JSW Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

No. JSW/S/CO/2026/297 A

Date: 25/05/2026

To,
Deputy Director General of Forests (C),
Ministry of Environment, Forest and Climate Change, Regional Office (Eastern Zone),
A/3, Chandersekharpur, Bhubaneswar – 751023

Sub: - Submission of Six-monthly EC compliance report in respect of **Narayanposhi Iron & Manganese Ore Mine of M/s JSW Steel Ltd for the period October 2025 to March 2026**.

Ref: -1. Environment Clearance Letter dated 18.06.2019 issued by MOEF&CC, GOI.

Dear Sir,

We are submitting herewith six-monthly EC compliance report of Narayanposhi Iron and Manganese Ore Mine, M/s JSW Steel Ltd. for the period October 2025 to March 2026 as per EIA notification 2006. The same is also attached in Soft copy to your good office on e-mail to roez.bsr- mef@nic.in, Copy ; monitoring-ec@nic.in for your ready reference.

We trust that the measures taken towards environmental safeguards comply with the stipulated conditions. We look forward to your guidance which shall certainly help us in our endeavor for improving upon our environmental management practices.

Seeking your co-operation as always.

Thanking you,

Yours Faithfully
For JSW Steel Ltd

Vijay Kumar 25/05/2026

Vijay Kumar

(Authorized Signatory)

Encl: As above

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Copy to:

1. Zonal Office Kolkata, Central Pollution Control Board, South end Conclave, Block 502, 5th and 6th Floors, 1582 Razidanga Main Road, Kolkata, West Bengal 700107.
2. The Member Secretary, State Pollution Control Board, A/118, Nilakantha Nagar, Bhubaneswar, Odisha-751012.
3. Copy to: The Regional Officer, Regional Office, Rourkela Office of the State Pollution Control Board, At- Near Panposh Hockey Chowk, AT/PO. - Panposh, Rourkela – 769 004, Dist – Sundargarh, Odisha.
4. Copy to: Monitoring Cell (Environment, Forests and Wildlife Clearances) Ministry of Environment, Forest and Climate Change Government of India New Delhi.

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ENVIRONMENT CLEARANCE COMPLIANCE STATUS
NARAYANPOSHI MINE

Compliance report of Environmental Clearance for Narayanposhi Iron & Manganese Ore Mine, JSWSteel Ltd.

Reference letter from MoEF&CC, New Delhi- J-11015/288/2008-IA.II(M), Dtd. 18.06.2019.

Capacity- 6.0 MTPA Iron Ore (ROM) & 0.036 MTPA Mn Ore and 2 MTPA Beneficiation Plant.

<table>
<tr><th>Sl No</th><th>Stipulated Conditions</th><th>Self Declaration</th><th>Compliance</th></tr>
<tr><td>A.</td><td>SPECIFIC CONDITIONS</td><td></td><td></td></tr>
<tr><td>1</td><td>The enhanced production shall be on pro- rata basis for the effective period of valid environment clearance granted herein. The PP shall ensure its compliance by getting concurrence in mining plan approved by concern authority in this regard.</td><td>COMPLIED</td><td>EC accorded for 6.0MTPA(ROM) of Iron ore and 0.036 MTPA Mn ore.

PRODUCTION DETAILS as per Annually submitted IBM Returns.

<table>
<tr><td>Year</td><td colspan="2">Production in Million Tonnes</td></tr>
<tr><td>Mineral</td><td>Fe</td><td>Mn</td></tr>
<tr><td>2020-21</td><td>4.48</td><td>0.0004</td></tr>
<tr><td>2021-22</td><td>5.44</td><td>0.0047</td></tr>
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<tr><td>2023-24</td><td>5.63</td><td>0.0005</td></tr>
<tr><td>2024-25</td><td>5.84</td><td>0.00016</td></tr>
<tr><td>2025-26</td><td>4.17</td><td>0.00218</td></tr>
</table>
</td></tr>
<tr><td>2</td><td>This EC for expansion proposal (Iron ore production from 3.0 MTPA to 6.0 MTPA (ROM) and existing 0.036 MTPA Manganese ore and establishment of Beneficiation Plant with capacity of 2.0 Million TPA along with crusher and screening plant within the mine lease area) shall be operational after submission of an undertaking through affidavit to MoEF & CC within 15 days of receipt of this letter, for compliance of all the conditions prescribed herein.</td><td>COMPLIED</td><td>EC capacity of 6.0 MTPA was accorded to ex-lease in the year 2019 in the name of M/s Aryan Mining & Trading Corp. Pvt. Ltd. Vesting order was given to M/s. JSW Steel Limited from Steel & Mines Department, Government of Odisha vide Order no. 4212/SM, dated 30th May 2020 as per MMDR Act, 1957 and Mineral concession Rules, 2016. Further it was vested for 50 years vide order no. 1335/ 1V (B) SM -21/2020.

Undertaking through affidavit for compliance of all the conditions given in EC is attached.
Enclosed the affidavit copy as <u>ANNEXURE-I.</u></td></tr>
<tr><td>3</td><td>Project Proponent and Department of Steel & Mines, Govt. of Odisha shall ensure the implementation of recommendations of carrying capacity study report conducted by CSIR-NEERI w.r.t. mining proposal of Iron Ore and/or manganese in the State of Odisha.</td><td>COMPLIED</td><td>The recommendations of CSIR-NEERI are effectively implemented at the site. The CSIR-NEERI Compliance Status Report is submitted to the board on annual basis. The last report was submitted via letter no. JSW/S/CO/2026/301 dated 25/05/2026.

The CSIR-NEERI Compliance Status Report is hereby attached as <u>ANNEXURE II.</u></td></tr>
</table>

<table>
<tr>
<td>4</td>
<td>Department of Steel & Mines, Govt. of Odisha should prepare 5 years' regional plan for annual Iron ore requirement from the state, which in turn shall be met from different mines/zones (e.g. Joda, Koira.) in the state. Accordingly, sustainable annual production (SAP) for each zone/mine may be followed adopting necessary environmental protection measures</td>
<td>COMPLIED</td>
<td>Detail of production furnished below: -
<table>
<tr><td>Year</td><td colspan="2">Production in Million Tonnes</td></tr>
<tr><td>Mineral</td><td>Fe</td><td>Mn</td></tr>
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EC accorded for 6.0MTPA(ROM) of Iron ore and 0.036 MTPA Mn ore</td>
</tr>
<tr>
<td>5</td>
<td>Project Proponent shall construct the cement concrete road from mine entrance and exit to the main road with proper drainage system and green belt development along the roads and also construction of road with minimum 300 m inside the mine. This should be done within one year for existing mines and new mine should have since beginning. The Department of Steel & Mines, Govt. of Odisha should ensure the compliance and should not issue the Mining Permits, if mine lease holder has not constructed proper cement concrete road as suggested. This Environmental Clearance for the expansion project shall be operated only after the compliance of the above-mentioned specific condition.</td>
<td>COMPLIED</td>
<td>Concrete road is provided from the exit of Manganese quarry to NH. Concrete road is also available at Gate 2, the main entrance and exit gate of the mines.
Photographs of concrete roads submitted as <u>ANNEXURE III.</u></td>
</tr>
<tr>
<td>6</td>
<td>The Committee observed that as per the recommendations of NEERI report the PP needs to do regular vacuum cleaning of all mineral carrying roads aiming at "zero dust re-suspension" within 3 months. This Environmental Clearance for the expansion project shall be operated only after the</td>
<td>COMPLIED</td>
<td>One Vacuum Road Sweeping Machine is deployed in the mines that operates on the mineral carrying roads every day.

Photograph of the operational Road Sweeping Machine is attached as <u>ANNEXURE IV.</u></td>
</tr>
</table>

	compliance of the above-mentioned specific condition.		
7	Project Proponent shall monitor the environmental quality parameters as per EC and CTE/CTO conditions, and implementation of suggested measures for control of road dust and air pollution. Odisha State Pollution Control Board has to ensure the compliance of CTE/CTO. Regional office of the MoEF&CC, Bhubaneswar shall monitor the compliance of the EC conditions. Regional office of the Indian Bureau of Mines (IBM) shall monitor the compliance of mining plan and progressive mine closure plan. Any violation by mine lease holder may invite actions per the provisions of applicable Acts.	COMPLIED	Environmental quality parameter such as Ambient air quality, Fugitive emission, Noise level, Surface water quality, Ground water quality etc. has been monitored through NABL Accredited Agency M/s-Visiontek Consultancy Services Pvt Ltd. Regional Office of MOEFCC monitors the compliance status of the stipulated Environmental clearance conditions. Six monthly average Environmental Monitoring report for the period Oct 2025 – Mar 2026 is attached herewith as **ANNEXURE V.**
8	Project Proponent shall ensure the compliance of Suggested Ore Transport Mode (SOTM) with association of the State Government of Odisha. All existing mines should ensure adoption of SOTM within next 5 years. New mines or mines seeking expansion should incorporate provision of SOTM in the beginning itself, and should have system in place within next 5 years	BEING COMPLIED	Ore transportation through dumper truck has been observed. 24 percent ore are being transported to railway siding (located at a distance of 10 km to 25 km approx.), 51 percent for shipping (located at a distance 300 km approx.) and 25 percent to the end user (located at a distance of 200 km. approx) by dumper. Construction of slurry pipeline is under progress through which the ore/concentrate will be transported to Paradeep.
9	The State Govt. of Odisha shall ensure dust free roads in mining areas wherever the road transportation of mineral is involved. The road shoulders shall be paved with fence besides compliance with IRC guidelines. All the roads should have proper drainage system and apart from paving of entire carriage width the remaining right of way should have native plantation (dust capturing species). Further, regular maintenance should also be ensured by the Govt. of Odisha. Progress on development of dust free roads, implementation of SOTM, increased use of existing rail network, development of additional railway network/	COMPLIED	Adequate cleaning of transport roads is carried out by a dedicated Road sweeping machine (mechanical type) on regular basis. In addition to this water tankers have also been deployed for dust control measures. Avenue plantation along road side has been done and is being maintained. Photographs of avenue plantation along road side done is attached as **Annexure VI.** Construction of slurry pipeline is under progress through which the ore/concentrate will be transported to Paradeep.

<table>
<tr><td></td><td>conveyor belt/ pipelines etc. shall be submitted periodically to regional office of the MoEF&CC.</td><td></td><td></td></tr>
<tr><td>10</td><td>Project Proponent shall develop the parking plazas for trucks with proper basic amenities/ facilities inside the mine. This should be done within one year for existing mines and new mines should have since beginning. This Environmental Clearance for the expansion project shall be operated only after the compliance of the above- mentioned specific condition.</td><td>COMPLIED</td><td>A Parking Plaza of capacity of 200 trucks has been developed at the site along with facilities such as toilet and rest area.

