016	28	82	5.3	16.6	423.25
4	13/14-10-2016	22	73	4.4	11.9	509.96
5	18/19-10-2016	27	66	<4.0	14.4	602.37
6	21/22-10-2016	33	73	4.9	12.8	484.22
7	25/26-10-2016	26	84	4.6	16.4	568.47
8	29/30-10-2016	24	69	<4.0	13.4	530.59

Table 13: Detail Ambient Air Quality results for Antagarh (AN4)

Sample No.	Date	Results in µg/m^3				
		$PM_{2.5}$	PM_{10}	SO_2	NOx	CO
1	03/04-10-2016	22	56	4.6	14.2	316.83
2	07/08-10-2016	26	67	<4.0	11.5	529.00
3	10/11-10-2016	28	74	4.4	13.8	388.78
4	13/14-10-2016	23	87	5.6	16.8	461.50
5	18/19-10-2016	31	82	<4.0	12.4	532.37
6	21/22-10-2016	27	71	5.6	18.2	496.55
7	25/26-10-2016	36	92	4.2	13.6	567.27
8	29/30-10-2016	41	86	6.2	15.5	442.73

Table 14: Detail Ambient Air Quality results for Masbaras (AN5)

Sample No.	Date	Results in µg/m^3				
		$PM_{2.5}$	PM_{10}	SO_2	NOx	CO
1	03/04-10-2016	33	84	<4.0	11.2	318.70
2	07/08-10-2016	21	77	4.7	15.7	372.90
3	10/11-10-2016	26	63	<4.0	12.9	387.88
4	13/14-10-2016	19	54	5.1	17.4	561.50
5	18/19-10-2016	32	78	4.2	14.1	485.45
6	21/22-10-2016	25	70	<4.0	11.7	533.69
7	25/26-10-2016	21	64	4.3	15.2	595.01
8	29/30-10-2016	30	75	<4.0	10.6	529.72

Table 15: Detail Ambient Air Quality results for Keonti (AN6)

Sample No.	Date	Results in µg/m^3				
		$PM_{2.5}$	PM_{10}	SO_2	NOx	CO
1	03/04-10-2016	22	67	<4.0	11.8	295.19
2	07/08-10-2016	28	57	4.1	14.2	482.22
3	10/11-10-2016	33	75	<4.0	<10	353.98
4	13/14-10-2016	29	66	5.1	13.6	429.96
5	18/19-10-2016	35	84	4.6	16.3	448.53
6	21/22-10-2016	31	76	<4.0	12.3	375.12
7	25/26-10-2016	27	69	5.1	17.1	505.41
8	29/30-10-2016	38	80	4.8	12.9	498.03

Methods of Sampling and Analysis

The methods of sample collection, equipments used and analysis procedures as followed are given in Table 16. Samples of 24 hourly duration were taken for monitoring $PM_{2.5}$, PM_{10}, SO_2 and NO_x twice a week for four weeks. CO was monitored on hourly basis on selected days.

Table 16: Methodology of Sampling & Analysis and Equipment used

Sl. No.	Parameter	Instrument/ Apparatus Used	Methodology	Reference
1.	SO_2 (µg/m^3)	RDS with Impinger Tube, Spectro–photometer	Improved West & Gaecke Method	MOE&F G.S.R 826 (E) dtd. 16.11.09
2.	NO_x (µg/m^3)	RDS with Impinger Tube, Spectro–photometer	Modified Jacobs & Hoccheiser Modified (Na-Arsenite) Method	
3.	PM_{10} (µg/m^3)	Respirable Dust Sampler	Gravimetric	
4.	$PM_{2.5}$ (µg/m^3)	$PM_{2.5}$ Fine-Dust Sampler	Gravimetric	
5.	CO (mg/m^3)	NDIR Spectrophotometer	Non Dispersive Infra Red (NDRI) Spectoscopy	

Results and Discussion

The AAQ at various locations as observed were compared with National Ambient Air Quality Standards (NAAQS, 2009) as given in Table 17.

Table 17: National Ambient Air Quality Standards

Sl	Parameter	Time Weighted Average	Concentration in Ambient Air	
			Industrial, Residential, Rural & Other Areas	Ecologically Sensitive Area (Notified by Central Government)
1	SO_2 ; ($\mu g/m^3$)	Annual*	50	20
		24 Hours**	80	80
2	NOx ; ($\mu g/m^3$)	Annual*	40	30
		24 Hours**	80	80
3	PM_{10}; ($\mu g/m^3$)	Annual*	60	60
		24 Hours**	100	100
4	$PM_{2.5}$; ($\mu g/m^3$)	Annual*	40	40
		24 Hours**	60	60
5	CO; (mg/m^3)	8 Hours**	02	02
		1 Hours**	04	04

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals

** 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be compiled with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days.