Photographs of the same has been attached as <u>ANNEXURE VII.</u></td></tr>
<tr><td>11</td><td>Department of Steel & Mines shall ensure the construction of NH 215 as minimum 4 lane road with proper drainage system and plantation and subsequent regular maintenance of the road as per IRC guidelines. Construction of other mineral carrying roads with proper width and drainage system along with road side plantation to be carried out. This shall be completed within 2 Years.</td><td>COMPLIED</td><td>NH 215 with proper drainage system and plantation has been constructed by State government and subsequent regular maintenance are being carried out.

Photographs are attached as <u>ANNEXURE VIII.</u></td></tr>
<tr><td>12</td><td>Regular vacuum cleaning of all mineral carrying roads aiming at “Zero Dust Re- suspension” shall be adopted by PWD / NHAI/ Mine Lease Holders within a time Period of 3 months for existing roads. This Environmental Clearance for the expansion project shall be operated only after the compliance of the above-mentioned specific condition.</td><td>COMPLIED</td><td>One Vacuum Road Sweeping Machine is deployed in the mines that operates on the mineral carrying roads every day.

Photograph of the operational Road Sweeping Machine is attached as <u>ANNEXURE IV.</u></td></tr>
<tr><td>13</td><td>In case the total requirement of iron ore exceeds the suggested limit for that year, permission for annual production by an individual mine may be decided depending on approved EC capacity (for total actual dispatch) and actual production rate of individual mine during last year or any other criteria set by the State Govt., i.e. Dept. of Steel & Mines. Department of Steel and Mines in consultation with Indian Bureau of Mines-RO should prepare in advance mine-wise annual production scenario so that demand for iron ore can be anticipated, and</td><td>COMPLIED</td><td>The Iron ore production for FY 2024-2025 is within the capacity of 6 MTPA mentioned in EC.

PRODUCTION DETAILS as per Annually submitted IBM Returns
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<tr>
<td></td>
<td>actual production/dispatch does not exceed the suggested annual production.</td>
<td></td>
<td>
<table>
<tr><td>2024-25</td><td>5.84</td><td>0.00016</td></tr>
<tr><td>2025-26</td><td>4.17</td><td>0.00218</td></tr>
</table>
</td>
</tr>
<tr>
<td>14</td>
<td>R&D studies towards utilization of low- grade iron ore should be conducted through research/academic institutes like IMMT, Bhubaneswar, NML, Jamshedpur, and concerned metallurgical departments in IITs, NITs etc., targeting full utilization of low-grade iron ore (Fe content up to 45% by 2020 and up to 40% by 2025). In fact, life cycle assessment of whole process including environmental considerations should be done for techno- economic and environmental viability. R&D studies on utilization of mine waste water having high concentration of Fe content for different commercial applications in industries such as cosmetics, pharmaceutical, paint industry should also be explored. Responsibility: IBM, Dept. of Steel & Mines, Individual Mine Lease Holders.</td>
<td>COMPLIED</td>
<td>R & D studies were conducted through IMMT, Bhubaneshwar.

Report on washing and de-sliming of iron ore fines prepared by IMMT Bhubaneswar for Narayanposhi Mines has been attached as <u>Annexure IX.</u>

JSW has not set up beneficiation plant at Narayanposhi mines. All low-grade ores are being transported to JSW steel plant (Bhushan Power & Steel Limited), where beneficiation plant is established and beneficiation is being carried out. As per the mining process no waste water is generated and discharged outside the lease, hence commercial application in other industries is not feasible.</td>
</tr>
</table>

15	The mining activity in Joda-Koira sector is expected to continue for another 100 years, therefore, it will be desirable to develop proper rail network in the region. Rail transport shall not only be pollution free mode but also will be much economical option for iron ore transport. The rail network and/or conveyor belt system up to public railway siding needs to be created. The total length of the conveyor belt system/ rail network to be developed from mines to nearest railway sidings by 11 mines in Joda region is estimated to be about 64 km. Similarly, in Koira region, total length of rail network/ conveyor system for 8 mines (under SOTM 1 & 2) is estimated to be around 95 km. Further, it is suggested to develop a rail network connecting Banspani (Joda region) and Roxy railway sidings in Koira region. Responsibility: Dept. of Steel & Mines, Govt. of Odisha and Concerned Mines along with Indian Railways. Time Period: Maximum 7 years (by 2025). The Department of Steel & Mines, Govt. of Odisha should follow-up with the concerned Departments and railways so that proposed proper rail network is in place by 2025.	BEING COMPLIED	Ore transportation through dumper truck has been observed. 24 percent ore are being transported to railway siding (located at a distance of 10 km to 25 km approx.), 51 percent for shipping (located at a distance 300 km approx.) and 25 percent to the end user (located at a distance of 200 km. approx) by dumper. Construction of slurry pipeline is under progress through which the ore/concentrate will be transported to Paradeep.
16	State Govt. of Odisha shall make all efforts to ensure exhausting all the iron & manganese ore resources in the existing working mines and from disturbed mining leases/zones in Joda and Koira region. The criteria suggested shall be applicable while suggesting appropriate lease area and sustainable mining rate. Responsibility: Dept. of Steel & Mines, Govt. of Odisha.	BEING COMPLIED	As per the directives of State Govt. of Odisha the necessary steps are taken for sustainable mining.
17	**Mining Operations/Process Related:** Project Proponent shall implement the following mitigation measures: (i) Appropriate mining process and machinery (viz. right capacity, fuel efficient) should be selected to carry out various mining operations that generate minimal dust/air	COMPLIED	(i) The Opencast Mechanized Mining process is carried out by deploying following machineries: The selection of equipment is made keeping in view the terrain condition, productivity of each equipment, equipment required for support activity, care required for working environment. Due care is

	pollution, noise, wastewater and solid waste. e.g. drills should either be operated with dust extractors or equipped with water injection system. (ii) After commencement of mining operation, a study should be conducted to assess and quantify emission load generation (in terms of air pollution, noise, waste water and solid waste) from each of the mining activity (including transportation) on annual basis. Efforts should be made to further eliminate/ minimize generation of air pollution/dust, noise, wastewater, solid waste generation in successive years through use of better technology. This shall be ensured by the respective mine lease holders. (iii) Various machineries/equipment selected (viz. dumpers, excavators, crushers, screenplants etc.) and transport means should have optimum fuel/power consumption, and their fuel/power consumption should be recorded on monthly basis. Further, inspection and maintenance of all the machineries/ equipment/ transport vehicles should be followed as per manufacturer's instructions/ recommended time schedule and record should be maintained by the respective mine lease holders. (iv) Digital processing of the entire lease area using remote sensing technique should be carried out regularly once in 3 years for monitoring land use pattern and mining activity taken place. Further, the extent of pit area excavated should also be demarcated based on remote sensing analysis. This should be done by ORSAC (Odisha Space Applications Centre, Bhubaneswar) or an agency of national repute or if done by a private agency, the report shall be vetted/ authenticated by ORSAC, Bhubaneswar. Expenses towards the same shall be borne by the respective mine lease holders. Responsibility: Individual Mine Lease Holders.		<table><tr><th>Type of Fleet</th><th>Make/Model</th></tr><tr><td>Komatsu Excavator</td><td>PC 1250-8R 5.5 m³</td></tr><tr><td>Komatsu Dumpers</td><td>HD785 91 MT / 100 US ST</td></tr><tr><td>Komatsu Wheel Loader</td><td>WA-900 9 m³</td></tr><tr><td>Komatsu Track Dozer</td><td>D275A-5R 13.6 m³</td></tr><tr><td>Komatsu Wheel Dozer</td><td>WD600-6R 10.3 m³</td></tr><tr><td>Komatsu Motor Grader</td><td>GD825A-2 4.8 mts</td></tr><tr><td>Komatsu Water Sprinkler</td><td>HD465-7E0 50 KL</td></tr><tr><td>Epiroc Blast Hole Drill (Top Ham)</td><td>Epiroc- Smart ROC D65 165 mm</td></tr><tr><td>Epiroc Blast Hole Drill (DTH)</td><td>Epiroc- Smart ROC T45 165 mm</td></tr><tr><td>Epiroc Exploration Drill</td><td>Epiroc - Boyle C15 100 mm</td></tr></table> taken for adopting latest technology and track record of equipment in surrounding area. Accordingly, Komatsu make equipment fleet of latest model is deployed. Excavator with 5.5cum is grouped with 3 nos. of 100T dumpers. Matching capacity drills, dozers and support equipment are deployed. All the noise generating units in the machinery is provided with padded enclosures for attenuation of noise. Drill machine is provided with dual system of water injection and dust extraction system. Excavators are provided with smart idling systems for fuel efficiency. (ii) Annual Study report of emission load calculation attached as **Annexure- X.** (iii) All the equipments are having latest state of art technology with very low level of emission and best fuel efficiency engine. Maintenance is done as per the manufacturer's instructions/ recommended time schedule. (iv) The digital processing of entire lease area using remote sensing technique is carried out through drone.

<table>
<tr>
<td>18</td>
<td>Air Environment Related: Project Proponent shall implement the following mitigation measures: (i) Fugitive dust emissions from all the sources should be controlled regularly on daily basis. Water spraying arrangement on haul roads, loading and unloading and at other transfer points should be provided and properly maintained. Further, it will be desirable to use water fogging system to minimize water consumption. It should be ensured that the ambient air quality parameters conform to the norms prescribed by the CPCB in this regard. (ii) The core zone of mining activity should be monitored on daily basis. Minimum four ambient air quality monitoring stations should be established in the core zone for SPM, PM10, PM2.5, SO2, NOx and CO monitoring. Location of air quality monitoring stations should be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets and frequency of monitoring should be undertaken in consultation with the State Pollution Control Board (based on Emission Load Assessment Study). The number of monitoring locations may be more for larger capacity mines and working in larger area. Out of four stations, one should be online monitoring station in the mines having more than 3 MTPA EC Capacity. (iii) Monitoring in buffer zone should be carried out by SPCB or through NABET accredited agency. In addition, air quality parameters (SPM, PM10, PM2. 5, 5O2, NOx and CO) shall be</td>
<td>COMPLIED</td>
<td>(i) Fugitive dust emissions are regularly controlled at all the sources.
<table>
<tr><td>Activity</td><td>Control Mechanism</td></tr>
<tr><td>Drill machine</td><td>Wet drilling and dust extractors</td></tr>
<tr><td>Haul road</td><td>Water sprinkling using fixed sprinklers for a stretch of 1.1 km on haul road and 2 nos. of mobile sprinklers of 50 KL and 16 KL capacity fitted with atomizer spray.</td></tr>
<tr><td>Blasting</td><td>Sequential blasting using Nonel, Wet stemming & face wetting</td></tr>
<tr><td>Crushing and screening</td><td>Dry fog systems</td></tr>
</table>
Ambient air quality parameters conform to the prescribed standards. The monitoring report is attached as <u>ANNEXURE – V</u> for favor of reference.

(ii) Core zone of mining activity is monitored regularly. Three numbers of Online monitoring stations are installed in the core zone for regular monitoring and monitored data is directly connected to the SPCB Server.
In addition to the above, required numbers of ambient and fugitive air quality monitoring stations are also installed and regular monitoring is carried out.
The photos for reference have been attached as <u>ANNEXURE - XI</u>.

(iii) Monitoring in buffer zone is carried out regularly.
All the monitoring is carried out through NABET Accredited Agency M/s-Visiontek Consultancy Services Pvt Ltd. The NABET Accreditation certificate is enclosed as <u>ANNEXURE XII</u>.

(iv) We are regularly monitoring the emission of the vehicle (PUC) to ascertain emission limits as per the pollution norms.

(v) Iron Ore is transported through tarpaulin covered trucks up to the nearest railway siding and port from where it is transported to user destination by railway wagons and ships respectively.</td>
</tr>
</table>

	regularly monitored at locations of nearest human habitation including schools and other public amenities located nearest to source of the dust generation as applicable. (iv) Emissions from vehicles as well as heavy machinery should be kept under control and regularly monitored. Measures should be taken for regular maintenance of vehicles used in mining operations and in transportation of mineral. (v) The vehicles shall be covered with a tarpaulin and should not be overloaded. Further, possibility of closed container trucks should be explored for direct to destination movement of iron ore. Air quality monitoring at one location should also be carried out along the transport route within the mine (periodically, near truck entry and exit gate), Responsibility: Individual Mine Lease Holders and SPCB.		Closed container truck is not readily available in the market for iron ore transportation Construction of slurry pipeline is under progress through which the ore/concentrate will be transported from Nuagaon to Paradeep. Photos of the tarpaulin covered trucks; dust control systems are attached as **ANNEXURE – XIII.**
19	Noise and Vibration Related: Project Proponent shall implement the following mitigation measures: (i) Blasting operation should be carried out only during daytime. Controlled blasting such as Nonel, should be practiced. The mitigation measures for control of ground vibrations and to arrest fly rocks and boulders should be implemented. (ii) Appropriate measures should be taken for control of noise levels below 85 DB in the work environment. Workers engaged in operations of HEMM, etc. should be provided with ear plugs/muffs.	COMPLIED	(i) Blasting operation is carried out only during daytime. Controlled blasting for control of ground vibrations and to arrest fly rocks and boulders are practiced with Sequential blasting using Nonel, Wet stemming & face wetting. (ii) All the equipments are having latest state of art technology with very low level of emission and best fuel efficiency engine. All the noise generating units in the machinery is provided with padded enclosures for attenuation of noise. Workers engaged are provided with ear plugs. (iii) Source noise are monitored on weekly basis near the major sources of noise generation within the core zone. The monitored data is within the acceptable limits of CPCB (CPCB, 2000). The report is attached in **ANNEXURE V.**

	(iii) Noise levels should be monitored regularly (on weekly basis) near the major sources of noise generation within the core zone. Further, date, time and distance of measurement should also be indicated with the noise levels in the report. The data should be used to map the noise generation from different activities and efforts should be made to maintain the noise levels with the acceptable limits of CPCB (CPCB, 2000) (iv) Similarly, vibration at various sensitive locations should be monitored at least once in month, and mapped for any significant changes due to successive mining operations. Responsibility: Individual Mine Lease Holders.		(iv) Noise level at various sensitive locations is monitored once in month. Reports are available in **ANNEXURE V.**
20	Water/Wastewater Related: Project Proponent shall implement the following mitigation measures: (i) In general, the mining operations should be restricted to above ground water table and it should not intersect groundwater table. However, if enough resources are estimated below the ground water table, the same may be explored after conducting detailed geological studies by GSI and hydro- geological studies by CGWB or NIH or institute of national repute, and ensuring that no damage to the land stability/ water aquifer system shall happen. The details/ outcome of such study may be reflected/incorporated in the EIA/EMP report of the mine appropriately. (ii) Natural watercourse and/or water resources should not be obstructed due to any mining operations. Regular monitoring of the flow rate of the springs and	COMPLIED	(i) Mining Operations in Iron ore pits are restricted to above groundwater table. In case, the mining scheme envisages intersection of ground water table, then formal clearance from CGWA will be undertaken. Hydrogeological study has been conducted and CGWA NOC vide application no. MIN/OD/2025/18602/R-3 is approved. Hydrogeological Report attached as **ANNEXURE XIV** Hydrogeological study of the area is conducted by M/s GCRS (an empaneled agency of CGWB). Suitable conservation measures are enlisted in the report and implementation is done accordingly. The report is submitted to CGWB as part of consultation, which was perused and suitable updations are also done based on specific query. Based on this consideration, NOC is awarded. (ii) It is confirmed that no natural water course has been obstructed due to mining operations.

	perennial nallas should be carried out and records should be maintained. Further, regular monitoring of water quality of nallas and river passing thorough the mine lease area (upstream and downstream locations) should be carried out on monthly basis. (iii) Regular monitoring of ground water level and its quality should be carried out within the mine lease area by establishing a network of existing wells and constructing new piezometers during the mining operation. The monitoring should be carried out on monthly basis. (iv) In order to optimize water requirement, suitable conservation measures to augment ground water resources in the area should be undertaken in consultation with Central Ground Water Board (CGWB). (v) Suitable rainwater harvesting measures on long term basis should be planned and implemented in consultation with CGWB, to recharge the ground water source. Further, CGWB can prepare a comprehensive plan for the whole region. (vi) Appropriate mitigation measures (viz. ETP, STP, garland drains, retaining walls, collection of run off etc.) should be taken to prevent pollution of nearby river/other water bodies. Water quality monitoring study should be conducted by State Pollution Control Board to ensure quality of surface and ground water sources on regular basis. The study can be conducted through NABL/NABET approved water testing laboratory. However, the report should be vetted by SPCB. (vii) Industrial wastewater (workshop and		Surface flow rate and water quality analysis (upstream and downstream locations) of the springs and perennial nallas are carried out and records are maintained. The monitoring report is attached as **ANNEXURE – V** for favor of reference. (iii) Ground water level and its quality is monitored on a regular basis and the reports are submitted to the board on quarterly basis. Quarterly ground water report submitted to the board is attached as **ANNEXURE XVI.** (iv)Suitable conservation measures have been implemented for ground water augmentation in mining area in accordance with a detailed study carried out by M/s Geo Climate Risk Solutions (an empaneled agency of CGWB). (v) Rainwater is stored in the mined-out pits and other settling ponds within the mine lease area to facilitate groundwater recharge. **Sl No** | **Location** | **Capacity (m^3)** 1 | Pond 1 | 2478.7 2 | Pond 2 | 5779.5 3 | Pond 3 | 6789.7 4 | Manganese Quarry pit | 37800.0 In addition to this, rainwater harvesting measures have also been implemented through roof top rain water harvesting structures in the colony premises with recharging system. Photos of the same are attached as **ANNEXURE – XVII.** (vi) No wastewater is discharged out. Water quality monitoring study is conducted by NABL and NABET approved laboratory M/s-Visiontek Consultancy Services Pvt Ltd. The NABL Accredited certificate is hereby attached as **ANNEXURE XVIII.**

	wastewater from the mine) should be properly collected, treated in ETP so as to conform to the discharge standards applicable. (viii) Oil and grease trap should be installed before discharge of workshop effluents. Further, sewage treatment plant should be installed for the employees/colony, wherever applicable. (ix) Mine lease holder should ensure that no silt originating due to mining activity is transported in the surface water course or any other water body. Appropriate measures for prevention and control of soil erosion and management of silt should be undertaken. Quantity of silt/soil generated should be measured on regular basis for its better utilization. (x) Erosion from dumps site should be protected by providing geo-textile matting or other suitable material, and thick plantation of native trees and shrubs should be carried out at the dump slopes. Further, dumps should be protected by retaining walls. (xi) Trenches/ garland drain should be constructed at the foot of dumps to arrest silt from being carried to water bodies. Adequate number of check dams should be constructed across seasonal/perennial nallas (if any) flowing through the mine lease areas and silt be arrested. De-silting at regular intervals should be carried out and quantity should be recorded for its better utilization, after proper soil quality analysis. (xii) The water so collected in the reservoir within the mine should be utilized for the sprinkling on hauls roads, green belt		(vii) ETP of 15KLD capacity established along with washing bay system. Additionally, Oil and grease trap system is also installed for the workshop waste water treatment. The treated water is recirculated and used for washing the vehicles. Photograph of ETP is attached as **ANNEXURE-XIX.** (viii) STP of 50 KLD is in operation. The treated water is used for gardening and watering plantations at operator colony and other areas. Photograph of STP is attached as **ANNEXURE-XX.** (ix) Proper Runoff management is carried out to and preventive measures have been taken accordingly such that no silt is transported in the surface water course. Plan showing the runoff management plan is attached as **ANNEXURE-XXI.** (x) Dump site is protected by providing geotextile mats along with plantation, seed broadcasting, vetiver grassing over the dumps. Photos of the same are attached as **ANNEXURE – XXII.** (xi) Garland drains, retaining walls are provided at the foot of the dumps to arrest silt. Adequate check dams are constructed. The drains and settling ponds are de-silted on a regular basis. **Photographs of the same are attached as ANNEXURE XXIII.** **(xii)** Water collected in reservoir are used for dust suppression using fixed and mobile water sprinklers. Photos of the same are attached as in **ANNEXURE – XXIV.** No wastewater is discharged to outside of mines lease.