Table 18: Summarised Ambient Air Quality in the Study area

Monitoring equipment	$PM_{2.5}$ Respirable Dust Sampler (RDS)			PM_{10} Respirable Dust Sampler (RDS)			SO_2 RDS & Spectrophoto-meter			NOx RDS & Spectrophoto-meter			CO NDIR Spectrophotometer		
Equipment sensitivity	Detection Limit: 5 «g/m^3			Detection Limit: 5 «g/m^3			Detection Limit: 4«g/m^3			Detection Limit: 10 «g/m^3			Detection Limit: 0.057 mg/m^3		
Monitoring station	Max.	Min.	C_{98}	Max.	Min.	C_{98}	Max.	Min.	C_{98}	Max.	Min.	C_{98}	Max.	Min.	C_{98}
(AN1) Bharanda	41.0	23.0	40.6	82.0	59.0	81.9	5.7	4.2	5.7	17.1	11.2	17.0	0.56	0.32	0.43
(AN2) Dandakvan	32.0	20.0	31.9	81.0	65.0	80.9	4.9	4.3	4.9	16.5	11.6	16.4	0.53	0.23	0.39
(AN3) Talabera	33.0	22.5	33.0	84.0	56.0	83.7	5.3	4.4	5.3	16.6	11.3	16.6	0.60	0.25	0.45
(AN4) Antagarh	41.0	22.0	40.3	92.0	56.0	91.3	6.2	4.2	6.1	18.2	11.5	14.5	0.56	0.32	0.47
(AN5) Masbaras	33.0	19.0	32.9	84.0	54.0	83.2	5.1	4.2	5.1	17.4	10.6	17.2	0.60	0.32	0.47
(AN6) Keonti	38.0	22.0	37.6	84.0	57.0	83.4	5.1	4.1	5.1	17.1	<10	17.0	0.51	0.30	0.42

From the above table following observation are made:

Particulate Matter (PM2.5): The Value of PM2.5 ranges between 19.0 µg/m3 to 41 µg/m3. However, the C98 value of PM2.5 ranges between 31.9 µg/m3 to 40.6 µg/m3. The results are well within the sensitive area norm as prescribed by CPCB.

Particulate Matter (PM10): The Value of PM10 ranges between 54 µg/m3 to 92 µg/m3. However, the C98 value of PM10 ranges between 80.9 µg/m3 to 91.3 µg/m3. The results are well within the sensitive area norm as prescribed by CPCB.

Sulphur Dioxide (SO2): The Value of SO2 ranges between 4.1 µg/m3 to 6.2 µg/m3. However, the C98 value of SO2 ranges between 4.9 µg/m3 to 6.1 µg/m3. The results are well within the sensitive area norm as prescribed by CPCB.

Oxides of Nitrogen (NOX): The Value of NOX ranges between <10.0 µg/m3 to 18.2 µg/m3. However, the C98 value of NOX ranges between 14.5 µg/m3 to 17.2 µg/m3. The results are well within the sensitive area norm as prescribed by CPCB.

Carbon Monoxide (CO): The results are well within the sensitive area norm as prescribed by CPCB.

6.3 Noise level

Noise monitoring were carried out at six (06) locations as listed in Table 19.

Table 19: Ambient Noise Monitoring Stations

Sl. No.	Location	Station Code	Latitude	Longitude	Remarks
1.	Bharanda	AN1	19°49'10.83"N	81°13'15.78"E	Represents control station
2.	Dandakvan	AN2	19°52'47.70"N	81°12'25.26"E	Within 500m of the ML in the predominant downwind direction.
3.	Talabera	AN3	19°55'37.21"N	81°10'43.50"E	On the evacuation corridor
4.	Antagarh	AN4	20° 5'51.51"N	81° 9'30.14"E	At the mid of the evacuation corridor.
5.	Masbaras	AN5	20° 8'49.87"N	81° 8'40.10"E	On the evacuation corridor
6.	Keonti	AN6	20°13'34.85"N	81° 5'5.21"E	End point on evacuation corridor

Leq. noise level was recorded at hourly intervals, continuously for 24 hours by operating the noise-recording instrument for fifteen minutes during each hour.

Table 20: Ambient Air Quality norms in respect of Noise

Type of Area	Day (0600 - 2200 hrs).	Night (2200 – 0600 hrs.)
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40

All Values in dB (A)

Table 21: Detail Ambient Noise Monitoring Data

Sl. No.	Time (Hrs.)	AN1	AN2	AN3	AN4	AN5	AN6
1	6:00	42.6	39.8	41.8	40.4	42.6	41.6
2	7:00	43.8	40.2	42.6	41.2	42.9	43.4
3	8:00	44.1	41.5	43.4	42.0	43.5	44.0
4	9:00	44.7	46.8	44.1	42.4	44.8	45.8
5	10:00	46.7	48.2	46.2	45.2	46.2	46.9
6	11:00	47.8	49.6	48.3	48.3	49.8	47.3
7	12:00	48.2	50.3	49.4	47.3	47.3	49.2
8	13:00	49.3	50.4	47.3	46.4	46.4	48.5
9	14:00	47.5	49.7	46.5	49.7	48.5	46.3

Sl. No.	Time (Hrs.)	AN1	AN2	AN3	AN4	AN5	AN6
10	15:00	46.8	48.3	47.3	48.5	44.9	45.9
11	16:00	44.2	42.6	44.8	46.0	44.0	47.5
12	17:00	45.0	40.8	43.9	45.3	43.8	46.9
13	18:00	43.8	39.5	46.2	44.8	41.2	44.5
14	19:00	46.3	37.4	44.5	42.6	40.7	42.9
15	20:00	48.9	38.9	43.0	41.5	40.1	41.8
16	21:00	40.4	42.8	42.9	41.0	39.7	40.4
17	22:00	39.2	41.7	41.7	40.3	38.2	40.8
18	23:00	38.7	38.3	40.2	39.5	37.3	39.6
19	24:00	36.2	38.0	39.3	39.1	38.5	38.7
20	1:00	36.0	37.8	38.2	38.7	37.0	38.0
21	2:00	37.8	37.2	38.0	37.3	37.3	37.3
22	3:00	38.1	39.4	37.5	37.1	38.4	38.5
23	4:00	39.8	40.1	39.2	39.5	39.8	39.2
24	5:00	41.6	40.7	40.4	39.8	40.6	39.8

All Values in dB (A)

Results and Discussions

The results of ambient noise monitoring are summarized in Table 22. The results have been compared with MoEFCC norms (Noise Regulation & Control - Rules, 2000), as given in Table 22.

Table 22: Summarised Results of Noise Monitoring

Stn. No.	Location	Results					
		Day (0600-2200 hr.)			Night (2200-0600 hr.)		
		Max.	Min.	Avg.*	Max.	Min.	Avg.*
AN1	Bharanda	49.2	40.4	45.9	40.8	37.3	39.1
AN2	Dandakvan	49.8	39.7	45.1	40.6	37.0	38.6
AN3	Talabera	49.7	40.4	45.5	40.3	37.1	39.0
AN4	Antagarh	49.4	41.8	45.7	41.7	37.5	39.5
AN5	Masbaras	50.4	37.4	46.3	41.7	37.2	39.4
AN6	Keonti	49.3	40.4	46.2	41.6	36.0	38.8

* Logarithmic Averages. All Values in dB (A).

All the ambient noise levels are within the permissible limits as specified for residential area.

Prediction of Changes in Air Quality

The fugitive dust emissions have been estimated using the methodologies outlined in the AP-42 (USEPA) and National Pollutant Inventory (NPI) Emission Estimation Technique Manual (EET) for Mining Version 2.3 (DEH 2001) (Australia). For modelling, following sources were considered to estimate the pollution load for revised condition.

- Drilling
- Loading of material into haul trucks
- Vehicle (wheel) generated dust (on haul road & SH-5)
- Un-loading of materials.

Dust estimate summary

Activity wise dust emissions during excavation of ore have been estimated. A summary of the dust emission rates for each source identified at proposed mine are summarised below in Table 17.

Table 17: Summary of dust estimations

Sl. No	Source	Estimated emissions
1	Drilling	0.1473107 g/s
2	Loading	0.090921 g/s
3	Haul Road	0.00580518 g/m^2/s
4	Transportation road	0.003923083 g/m^2/s
5	Unloading	0.047911673 g/s

Modeling Methodology

Air quality impacts from the altered proposed mining and processing operations have been assessed using the ISC3 computer dispersion model, developed by US EPA. Using the model, maximum 24-hour ground-level PM10 concentrations at the nearest sensitive receiver to the site has been predicted.

ISC3 model is designed to predict ground-level concentrations or dry deposition of pollutants emitted from one or more sources, which may be stacks, area sources, volume sources, open pits or any combination of these. ISC3 is essentially a statistical Gaussian plume model that requires a time series of both meteorological and source emission data.

For the present study all queries have been modeled using Open pit option of ISC3. Also all waste dumps have been considered as area sources.

Grid System

ISC3 can calculate concentrations both on a set grid (typically Cartesian) or at specified locations. In the present study the model was configured to predict the

ground-level concentrations on discrete receptors. This grid approach was chosen to restrict the duration of model runs.

Meteorological Data

So that comparison of the proposed altered scenario with production and transportation scenario becomes possible, the earlier meteorological data generated for one month at project site during Oct.-Nov. 2016 has been used. Overall including day and night the predominant wind direction is from SSW (2.48%), followed by S (2.07%), SW (1.66%) and N (1.66%). The calm conditions prevailed for 88.02% of the time. During day time predominant wind direction was SSW (4.64%) followed by NNW (4.10%), S (3.83%) and N (3.01%); calm conditions prevailed for 78.69% of the time. During night time the predominant wind is SSE (0.83%) followed by N, NNE, ESE, SE, S and SSW (0.28%) and calm condition prevailed for 97.28% of the time.