	development etc. There should be zero waste water discharge from the mine. Based on actual water withdrawal and consumption/ utilization in different activities, water balance diagram should be prepared on monthly basis, and efforts should be made to optimize consumption of water per ton of ore production in successive years. Responsibility: Individual Mine Lease Holders, SPCB and CGWB.		
21	**Land/Soil/Overburden Related**: Project Proponent shall implement the following mitigation measures: (i) The top soil should temporarily be stored at earmarked site(s) only and it should not be kept unutilized for long (not more than 3 years or as per provisions mentioned in the mine plan/ scheme). The topsoil should be used for land reclamation and plantation appropriately. (ii) Fodder plots should be developed in the non-mineralised area in lieu of use of grazing land, if any. (iii) Over burden/ low grade ore should be stacked at earmarked dump site (s) only and should not be kept active for long period. The dump height should be decided on case-to- case basis, depending on the size of mine and quantity of waste material generated. However, slope stability study should be conducted for larger heights, as per IBM approved mine plan and DGMS guidelines. The OB dump should be scientifically vegetated with suitable native species to prevent erosion and surface run off. In critical areas, use of geo textiles should be undertaken for stabilization of the dump. Monitoring and management of	COMPLIED	(i) No top soil is generated as it is a working mine. (ii) Fodder plots have been developed in the non-mineralized area of the Mining lease. Photographs of the same is enclosed as **ANNEXURE – XXV.** (iii) Overburden and low-grade iron ore are stacked at earmarked area as per approved mining plan. Slope stability study has been conducted as per DGMS guidelines. Copy of the report is attached as **ANNEXURE – XXVI.** Dump site is scientifically protected by providing and maintaining geotextile mats along with plantation, seed broadcasting, vetiver grassing over the dumps. The growth and lifecycle of the species are monitored. Photos of the same are attached as **ANNEXURE – XXII.** (iv) Garland drains, retaining walls are provided at the foot of the dumps to arrest silt. Settling ponds and check dams are constructed with adequate sump capacity designed with appropriate safety margin based on long term rainfall data to arrest silt and sediment flows from mine operation, soil, OB and mineral dumps, thus collected water is used for dust suppression and green belt development. The drains and settling ponds are de-silted on a regular basis. (v) Backfilling is in progress in line with approved mining plan. (vi) Hazardous waste has been disposed of as per provisions of Hazardous waste management Rules 2016. Waste oil, lubricants (as per Cat.5.1, Schedule-I) are disposed to authorized recyclers. Annual

	rehabilitated areas should continue until the vegetation becomes self-sustaining. Proper records should be maintained regarding species, their growth, area coverage etc. (iv) Catch drains and siltation ponds of appropriate size shouldbe constructed to arrest silt and sediment flows from mine operation, soil, OB and mineral dumps. The water so collected can be utilized for watering the mine area, roads, green belt development etc. The drains should be regularly de-silted, particularly after monsoon and should be maintained properly. Appropriate documents should be maintained. Garland drain of appropriate size, gradient and length should be constructed for mine pit, soil, OB and mineral dumps and sump capacity should be designed with appropriate safety margin based on long term rainfall data. Sump capacity should be provided for adequate retention period to allow proper settling of silt material. Sedimentation pits should be constructed at the corners of the garland drains and de- silted at regular intervals. (v) Backfilling should be done as per approved mining plan/scheme. There should be no OB dumps outside the mine lease area. The backfilled area should be afforested, aiming to restore the normal ground level. Monitoring and management of rehabilitated areas should continue till the vegetation is established and becomes self- generating. (vi) Hazardous waste such as, waste oil, lubricants, resin, and coal tar etc. should be disposed off as per provisions of Hazardous Waste Management Rules, 2016, as amended from time to time. Responsibility: Individual Mine Lease Holders.		returns in Form-IV are being submitted to SPCB, Odisha in regular basis. Copy of last annual return is attached as **ANNEXURE- XXVII.**
22	**Ecology/Biodiversity (Flora-Fauna) Related**: Project Proponent shall implement the following		It is to inform that study on biological environment have been carried out in core zone and buffer zone. Floral species like Shorea robusta,

	mitigation measures: (i) All precautionary measures should be taken during mining operation for conservation and protection of endangered fauna namely elephant, sloth bear etc. spotted in the study area. Action plan for conservation of flora and fauna should be prepared and implemented in consultation with the State Forest and Wildlife Department within the mine lease area, whereas outside the mine lease area, the same should be maintained by State Forest Department. (ii) Afforestation is to be done by using local and mixed species saplings within and outside the mining lease area. The reclamation and afforestation is to be done in such a manner like exploring the growth of fruit bearing trees which will attract the fauna and thus maintaining the biodiversity of the area. As afforestation done so far is very less, forest department needs to identify adequate land and do afforestation by involving local people in a time bound manner. (iii) Green belt development carried out by mines should be monitored regularly in every season and parameters like area under vegetation/plantation, type of plantation, type of tree species /grass species/scrubs etc., distance between the plants and survival rate should be recorded. (iv) Green belt is an important sink of air pollutants including noise. Development of green cover in mining area will not only help reducing air and noise pollution but also will improve the ecological conditions and prevent		Terminalia tomentosa, Grewia tiliaefolia, Syzygium cumini, Adina cordifolia, Madhuca Indica and Ficus religiosa, Morinda tinctoria, Azadirachata indica, Tamarindus chebula and Syzygium cumini are available. Study of Faunal composition reveals that there is no National Park, Wildlife Sanctuary, Elephant Reserve, Biosphere Reserve, Ramsar site or Tiger Reserve in the study area. Karo - Karampada elephant corridor is located at about 18.0 km from the mine lease area in North direction. Elephant, Sloth bear, Python and Monitor Lizard are placed under Schedule-I as per Wild Life (Protection) Act, 1972 is found in the buffer area, for which Site-Specific Wild life conservation plan was prepared and got approved from PCCF (Wildlife) & Chief Wildlife Warden, Odisha. Accordingly, Rs. 288.00 lakh of which Rs. 92.00 lakh has been earmarked for implementation of the Plan within the Mining Lease area and Rs. 196.00 Lakh has been earmarked for implementation in the buffer zone area. It is requested to DFO, Bonai division, Dist. Sundergarh to get the implementation status. Copy of the letter is enclosed as **ANNEXURE-XXIX and ANNEXURE-XXVIII**. These scheme covers conservation measures for wildlife management and development of flora by plantation of intimate mixture of food and cover species, goe-textile, grass seedling, etc. In addition to this afforestation covering 30,398 nos. of saplings of mixed local species is carried out till date. This is in addition to the afforestation carried out by Ex-leassee (M/s. AMTC) before 2020. Green belt development is regularly being carried out by mines and maintained/ monitored regularly. The plantation includes local species such as Gulmohar, Imli, jamun which helps in arresting the dust. Vetiver grass is planted on inactive dumps for the slope stabilization. Photographs of vetiver grass plantation over inactive dump is enclosed as **ANNEXURE – XXX.** Compensatory afforestation is being carried out by State Forest department. Financial outlay for activities in project area given Rs. 27,43,000 for Compensatory afforestation and implementation certificate is awaited from DFO, Bonai, Odisha

	soil erosion to a greater extent. Further, selection of tree species for green belt should constitute dust removal/dust capturing plants since plants can act as efficient biological filters removing significant amounts of particulate pollution. Thus, the identified native trees in the mine area may be encouraged for plantation. Tree species having small leaf area, dense hair on leaf surface (rough surface), deep channels on leaves should be included for plantation. (v) Vetiver plantation on inactive dumps may be encouraged as the grass species has high strength of anchoring besides medicinal value. (vi) Details of compensatory afforestation done should be recorded and documented by respective forest divisions, and State Forest Department should present mine-wise annual status, along with expenditure details. Responsibility: Individual Mine Lease Holders and State Forest & Wildlife Department.		A SSWLCP was prepared and approved by PPCF and Chief wild life warden enumerating Fauna in core and buffer zone. Remittance of financial outlay for conservation measures as enlisted in the plan is made. We have requested the O/o DFO for furnishing the information regarding implementation status of SSWLCP. SSWLCP is attached as **Annexure- XXXII** Mail correspondence is attached as **Annexure- XXXI** On receipt, we undertake to submit the status report forthwith.
23	**Socio-Economic Related**: Project Proponent shall implement the following mitigation measures: (i) Public interaction should be done on regular basis and social welfare activities should be done to meet the requirements of the local communities. Further, basic amenities and infrastructure facilities like education, medical, roads, safe drinking water, sanitation, employment, skill development, training institute etc. should be developed to alleviate the quality of life of the people of the region. (ii) Land outees and land losers/affected people, if any, should be	COMPLIED	Public interactions are being carried out on regular basis and social welfare activities are being done to meet the requirements of the local communities Activities like education, medical, roads, safe drinking water, sanitation, employment, skill development, training institute etc. has been developed to alleviate the quality of life of the people.

	compensated and rehabilitated as per the national/state policy on Resettlement and Rehabilitation. (iii) The socio-economic development in the region should be focused and aligned with the guidelines/initiatives of Govt. of India/ NITI Aayog around prosperity, equality, justice, cleanliness, transparency, employment, respect to women, hope etc. This can be achieved by providing adequate and quality facilities foreducation, medical and developing skills inthe people of the region. District administration in association with mine lease holders should plan for "Samagra Vikas" of these blocks well as other blocks of the district. While planning for different schemes in the region, the activities should be prioritized as per Pradhan Mantri Khanij Kshetra Kalyan Yojna (PMKKKY), notified by Ministry of Mines, Govt. of India, vide letter no. 16/7/2017-M.VI (Part), dated September 16, 2015. Responsibility: District Administration and Individual Mine Lease Holders.		
24	**Road Transport Related**: Project Proponent shall implement the following mitigation measures: (i) All the mine lease holders should follow the suggested ore transport mode (SOTM), based on its EC capacity within next 5 years. (ii) The mine lease holders should ensure construction of cement road of appropriate width from and to the entry and exit gate of the mine. Further, maintenance of all the roadsshould be carried out as per the requirement to ensure dust free road transport. (iii) Transportation of ore should be done by covering the trucks with tarpaulin or other suitable mechanism so that no spillage of ore/dust takes	COMPLIED	Concrete road is provided from the exit of Manganese quarry to NH. Concrete road is also available at Gate 2, the main exit gate of the mines. Photographs of concrete roads submitted as **ANNEXURE III** Iron Ore is transported through tarpaulin covered trucks up to the nearest railway siding and port from where it is transported to user destination by railway wagons and ships respectively. Construction of slurry pipeline is under progress through which the ore/concentrate will be transported to Paradeep. Photos of the tarpaulin covered trucks; dust control systems are attached as **ANNEXURE – XIII.**

	place. Further, air quality in terms of dust, PM:10 should be monitored near the roads towards entry & exit gate on regular basis, and be maintained within the acceptable limits. Responsibility: Individual Mine Lease Holders and Dept. of Steel & Mines.		PM10 along with other parameters are monitored near the roads towards entry & exit gate on regular basis and are maintained within the acceptable limits. The monitoring data is attached as **ANNEXURE V.**
25	**Occupational Health Related**: Project Proponent shall implement the following mitigation measures: (i) Personnel working in dusty areas should wear protective respiratory devices and they should also be provided with adequate training and information on safety and health aspects periodically. (ii) Occupational health surveillance program for all the employees/workers (including casual workers) should be undertaken periodically (on annual basis) to observe any changes due to exposure to dust, and corrective measures should be taken immediately, if needed. (iii) Occupational health and safety measures related awareness programs including identification of work-related health hazard, training on malaria eradication, HIV and health effects on exposure to mineral dust etc., should be carried out for all the workers on regular basis. A full-time qualified doctor should be engaged for the purpose. Periodic monitoring (on 6 monthly basis) for exposure to respirable minerals dust on the workers should be conducted, and record should be maintained including health record of all the workers. Review of impact of various health measures undertaken (at an interval of 3 years or less) should be conducted followed by follow-up of actions, wherever required. Occupational health centre should be established near mine site itself. Responsibility: Individual Mine Lease Holders and District Administration (District Medical Officer).	COMPLIED	(i) All workers are provided with proper PPE, with adequate training and information on safety and health aspects periodically. (ii)Occupational health surveillance program for all the employees/workers are done on annual basis to observe any changes due to exposure to various parameters including dust. PPEs like safety shoes, reflective jacket, safety glass, ear plugs, helmets etc. have been distributed. Personnel working in dusty areas wear protective respiratory devices and vocational training and information on safety and health aspects are being given to them periodically. All employees and workers will be given trainings in the Vocational Training centers. IME is a mandate to work inside the mines. An occupational health center is established within the mine lease area.