A time series air quality meteorological data file, containing hourly averaged values of (i) Wind speed and direction; (ii) Ambient air temperature (iii) Pasquill- Gifford stability class; and (iv) Atmospheric mixing height were required for the for the modeling studies . The wind speed, direction and temperature data were obtained from meteorological measurements recorded at site. Atmospheric stability categories were determined using the net radiation index method, or Turner's method as described in USEPA (1998). This method estimates stability from solar altitude, wind speed and cloud observations. Mixing heights were collected from the CPCB publication on "spatial variations of mixing heights over India". Stability, wind speeds, and mixing heights on the day when maximum GLC occurred is given below (Table 18)

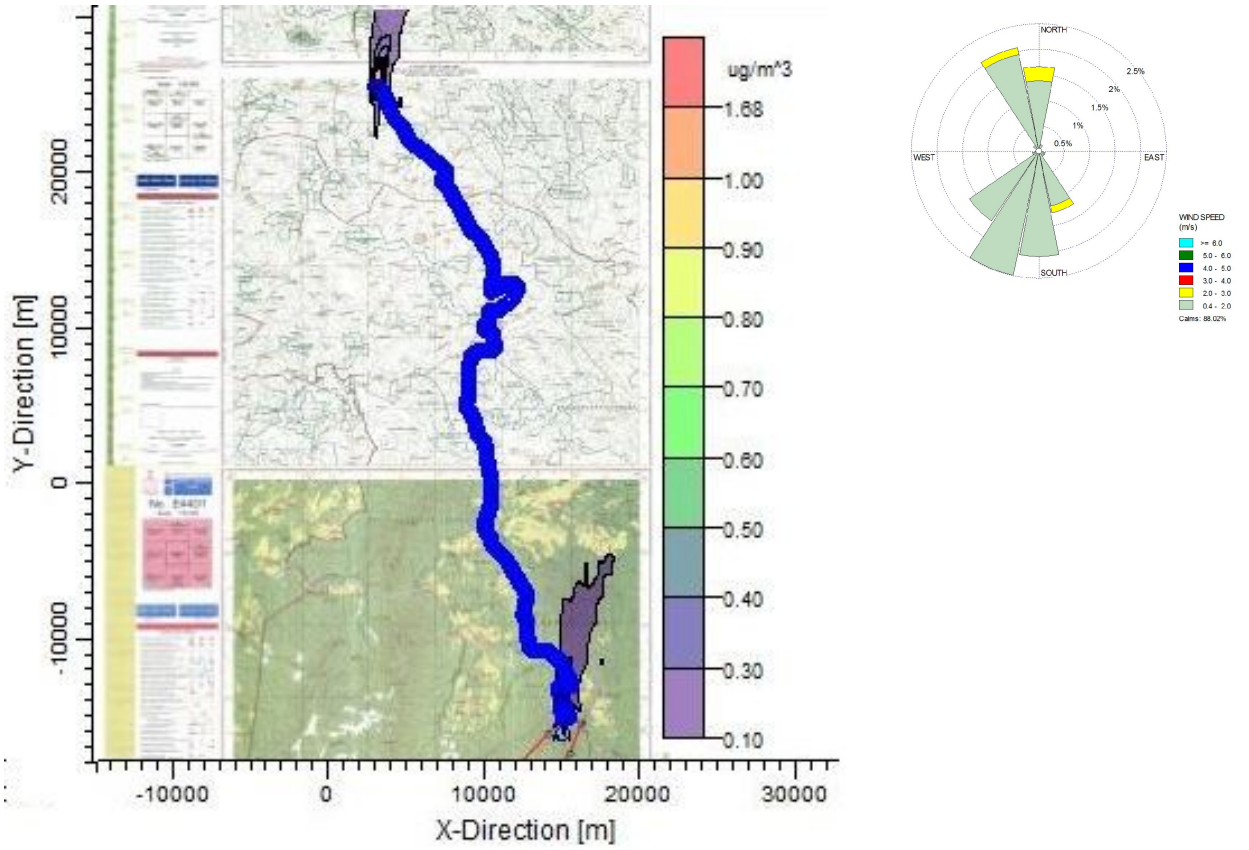
Table 18: Meteorological data used for GLC prediction

Hour	Wind dir. (from)	Wind speed (m/s)	Temp. (^{o}K)	Stability class	Mixing height (m)
01	26	0.00	298	6	100.0
02	109	0.00	298	6	100.3
03	199	0.17	298	6	200.6
04	191	0.11	298	6	248.9
05	189	0.03	298	5	380.2
06	195	0.06	298	4	411.5
07	210	0.11	298	3	542.8
08	206	0.00	298	3	974.1
09	185	0.14	299	2	995.5
10	185	0.75	299	2	1036.8
11	212	0.50	299	1	1068.1
12	215	0.33	301	1	1099.4
13	206	0.50	301	1	1130.7
14	194	0.39	303	2	1162.0
15	205	0.53	304	3	1162.0