	B. Standard Conditions **I. Statutory Compliance**		
1	This Environmental Clearance (EC) is subject to orders/judgment of Hon'ble Supreme Court of India, Hon'ble High Court, Hon'ble NGT and any other Court of Law, Common Cause Conditions as may be applicable.	AGREED UPON	Agreed to abide by the condition
2	This EC is valid up to 31.03.2020 as the lease validity i.e. valid up to 31st March 2020 as per the Amended MMDR Act. 2015		EC has been vested to JSW Steel Ltd for 2 years and then further for 50 years. As per MOEF&CC OM dated 13.07.2021, EC transferred till life of the mine. EC capacity of 6.0 MTPA was accorded to ex-lease in the year 2019 in the name of M/s Aryan Mining & Trading Corp. Pvt. Ltd. Vesting order was given to M/s. JSW Steel Limited from Steel & Mines Department, Government of Odisha vide Order no. 4212/SM, dated 30th May 2020 as per MMDR Act, 1957 and Mineral concession Rules, 2016. Further it was vested for 50 years vide order no. 1335/ 1V (B) SM -21/2020. Vesting order copy is attached as **ANNEXURE XXXIII**
3	The Project proponent complies with all the statutory requirements and judgment of Hon'ble Supreme Court dated 2nd August, 2017 in Writ Petition (Civil) No. 114 of 2014 in matter of Common Cause versus Union of India &Ors. before commencing the mining operations.	AGREED UPON	Agree to abide by the condition
4	The State Government concerned shall ensure that mining operation shall not be commenced till the entire compensation levied, if any, for illegal mining paid by the Project Proponent through their respective Department of Mining & Geology in strict compliance of Judgment of Hon'ble Supreme Court dated 2nd August, 2017 in Writ Petition (Civil} No. 114 of 2014 in matter of Common Cause versus Union of India & Ors.		State Government (Steel & Mines Department) has given vested order in favour of M/s. JSW Steel Limited vide No. 1335/SM, dated 15.02.2022 for grant of mining lease for 50 years and all clearances, vested under section-8A, Sub section-2 of Mines and Mineral Development Regulation Act, 1957.
5	This Environmental Clearance shall become operational only after receiving formal NBWL Clearance from MoEF&CC subsequent to the		As per the information furnished No Wild Life Sanctuary/Tiger Reserve/National Park/ within the core as well as within the buffer zone of the project.

	recommendations of the Standing Committee of National Board for Wildlife, if applicable to the Project.		
6	This Environmental Clearance shall become operational only after receiving formal Forest Clearance (FC) under the provision of Forest Conservation Act, 1980, if applicable to the Project.		As per the EC accorded total forest area is 259.191Ha. Forest Clearance accorded for 244.327 Ha to M/s JSW Steel Ltd. 19.25 Ha yet to diverted. (As reported by PP) out of 244.327 Ha ,184.591 Ha has been transferred to the new lessee. FC transfer letter is attached as **ANNEXURE XXXIV**
7	Project Proponent (PP) shall obtain Consent to Operate after grant of EC and effectively implement all the conditions stipulated therein. The mining activity shall not commence prior to obtaining Consent to Establish / Consent to Operate from the concerned State Pollution Control Board/Committee.	COMPLIED	Consent to operate has been accorded by Odisha Pollution Control Board vide letter no. 3791/IND-I-CON-2258 dated 23.03.2026 valid up to 31.03.2027.
8	The PP shall adhere to the provision of the Mines Act, 1952, Mines and Mineral (Development & Regulation), Act, 2015 and rules & regulations made there under. PP shall adhere to various circulars issued by Directorate General Mines Safety (DGMS) and Indian Bureau of Mines from time to time.	AGREED UPON	Agreed to comply
9	The Project Proponent shall obtain consents from all the concerned land owners, before start of mining operations, as per the provisions of MMDR Act, 1957 and rules made there under in respect of lands which are not owned by it.	COMPLIED	Present mining operation has been restricted within vested lease granted over 347.008 ha (as per DGPS).
10	The Project Proponent shall follow the mitigation measures provided in MoEFCC's Office Memorandum No. Z- 11013/57/2014-IA.II (M), dated 29th October, 2014, titled "Impact of mining activities on Habitations-Issues related to the mining Projects wherein Habitations and villages are the part of mine lease areas or Habitations and villages are surrounded by the	COMPLIED	As per the Office Memorandum No. Z- 11013/57/2014- IA.II (M), dated 29th October, 2014, titled "Impact of mining activities on Habitations-Issues of MoEFCC's, mitigative measures are being taken care of. This includes construction of garland drains, check dams, retaining walls and settling ponds.OM also states about the regular monitoring of natural stream, illumination survey and others which are being carried out.

	mine lease area".		
11	The Project Proponent shall obtain necessary prior permission of the competent authorities for drawl of requisite quantity of surface water and from CGWA for withdrawal of ground water for the project	COMPLIED	CGWA NOC was obtained. NOC No.: CGWA/NOC/MIN/REN/2/2024/10057 dated 17/10/2024. Presently, the CGWA NOC vide application no. MIN/OD/2025/18602/R-3 is approved. The renewal application along with the mail communication of its approval is attached as **ANNEXURE XV.**
12	A copy of EC letter will be marked to concerned Panchayat / local NGO etc. if any, from whom suggestion / representation has been received while processing the proposal.	COMPLIED	EC is granted to ex-lessee vide EC No. J11015/288/2008-IA.II(M), dated 18.06.2019. EC was operational and same was vested to JSW vide order no. 4212/SM/IV(B) SM-21/2020 dated 30.05.2020. As per the EIA report and PH proceedings there were no such suggestions received from local Panchayat or NGO. However, a copy of EC is submitted to Koira Panchayat vide our letter No. JSW/NP/PAO/ 1968/23-24, dated 02.08.2023. Copy is enclosed as **ANNEXURE XXXV.**
13	State Pollution Control Board/Committee shall be responsible for display of this EC letter at its Regional office, District Industries Centre and Collector's office/ Tehsildar's Office for 30 days.	COMPLIED	State Pollution Control Board/Committee has displayed EC letter at its Regional office, District Industries Centre and Collector's office/ Tehsildar's Office.
14	The Project Authorities should widely advertise about the grant of this EC letter by printing the same in at least two local newspapers, one of which shall be in vernacular language of the concerned area. The advertisement shall be done within 7 days of the issue of the clearance letter mentioning that the instant project has been accorded EC and copy of the EC letter is available with the State Pollution Control Board/Committee and web site of the Ministry of Environment, Forest and Climate Change (www.parivesh.nic.in). A copy of the advertisement may be forwarded to the concerned MoEFCC Regional Office for compliance and record.		EC is granted to ex-lessee vide EC No. J-11015/288/2008-IA.II(M), dated 18.06.2019 and same was vested to JSW vide order no. 4212/SM/IV(B) SM-21/2020 dated 30.05.2020. Advertisement of EC may have been submitted by the erstwhile lessee. Copy of EC is submitted to Koira Panchayat vide our letter No. JSW/NP/PAO/ 1968/23-24, dated 02.08.2023. We have not received any suggestions in this regard. Copy enclosed as **ANNEXURE – XXXV** The condition requires compliance in 2019 within 7 days of issuance of EC. It was the period Erstwhile lessee was operating.
15	The Project Proponent shall inform the MoEF&CC for any change in ownership of the mining lease. In case there is any change in ownership or mining lease is transferred than mining operation shall	COMPLIED	EC has been accorded to M/s Aryan Mining & Trading Corporation Pvt. Ltd. Subsequently, due to expiry of lease on 31.03.2020, it has been auctioned and M/s JSW has been declared as preferred bidder. Acknowledge letter has been accorded by MOEFCC vide letter dated 11/12/2021.

<table>
<tr><td></td><td>only be carried out after transfer of EC as per provisions of the para II of EIA Notification, 2006 as amended from time to time.</td><td></td><td>Copy for the same is attached as <u>ANNEXURE XXXVI.</u></td></tr>
<tr><td></td><td>II. Air quality monitoring and preservation</td><td></td><td></td></tr>
<tr><td>16</td><td>The Project Proponent shall install a minimum of 3 (three) online Ambient Air Quality Monitoring Stations with 1 (one) in upwind and 2 (two) in downwind direction based on long term climatological data about wind direction such that an angle of 120° is made between the monitoring locations to monitor critical parameters, relevant for mining operations, of air pollution viz. PM10, PM2.5, NO2, CO and SO2 etc. as per the methodology mentioned in NAAQS Notification No. B- 29016/2o/go/PCI/I, dated 18.11.2009 covering the aspects of transportation and use of heavy machinery in the impact zone. The ambient air quality shall also be monitored at prominent places like office building, canteen etc. as per the site condition to ascertain the exposure characteristics at specific places. The above data shall be digitally displayed within 03 months in front of the main Gate of the mine site.</td><td>COMPLIED</td><td>In consultation with SPCB, three numbers of Continuous ambient air monitoring stations (CAAQMS) have been installed for PM10, PM2.5, NO2, CO and SO2, maintaining an angle of 120^0 in such a way that one station is in upwind and two stations are in downwind direction.

Locations are as below-

CAAQMS 1 – Near Narayanposhi Mines Office
CAAQMS 2 – Near Gate No. 1
CAAQMS 3 - Near Gate No. 2
Digital Display Board- Near Gate No. 2

Installation of online Continuous ambient air monitoring stations (CAAQMS) was done based on climatological data and site conditions in consultation with the SPCB, Rourkela and letter of communication with SPCB is attached as <u>ANNEXURE – XXXVII</u> and map in support of the location of CAAQMS is attached as <u>ANNEXURE – XXXVIII</u>.</td></tr>
<tr><td>17</td><td>Effective safeguard measures for prevention of dust generation and subsequent suppression (like regular water sprinkling, metalled road construction etc.) shall be carried out in areas prone to air pollution wherein high levels of PM10 and PM2.5 are evident such as haul road, loading and unloading point and transfer points. The Fugitive dust emissions from all sources shall be regularly controlled by installation of required equipment's/ machineries and preventive maintenance. Use of suitable water-soluble chemical dust suppressing agents may be explored</td><td>COMPLIED</td><td>Fugitive dust emissions are regularly controlled at all the sources.
<table>
<tr><td>Activity</td><td>Control Mechanism</td></tr>
<tr><td>Drill machine</td><td>Wet drilling and dust extractors</td></tr>
<tr><td>Haul road</td><td>Water sprinkling using fixed sprinklers for a stretch of 1.1 km on haul road and 2 nos. of mobile sprinklers of 50 KL and 16 KL capacity fitted with atomizer spray.</td></tr>
<tr><td>Blasting</td><td>Sequential blasting using Nonel, Wet stemming & face wetting</td></tr>
<tr><td>Crushing and screening</td><td>Dry fog systems</td></tr>
</table></td></tr>
</table>

	for better effectiveness of dust control system. It shall be ensured that air pollution level conform to the standards prescribed by the MoEFCC/ Central Pollution Control Board		Dust suppressant chemicals are added in the mobile sprinklers which enhances the effectiveness of dust control system. Photographs of the same are attached as **ANNEXURE XXXIX**
	III. Water quality monitoring and preservation		
18	In case, immediate mining scheme envisages intersection of ground water table, then Environmental Clearance shall become operational only after receiving formal clearance from CGWA. In case, mining operation involves intersection of ground water table at a later stage, then PP shall ensure that prior approval from CGWA and MoEFCC is in place before such mining operations. The permission for intersection of ground water table shall essentially be based on detailed hydro-geological study of the area.		Mining Operations in Iron ore pits are restricted to above groundwater table. In case, the mining scheme envisages intersection of ground water table, then formal clearance from CGWA will be undertaken. Hydrogeological study has been conducted and CGWA NOC is under renewal against application no. MIN/OD/2025/18602/R-3. Hydrogeological Report attached as **ANNEXURE XIV.**
19	Regular monitoring of the flow rate of the springs and perennial nallahs flowing in and around the mine lease shall be carried out and maintain records. The natural water bodies and or streams which are flowing in an around the village, should not be disturbed. The Water Table should be nurtured so as not to go down below the pre- mining period. In case of any water scarcity in the area, the Project Proponent has to provide water to the villagers for their use. A provision for regular monitoring of water table in open dug wall located in village should be incorporated to ascertain the impact of mining over groundwater table. The Report on changes in Ground water level and quality shall be submitted on six- monthly basis to the Regional Office of the Ministry, CGWA and State Groundwater Department / State Pollution Control Board	COMPLIED	Surface flow rate and water quality analysis (upstream and downstream locations) of the springs and perennial nallas are carried out and records are maintained. The monitoring report is attached as **ANNEXURE – V** for favor of reference. It is confirmed that no natural water course has been obstructed due to mining operations. Ground water level and its quality is monitored on a regular basis and the reports are submitted to the board on quarterly basis. Quarterly ground water report submitted to the board is attached as **ANNEXURE XVI.** Suitable conservation measures have been implemented for ground water augmentation in mining area in accordance with a detailed study carried out by M/s Geo Climate Risk Solutions (an empaneled agency of CGWB).

			The Monitoring Report on Ground water level and quality is being submitted to the Regional Office of the Ministry and State Pollution Control Board.
20	Project Proponent shall regularly monitor and maintain records w.r.t. ground water level and quality in and around the mine lease by establishing a network of existing wells as well as new piezo-meter installations during the mining operation in consultation with Central Ground Water Authority/ State Ground Water Department. The Report on changes in Ground water level and quality shall be submitted on six-monthly basis to the Regional Office of the Ministry, CGWA and State Groundwater Department / State Pollution Control Board.	COMPLIED	Ground water level and its quality is monitored on a regular basis and the reports are submitted to the board on quarterly basis. Quarterly ground water report submitted to the board is attached as **ANNEXURE XVI.** The Monitoring Report on Ground water level and quality is being submitted on to the Regional Office of the Ministry and State Pollution Control Board.
21	The Project Proponent shall undertake regular monitoring of natural water course/ water resources/ springs and perennial nallahs existing/ flowing in and around the mine lease and maintain its records. The project proponent shall undertake regular monitoring of water quality upstream and downstream of water bodies passing within and nearby/ adjacent to the mine lease and maintain its records. Sufficient number of gullies shall be provided at appropriate places within the lease for management of water. PP shall Carryout regular monitoring w.r.t. pH and included the same in monitoring plan. The parameters to be monitored shall include their water quality vis-à-vis suitability for usage as per CPCB criteria and flow rate. It shall be ensured that no obstruction and/or alteration be made to water bodies during mining operations without justification andprior approval of MoEFCC. The	COMPLIED	Surface flow rate and water quality analysis as per CPCB Criteria (upstream and downstream locations) of the springs and perennial nallas are carried out and records are maintained. The monitoring report is attached as **ANNEXURE – V** for favor of reference. No obstruction is made to the water bodies due to mining operations. Water courses are monitored and the reports are sent regularly to the board on quarterly basis separately and also along with Six monthly EC Compliance Report.

	monitoring of water courses/ bodies existing in lease area shall be carried out four times in a Year viz. pre- monsoon(April-May). monsoon (August), post- monsoon (November) and winter (January)and the record of monitored data may be sent regularly to Ministry of Environment, Forest and Climate Change and its Regional Office, Central Ground Water Authority and Regional Director, Central Ground Water Board, State Pollution Control Board and Central Pollution Control Board. Clearly showing the trend analysis on six-monthly basis.		
22	Quality of polluted water generated from mining operations which include Chemical Oxygen Demand (COD) in mines run-off; acid mine drainage and metal contamination in runoff shall be monitored along with Total Suspended Solids (TDS), Dissolved Oxygen (DO), pH and Total Suspended Solids (TSS). The monitored data shall be uploaded on the website of the company as well as displayed at the project site in public domain, on a display board, at a suitable location near the main gate of the Company. The circular No. J- 20012/1/2006- IA.II (M) dated 27.05.2009 issued by Ministry of Environment, Forest and Climate Change may also be referred in this regard.	COMPLIED	The surface runoff water is monitored during monsoon. It is analysed for COD, TSS, TDS, DO, pH and other parameters. The monitored data is displayed in the digital display board of the mines for public domain. Runoff monitoring report is attached as **ANNEXURE XL.** Monitored data uploaded in the website of the company along with six monthly compliances.
23	Project Proponent shall plan, develop and implement rainwater harvesting measures on long term basis to augment ground water resources in the area in consultation with Central Ground Water Board/ State Groundwater Department. A report	COMPLIED	Suitable conservation measures have been implemented for ground water augmentation in mining area in accordance with a detailed study carried out by M/s Geo Climate Risk Solutions (an empaneled agency of CGWB).

<table>
<tr><td></td><td>on amount of water recharged needs to be submitted to Regional Office MoEFCC annually.</td><td></td><td>Rainwater is stored in the mined-out pits and other settling ponds within the mine lease area to facilitate groundwater recharge.
<table><tr><th>Sl No</th><th>Location</th><th>Capacity (m^3)</th></tr><tr><td>1</td><td>Pond 1</td><td>2478.7</td></tr><tr><td>2</td><td>Pond 2</td><td>5779.5</td></tr><tr><td>3</td><td>Pond 3</td><td>6789.7</td></tr><tr><td>4</td><td>Manganese Quarry pit</td><td>37800.0</td></tr></table>
In addition to this, rainwater harvesting measures have also been implemented through roof top rain water harvesting structures in the colony premises with recharging system.
Photos of the same are attached as <u>ANNEXURE – XVII</u>.</td></tr>
<tr><td>24</td><td>Industrial waste water (workshop and waste water from the mine) should be properly collected and treated so as to conform to the notified standards prescribed from time to time. The standards shall be prescribed through Consent to Operate (CTO) issued by concerned State Pollution Control Board (SPCB). The workshop effluent shall be treated after its initial passage through Oil and grease trap.</td><td>COMPLIED</td><td>ETP of 15KLD capacity established along with washing bay system. Additionally, Oil and grease trap system is also installed for the workshop waste water treatment. The treated water is recirculated and used for washing the vehicles.
Photograph of ETP is attached as <u>ANNEXURE-XIX</u>.

The quality of inlet and outlet water of ETP is monitored every month, the results are within the standards prescribed in the CTO issued by State Pollution Control Board (SPCB).

The report is attached as <u>ANNEXURE-V</u>.</td></tr>
<tr><td>25</td><td>The water balance/water auditing shall be carried out and measure for reducing the consumption of water shall be taken up and reported to the Regional Office of the MoEF&CC and State Pollution Control Board/Committee.</td><td>COMPLIED</td><td>The rainwater stored in the settling pits are used for dust suppression in fixed and mobile sprinklers. Chemical suppressants and pressurized sprinklers are used for minimizing water requirement.

Water balance sheet is attached as <u>ANNEXURE XLI</u> .</td></tr>
<tr><td></td><td>IV. Noise and vibration monitoring and prevention</td><td></td><td></td></tr>
<tr><td>26</td><td>The peak particle velocity at 500m distance or within the nearest habitation, whichever is closer</td><td>COMPLIED</td><td>The peak particle velocity at 500m distance or within the nearest habitation is monitored periodically.</td></tr>
</table>

	shall be monitored periodically as per applicable DGMS guidelines		Monitoring data is given in **ANNEXURE V.**
27	The illumination and sound at night at project sites disturb the villages in respect of both human and animal population. Consequent sleeping disorders and stress may affect the health in the villages located close to mining operations. Habitations have a right for darkness and minimal noise levels at night. PPs must ensure that the biological clock of the villages is not disturbed; by orienting the floodlights/ masks away from the villagers and keeping the noise levels well within the prescribed limits for day /night hours.	COMPLIED	Illumination and sound are restricted into core zone only. No project sites disturb the villages in respect of both human and animal population. All the high mast lights are oriented towards the core zone. Also, dense cover of plantation is available towards the boundary of mine lease area which acts as a protective barrier. Ambient Noise level monitoring are being carried out at 4 different locations in core zone as well as 4 locations in buffer zone. Monitoring report is attached as **ANNEXURE V.**
28	The Project Proponent shall take measures for control of noise levels below 85 dBA in the work environment. The workers engaged in operations of HEMM, etc. should be provided with ear plugs /muffs. All personnel including labourers working in dusty areas shall be provided with protective respiratory devices along with adequate training, awareness and information on safety and health aspects. The PP shall be held responsible in case it has been found that workers/ personals/ labourers are working without personal protective equipment.	COMPLIED	Noise monitoring is regularly carried out, where the noise level is observed to be below 85dBA in the work zone area. PPE set (including helmet, safety shoe, safety jacket, ear muffs, and dust musk) has been issued to personnel including labourers working in dust zones. Workers are equipped with PPEs in the working zone.
	V. Mining Plan		

<table>
<tr>
<td>29</td>
<td>The Project Proponent shall adhere to the working parameters of mining plan which was submitted at the time of EC appraisal wherein year-wise plan was mentioned for total excavation i.e., quantum of mineral, waste, over burden, inter burden and top soil etc. No change in basic mining proposal like mining technology, total excavation, mineral & waste production, lease area and scope of working (viz. method of mining, overburden & dump management, O.B & dump mining, mineral transportation mode, ultimate depth of mining etc.) shall not be carried out without prior approval of the Ministry of Environment, Forest and Climate Change, which entail adverse environmental impacts, even if it is a part of approved mining plan modified after grant of EC or granted by State Govt. in the form to Short Term Permit (STP), Query license or any other name.</td>
<td>COMPLIED</td>
<td>There is no change in basic mining proposal like mining technology, total excavation, mineral & waste production, lease area and scope of working (viz. method of mining, overburden & dump management, O.B & dump mining, mineral transportation mode, ultimate depth of mining etc.