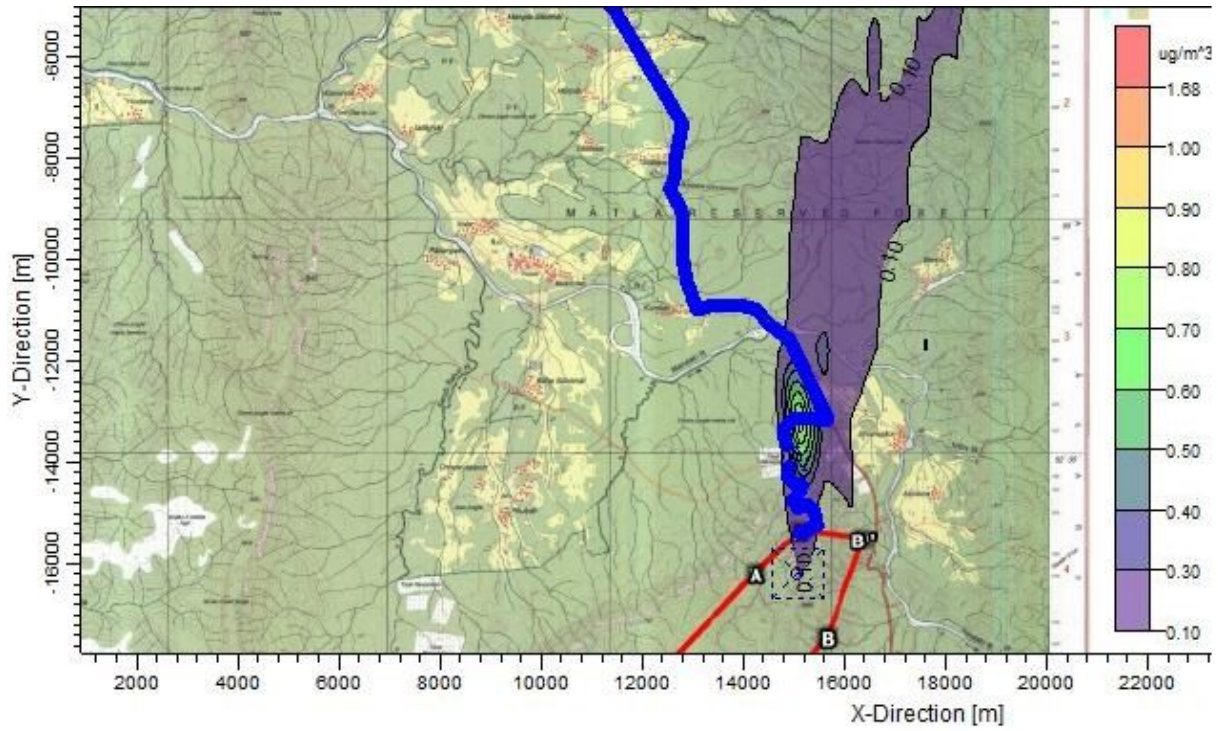
Hour	Wind dir. (from)	Wind speed (m/s)	Temp. (°K)	Stability class	Mixing height (m)
16	181	1.41	304	3	1162.0
17	215	0.47	305	4	1162.0
18	185	0.53	303	5	954.7
19	209	0.00	302	6	546.8
20	180	0.03	301	6	438.8
21	199	0.08	301	6	330.9
22	230	0.19	301	6	223.0
23	306	0.14	300	6	215.0
24	360	0.44	299	6	207.1

Predicted Futuristic Ground-level Dust Concentrations

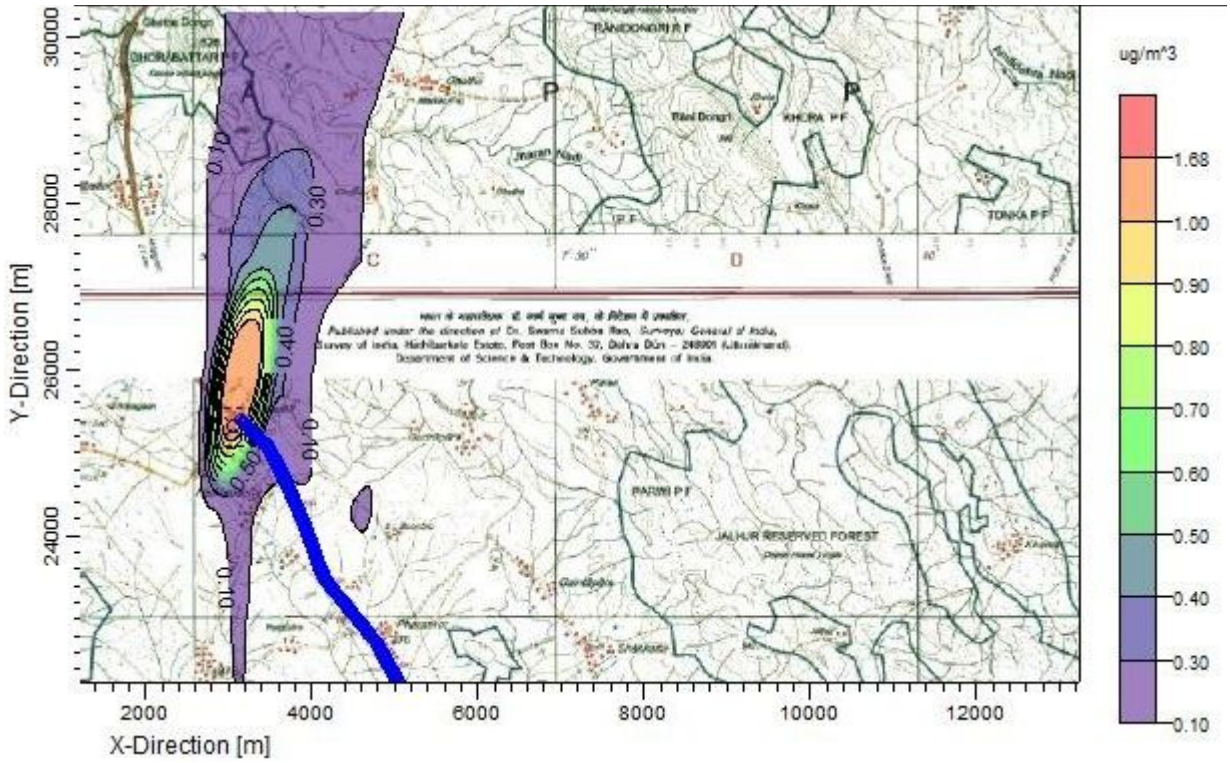
The results represent the maximum GLC that are predicted to occur along the road evacuation corridor. Isopleths have presented in Fig. 5a, 5b & 5c.



(Fig. 5a) Predicted (Max.) GLC in the entire road evacuation corridor



(Fig. 5b) Predicted (Max.) GLC at SH-5 entering point



(Fig. 5c) Predicted (Max.) GLC at un-loading point (Keonti)

When overlaying the additional contribution for the altered scenario with the monitored PM_{10} values Oct.-Nov. 2016, it can be seen that the resultant data are in general, well within norms (Table 19)

Table 19: Predicted Resultant Air Quality

Sl. No.	Location name/ code	Lat./Long.	Monitored PM_{10} (C_{98}) Summer 2015 ($\mu g/m^3$)	Contribution as per the proposed alteration ($\mu g/m^3$)	Resultant values ($\mu g/m^3$)
1.	(AN1) Bharanda	19°49'10.83"N 81°13'15.78"E	81.9	<1.0	82.0
2.	(AN2) Dandakvan	19°52'47.70"N 81°12'25.26"E	80.9	<1.0	81.0
3.	(AN3) Talabera	19°55'37.21"N 81°10'43.50"E	83.7	<1.0	84.0
4.	(AN4) Antagarh	20° 5'51.51"N 81° 9'30.14"E	91.3	<1.0	92.0
5.	(AN5) Masbaras	20° 8'49.87"N 81° 8'40.10"E	83.2	<1.0	84.0
6.	(AN6) Keonti	20°13'34.85"N 81° 5'5.21"E	83.4	<1.0	84.0

7.0 MITIGATION MEASURES TO MINIMIZE THE ENVIRONMENTAL IMPLICATIONS OF CHANGED SCENARIO

A project specific guideline will be established to maintain the air quality along the evacuation corridor. The guideline will include applicable project standards, mitigation measures, control techniques, regular monitoring programmes etc. The guideline will broadly cover but not limited to the followings:

- General measures proposed for the trucks carrying iron ore outside the ML area till Keonti siding:
  - Trucks will be operated & maintained strictly as per the manufacturers' guidelines;
  - All vehicle to comply the emission norms.

- General measures proposed for the evacuation corridor outside the ML area till Keonti siding:
  - All transportation will be undertaken outside the ML along the pre-designated route only.
  - Limiting the travel speeds based on road condition and surrounding sensitive receptors like community area, forest area, hospital, school etc.
  - Sufficient time lag between movement of two truck to allow settling of dust

- The stock piles to be wetted prior to commencement of truck loading operations.

- Afforestation along the evacuation corridor, especially on the stretches where it is passing through populated areas / sensitive receptors.

- Specialist training will be provided to the truck operators to ensure compliance with road safety.

- A periodic review (based on interaction with truck operators, local communities along the evacuation corridor) will be undertaken by SAIL to identify the significant dust generation sources/activities, if any. The action plan will be chalked out to mitigate the emission from dust generation sources/activities.