EC accorded for 6.0MTPA(ROM) of Iron ore and 0.036 MTPA Mn ore.

PRODUCTION DETAILS as per Annually submitted IBM Returns:

<table>
<tr><td>Year</td><td colspan="2">Production in Million Tonnes</td></tr>
<tr><td>Mineral</td><td>Fe</td><td>Mn</td></tr>
<tr><td>2020-21</td><td>4.48</td><td>0.0004</td></tr>
<tr><td>2021-22</td><td>5.44</td><td>0.0047</td></tr>
<tr><td>2022-23</td><td>5.3</td><td>0.0052</td></tr>
<tr><td>2023-24</td><td>5.63</td><td>0.0005</td></tr>
<tr><td>2024-25</td><td>5.84</td><td>0.00016</td></tr>
<tr><td>2025-26</td><td>4.17</td><td>0.00218</td></tr>
</table>
</td>
</tr>
<tr>
<td>30</td>
<td>The Project Proponent shall get the Final Mine Closure Plan along with Financial Assurance approved from Indian Bureau of Mines/Department of Mining & Geology as required under the Provision of the MMDR Act, 1957 and Rules/ Guidelines made there under. A copy of approved final mine closure plan shall be submitted within 2 months of the approval of the same from the competent authority to the concerned Regional Office of the Ministry of Environment, Forest and Climate Change for record and verification.</td>
<td>AGREED UPON</td>
<td>Agreed to abide by the condition.</td>
</tr>
</table>

31	The land-use of the mine lease area at various stages of mining scheme as well as at the end-of-life shall be governed as per the approved Mining Plan. The excavation vis-â-vis backfilling in the mine lease area and corresponding afforestation to be raised in the reclaimed area shall be governed as per approved mining plan. PP shall ensure the monitoring and management of rehabilitated areas until the vegetation becomes self-sustaining. The compliance status shall be submitted half- yearly to the MoEFCC and its concerned Regional Office.	COMPLIED	All the mining operations are being carried out as per approved Mine Plan including excavation and backfilling.
	VI. Land Reclamation		
32	The Overburden (O.B.) generated during the mining operations shall be stacked at earmarked OB dump site(s) only and it should not be kept active for a long period of time. The physical parameters of the OB dumps like height, width and angle of slope shall be governed as per the approved Mining Plan as per the guidelines/circulars issued by D.G.M.S w.r.t. safety in mining operations shall be strictly adhered to maintain the stability of top soil/OB dumps. The topsoil shall be used for land reclamation and plantation.	COMPLIED	Over burden being stacked at earmarked site and after maturity same is being stabilized with plantation. Dump site is protected by providing geotextile mats along with plantation, seed broadcasting, vetiver grassing over the dumps. Height of the dump reported to be 20m, 27m, 12m, width 240m, 170m, 150m and slope 31^{o}, 22^{0} and 18^{0} respectively. Coir matting of 8500 m2 (in 1^{st} phase), 7800 m2 (in 2^{nd} phase), 2040 m2 (in 3^{rd} phase) and 6500 m2 (in 4^{th} phase) has already been completed, followed by plantation with native species. Photos of the same are attached as **ANNEXURE – XXII.**
33	The reject/waste generated during the mining operations shall be stacked at earmarked waste dump site(s) only. The physical parameters of the waste dumps like height, width and angle of slope shall be governed as per the approved Mining Plan as per the guidelines/circulars issued by DGMS w.r.t. safety in mining operations shall be strictly adhered to maintain the stability of waste dumps.	COMPLIED	Over burden being stacked at earmarked site and after maturity same is being stabilized with plantation. Dump site is protected by providing geotextile mats along with plantation, seed broadcasting, vetiver grassing over the dumps. Height of the dump reported to be 20m, 27m,12m, width 240m, 170m, 150m and slope 31^{o}, 22^{0} and 18^{0} respectively. Coir matting of 8500 m2 (in 1^{st} phase), 7800 m2 (in 2^{nd} phase), 2040 m2 (in 3^{rd} phase) and 6500 m2 (in 4^{th} phase) has already been completed, followed by plantation with native species. Photos of the same are attached as **ANNEXURE – XXII.**

34	The reclamation of waste dump sites shall be done in scientific manner as per the Approved Mining Plan cum Progressive Mine Closure Plan.	COMPLIED	Reclamation will be done as per the approved mine plan.
35	The slope of dumps shall be vegetated in scientific manner with suitable native species to maintain the slope stability, prevent erosion and surface run off. The selection of local species regulates local climatic parameters and help in adaptation of plant species to the microclimate. The gullies formed on slopes should be adequately taken care of as it impacts the overall stability of dumps. The dump mass should be consolidated with the help of dozer/ compactors thereby ensuring proper filling/ levelling of dump mass. In critical areas, use of geo textiles/ geo-membranes / clay liners / Bentonite etc. shall be undertaken for stabilization of the dump.	COMPLIED	Dump site is protected by providing geotextile mats along with plantation, seed broadcasting, vetiver grassing over the dumps. The dump mass should be consolidated with the help of dozer/ compactors thereby ensuring proper filling/ levelling of dump mass Photos of coir matting and vetiver grassing over dump is attached as **ANNEXURE – XXII** and **ANNEXURE - XXX** respectively.
36	The Project Proponent shall carry out slope stability study in case the dump height is more than 30 meters. The slope stability report shall be submitted to concerned regional office of MoEF&CC.	COMPLIED	Slope stability study has been conducted as per DGMS guidelines. Copy of the report is attached as **ANNEXURE – XXVI.**
37	Catch drains, settling tanks and siltation ponds of appropriate size shall be constructed around the mine working, mineral yards and Top Soil/OB/Waste dumps to prevent run off of water and flow of sediments directly into the water bodies (Nallah/ River/ Pond etc.). The collected water should be utilized for watering the mine area, roads, green belt development, plantation etc. The drains/ sedimentation sumps etc. shall be de-silted regularly, particularly after monsoon season, and maintained properly	COMPLIED	Garland drains, retaining walls are provided at the foot of the dumps to arrest silt. Settling ponds and check dams are constructed with adequate sump capacity designed with appropriate safety margin based on long term rainfall data to arrest silt and sediment flows from mine operation, soil, OB and mineral dumps, thus collected water is used for dust suppression and green belt development. The drains and settling ponds are de-silted on a regular basis. Photographs of the same are attached as **ANNEXURE XXIII** and **ANNEXURE XXIV.**
38	Check dams of appropriate size, gradient and length shall be constructed around mine pit and OB dumps to prevent storm run-off and sediment flow into adjoining water bodies. A safety margin of 50% shall be kept for designing of sump structures over	COMPLIED	Garland drains, retaining walls are provided at the foot of the dumps to arrest silt. The drains are diverted to adequate settling ponds. Adequate check dams are constructed. The drains and settling ponds are de-silted on a regular basis.

	and above peak rainfall (based on 50 years' data) and maximum discharge in the mine and its adjoining area which shall also help in providing adequate retention time period thereby allowing proper settling of sediments/ silt material. The sedimentation pits/ sumps shall be constructed at the corners of the garland drains		Photographs of the same are attached as **ANNEXURE XXIII**.
39	The top soil, if any, shall temporarily be stored at earmarked site(s) within the mine lease only and should not be kept unutilized for long. The physical parameters of the top soil dumps like height, width and angle of slope shall be governed as per the approved Mining Plan and as per the guidelines framed by DGMS w.r.t. safety in mining operations shall be strictly adhered to maintain the stability of dumps. The topsoil shall be used for land reclamation and plantation purpose.	COMPLIED	No top soil is generated as it is a working mine.
	VII. Transportation		
40	No Transportation of the minerals shall be allowed in case of roads passing through villages/ habitations. In such cases, PP shall construct a 'bypass' road for the purpose of transportation of the minerals leaving an adequate gap (say at least 200 meters) so that the adverse impact of soundand dust along with chances of accidents could be mitigated. All costs resulting from widening and strengthening of existing public road network shall be borneby the PP in consultation with nodal State Govt. Department. Transportation of minerals through road movement in case ofexisting village/ rural roads shall be allowed in consultation with nodal State Govt. Department only after required strengthening such that the carrying	COMPLIED	No transportation of the minerals is allowed through the roads passing through villages/ habitations. Dispatch is done only through NH. Parking plaza of capacity 200 trucks is being provided to reduce traffic on the NH. Photograph is attached as **ANNEXURE VII.** Vacuum road sweeping machine is operational on Mineral transportation road. Necessary sprinkling is done through 16 KL mobile water sprinkler. Photograph of the operational Road Sweeping Machine is attached as **ANNEXURE IV.** PUC check are being done on regular basis. All vehicles entering the mine premises are checked for emission of the vehicle (PUC) to ascertain emission limits as per the pollution norms.