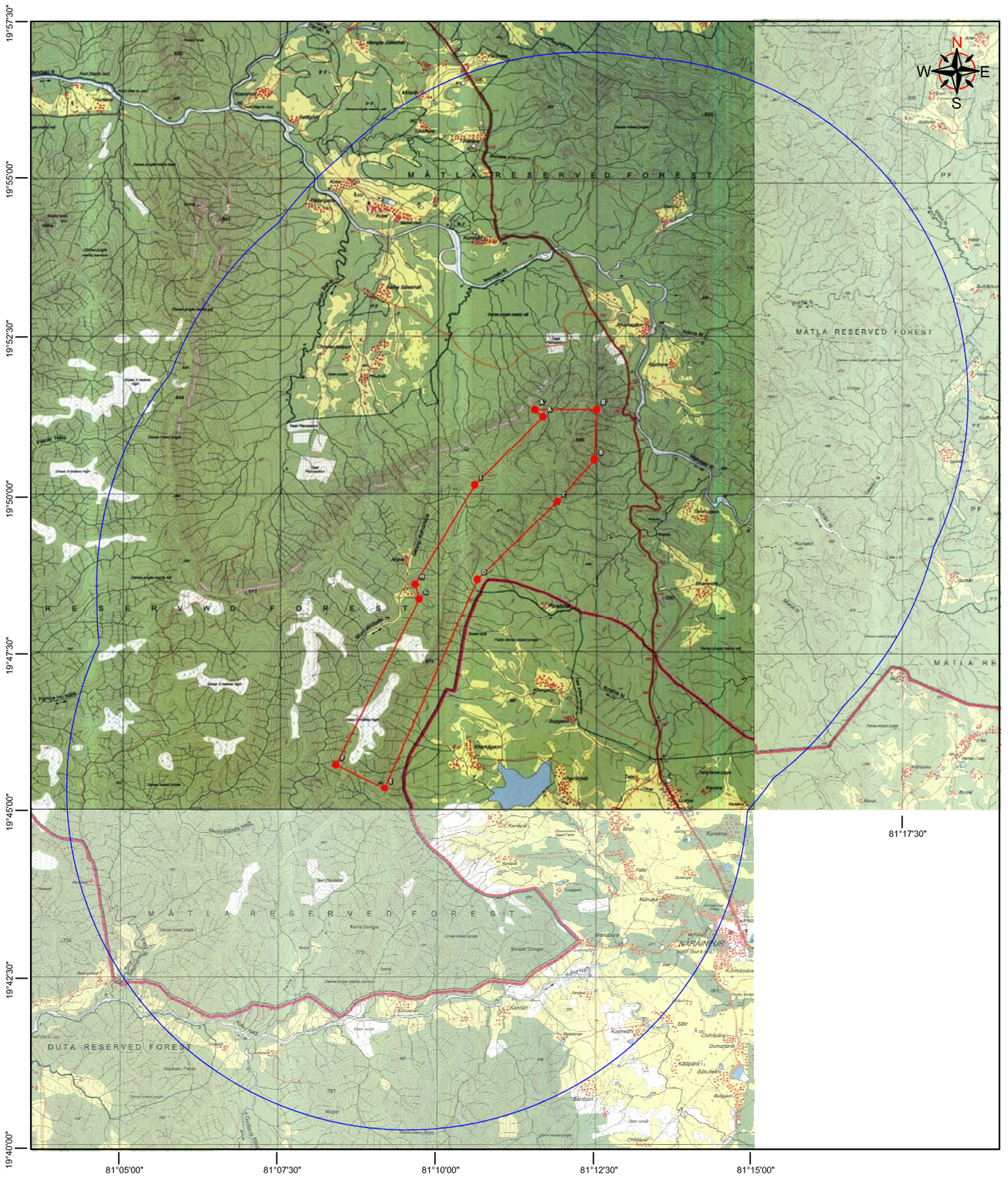
8.0 RESULTS AND DISCUSSIONS

The following conclusion can be drawn from the above comparison table (Table 19) and also the Isopleths:

1. The max. concentration (core zone) has come down in altered scenario.
2. The additional contribution in the altered scenario has not increased significantly.
3. In effect it can be concluded that due to the altered distribution, the predicted PM_{10} level has come down.

--- XXX ---

DRG.NO.MEC/11/16/C38G/1.0



LEGEND

ROWGHAT ML

10 km buffer zone

0 5 7.5 10km

PROJECT PROPONENT
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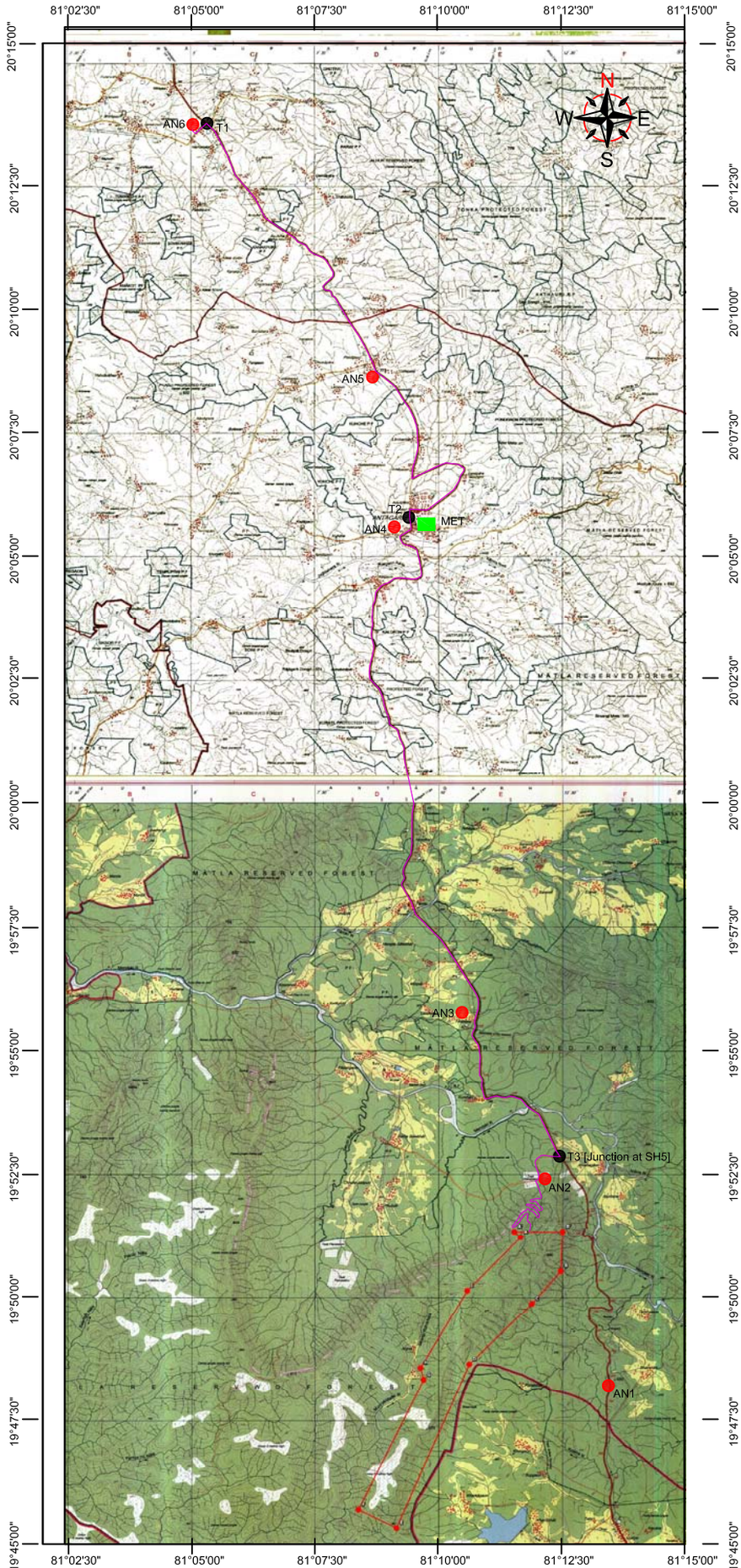
SECTION	RM & M
LOCATION	RANCHI

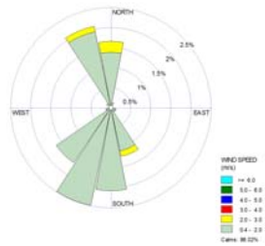
ROWGHAT IRON ORE MINE

ML AREA SUPERIMPOSED ON SOI TOPOSHEET

SOI TOPOSHEET NOS. 65 E/1, 65E/2 and 65E/5	SCALE : As shown	REV
REFERENCES	DRG.NO.MEC/11/16/C38G/1.0	0

DRG.NO.MEC/11/16/C38G/2.0





Windrose (Overall)
Oct.-Nov.- 2016 (Antagarh)

LEGEND

- Rowghat ML
- Road Evacuation Corridor
- MET — Meteorological Station
- AN1 — AAQ & Noise
- T1 — Traffic survey locations

	PROJECT PROPONENT STEEL AUTHORITY OF INDIA LIMITED
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SECTION: RM & M LOCATION: RANCHI	ROWGHAT IRON ORE MINE
© THIS DRAWING IS THE PROPERTY OF MECON AND IS ISSUED FOR THE SPECIFIC PROJECT MENTIONED THEREIN. THIS IS NOT TO BE COPIED OR USED FOR OTHER PROJECTS UNLESS EXPRESSLY PERMITTED BY MECON	MONITORING LOCATIONS SHOWING THE ROAD EVACUATION CORRIDOR
SOI TOPOSHEET NOS. 65 E/1, 64H/4 REFERENCES	SCALE : As shown DRG.NO.MEC/11/16/C38G/2.0
	REV 0

0 5 7.5 10km