	capacity of roads is increased to handle the traffic load. The pollution due to transportation load on the environment will be effectively controlled and water sprinkling will also be done regularly. Vehicular emissions shall be kept under control and regularly monitored. Project should obtain Pollution Under Control (PUC) certificate for all the vehicles from authorized pollution testing centres		
41	The Main haulage road within the mine lease should be provided with a permanent water sprinkling arrangement for dust suppression. Other roads within the mine lease should be wetted regularly with tanker-mounted water sprinkling system. The other areas of dust generation like crushing zone, material transfer points, material yards etc. should invariably be provided with dust suppression arrangements. The air pollution control equipment's like bag filters, vacuum suction hoods, dry fogging system etc. shall be installed at Crushers, belt- conveyors and other areas prone to air pollution. The belt conveyor should be fully covered to avoid generation of dust while transportation. PP shall take necessary measures to avoid generation of fugitive dust emissions	COMPLIED	Fixed water sprinkler of around 1.1 Km has been provided in part of the haul road. Water sprinkling are being done along the haul road by two number of truck mounted tanker of capacity 50KL and 16KL. Dust Suppression System (Dry fog system) has been provided at crusher and screening plant. Generation of fugitive dust emissions are controlled by regular water sprinkling on haul roads and mechanical road sweepers on concrete road, paved areas. Water sprinkling are being done on the haul road and vacuum sweeping on the national Highway to control fugitive dust. Photographs of the same are attached as **ANNEXURE XIII.**
	VIII. Green Belt		
42	The Project Proponent shall develop greenbelt in 7.5m wide safety zone all along the mine lease boundary as per the guidelines of CPCB in order to arrest pollution emanating from mining operations within the lease. The whole Green belt shall be developed within first 5 years starting from windward side of the active mining area. The development of greenbelt shall be governed as per the EC granted by the Ministry irrespective of the stipulation made in approved mine plan.	COMPLIED	A total of 4318 saplings are planted in the FY 2025-26. A total of 30398 saplings has been planted till date, which included safety zone plantation, dump plantation, nearby NH plantation etc. It covers about 12.16 Ha of area. Photographs of the same are attached as **ANNEXURE XLII.**
43	The Project Proponent shall carryout plantation/ afforestation in backfilled and reclaimed area of	COMPLIED	A total of 4318 saplings are planted in the FY 2025-26. A total of 30398 saplings has been planted till date, which included safety zone

	mining lease, around water body, along the roadsides, in community areas etc. by planting the native species in consultation with the State Forest Department/ Agriculture Department/ Rural development department/ Tribal Welfare Department/ Gram Panchayat such that only those species be selected which are of use to the local people. The CPCB guidelines in this respect shall also be adhered. The density of the trees should be around 2500 saplings per Hectare. Adequate budgetary provision shall be made for protection and care of trees		plantation, dump plantation, nearby NH plantation etc. It covers about 12.16 Ha of area. Photographs of the same are attached as **ANNEXURE XLII.**
44	The Project Proponent shall make necessary alternative arrangements for livestock feed by developing grazing land with a view to compensate those areas which are coming within the mine lease. The development of such grazing land shall be done in consultation with the State Government. In this regard, Project Proponent should essentially implement the directions of the Hon'ble Supreme Court with regard to acquisition of grazing land. The sparse trees on such grazing ground, which provide mid-day shelter from the scorching sun, should be scrupulously guarded/ protected against felling and plantation of such trees should be promoted.	COMPLIED	Fodder plots have been developed in the non-mineralized area of the Mining lease. Photographs of the same is enclosed as **ANNEXURE – XXV.**
45	The Project Proponent shall undertake all precautionary measures for conservation and protection of endangered flora and fauna and Schedule-I species during mining operation. A Wildlife Conservation Plan shall be prepared for the same clearly delineating action to be taken for conservation of flora and fauna. The Plan shall be approved by Chief Wild Life Warden of the State Govt.		The State Forest Department implements the Wild Life Conservation Plan as approved by PCCF (Wildlife) & Chief Wildlife Warden, Bhubaneswar. Letter with detail cost breakup is enclosed as **ANNEXURE-XLIII.** Compensatory afforestation is being carried out by State Forest department. Financial outlay for activities in project area given Rs. 27,43,000 for Compensatory afforestation and expenditure detail with its implementation certificate is requested to DFO, Bonai vide letter no- JSW/SSWCP/2023/457 dt. 3.8.2023 for obtaining the same. The letter copy is enclosed as **ANNEXURE XXXII.**
46	And implemented in consultation with the State Forest and Wild Life Department. A copy of Wildlife		The State Forest Department implements the Wild Life Conservation Plan as approved by PCCF (Wildlife) & Chief Wildlife Warden,

	Conservation Plan and its implementation status (annual) shall be submitted to the Regional Office of the Ministry.		Bhubaneswar. Letter with detail cost breakup is enclosed as **ANNEXURE-XLIII.** Compensatory afforestation is being carried out by State Forest department. Financial outlay for activities in project area given Rs. 27,43,000 for Compensatory afforestation and expenditure detail with its implementation certificate is requested to DFO, Bonai vide letter no- JSW/SSWCP/2023/457 dt. 3.8.2023 for obtaining the same. The letter copy is enclosed as **ANNEXURE-XXXII.**
	IX. Public hearing and human health issues		
47	The Project Proponent shall appoint an Occupational Health Specialist for Regular as well as Periodical medical examination of the workers engaged in the mining activities, as per the DGMS guidelines. The records shall be maintained properly. PP shall also carryout Occupational health check-ups in respect of Workers which are having ailments like BP, diabetes, habitual smoking, etc. The check-ups shall be undertaken once in six months and necessary remedial/ preventive measures be taken. A status report on the same may be sent to MoEFCC Regional Office and DGMS on half-yearly basis.	COMPLIED	Occupational health specialist for regular as well as periodical examination is appointed as per DGMS guidelines. Check-ups in respect of Workers which are having ailments like BP, diabetes, habitual smoking, etc are undertaken once in six months.
48	The Project Proponent must demonstrate commitment to work towards 'Zero Harm' from their mining activities and carry out Health Risk Assessment (HRA) for identification workplace hazards and assess their potential risks to health and determine appropriate control measures to protect the health and wellbeing of workers and nearby community. The proponent shall maintain accurate and systematic records of the HRA. The HRA for neighbourhood has to focus on Public Health Problems like Malaria, Tuberculosis, HIV, Anaemia, Diarrhoea in children under five, respiratory infections due to bio mass cooking.	COMPLIED	Health Risk Assessment (HRA) for identification of workplace hazards has been carried out. HIRA register and SOPs are in place, in which control measures for identified hazards are in place. It is periodically reviewed through both internal and external audits.

	The proponent shall also create awareness and educate the nearby community and workers for Sanitation, Personal Hygiene, Hand washing, not to defecate in open, Women Health and Hygiene (Providing Sanitary Napkins), hazard of tobacco and alcohol use. The Proponent shall carryout base line HRA for all the category of workers and thereafter every five years.		
49	The Proponent shall carry out Occupational health surveillance which be a part of HRA and include Biological Monitoring where practical and feasible, and the tests and investigations relevant to the exposure (e.g. for Dust a X-Ray chest; For Noise Audiometric; for Lead Exposure Blood Lead, For Welders Full Ophthalmologic Assessment; for Manganese Miners a complete Neurological Assessment by a Certified Neurologist, and Manganese (Pin) Estimation in Blood; For Inorganic Chromium- Fortnightly skin inspection of hands and forearms by a responsible person. Except routine tests all tests would be carried out in a Lab accredited by NABH. Records of Health Surveillance must be kept for 30 years, including the results of and the records of Physical examination and tests. The record of exposure due to materials like Asbestos, Hard Rock mining, Silica, Gold, Kaolin, Aluminium, Iron, Manganese, Chromium, Lead, Uranium need to be handed over to the Mining Department of the State in casethe life of the mine is less than 30 years. It would be obligatory for the State Mines Departments to make arrangements for the safe and secure storage of the records including X- Ray. Only conventional X- Ray will be accepted for record purposes and not the digital one). X-Ray must meet ILO criteria (17 x14 inches and of good quality).	COMPLIED	Medical examinations has been conducted for employees and workers of Narayanposhi Iron and Mn Ore mines. The X-ray test, audiometry test, neurological test, cardiological assessment, pathological assessments, vision test, PFT and lung function tests are being conducted. A sample Form-O, report of medical examination is attached as **ANNEXURE-XLIX**.

50	The Proponent shall maintained a record of performance indicators for workers which includes (a) there should not be a significant decline in their Body Mass Index and it should stay between 18.5 - 24.9, (b) the Final Chest X-Ray compared with the base line X-Ray should not show any capacities,(c) At the end of their leaving job there should be no Diminution in their Lung Functions Forced Expiratory Volume in one second (FEVI),Forced Vital Capacity (FVC), and the ratio) unless they are smokers which has to be adjusted, and the effect of age, (d) their hearing should not be affected. As a proof an Audiogram (first and last need to be presented), (e) they should not have developed any Persistent Back Pain, Neck Pain, and the movement of their Hip, Knee and other joints should have normal range of movement, (f) they should not have suffered loss of any body part. The record of the same should be submitted to the Regional Office, MoEFCC annually along with details of the relief and compensation paid to workers having above indications.	COMPLIED	The X-ray test, audiometry test, neurological test are being conducted. The employees have not developed any Persistent Back Pain, Neck Pain, and the movement of their Hip, Knee and other joints. Doctor's undertaking is attached as **ANNEXURE XLIV.**
51	The Projects Proponent shall ensure that Personnel working in dusty areas should wear protective respiratory devices and they should also be provided with adequate training and information on safety and health aspects.	COMPLIED	Personnel working in dusty areas are provided with nose mask, safety glass and ear plug with proper safety training. Vocational training is being provided to all the employees and associates through Group VTC of JSW.
52	Project Proponent shall make provision for the housing for workers/labours or shall construct labour camps within/outside (company owned land) with necessary basic infrastructure/ facilities like fuel for cooking, mobile toilets, mobile STP, safe	COMPLIED	Provision of Toilets, drinking water, health care facilities has been developed for the workers and truck drivers. associated in mining operation.

	drinking water, medical health care, crèche for kids etc. The housing may be provided in the form of temporary structures which can be removed after the completion of the project related infrastructure. The domestic waste water should be treated with STP in order to avoid contamination of underground water.		Labour camp has been provided with all basic amenities including 50 KLD STP.
53	The activities proposed in Action plan prepared for addressing the issues raised during the Public Hearing shall be completed as per the budgetary provisions mentioned in the Action Plan and within the stipulated time frame. The Status Report on implementation of Action Plan shall be submitted to the concerned Regional Office of the Ministry along with District Administration.	COMPLIED	Details of implementation of action plan prepared for addressing the issues raised during the Public Hearing has been attached as **ANNEXURE XLV**.
	X. Corporate Environment Responsibility (CER)		
54	The activities and budget earmarked for Corporate Environmental Responsibility (CER) as per Ministry's 0. M No 22-65/20 17-IA. II (M) dated 01.05.2018 or as proposed by EAC should be kept in a separate bank account. The activities proposed for CER shall be implemented in a time bound manner and annual report of implementation of the same along with documentary proof viz. photographs, purchase documents, latitude & longitude of infrastructure developed & road constructed needs to be submitted to Regional Office, MoEF&CC annually along with audited statement.	Being Complied	Details of expenditure on Corporate Environmental Responsibility is attached as **ANNEXURE XLVI.**
55	Project Proponent shall keep the funds earmarked for environmental protection measures in a separate account and refrain from diverting the same for other purposes. The Year wise expenditure of such funds should be reported to the MoEF&CC and its concerned	COMPLIED	An expenditure of Rs 2.69 Cr during the period of April 2025 to March 2026 has been incurred on dust suppression, fixed water sprinkling, online monitoring, water sprinkling on NH, OB Dump management etc. A separate cost center is kept for carrying out environmental management measures.

	Regional Office.		
	XI. Miscellaneous		
56	The Project Proponent shall prepare digital map (land use & land cover) of the entire lease area once in five Years purpose of monitoring land use pattern and submit a report to concerned Regional Office of the MoEF&CC.	COMPLIED	Digital Map (land use and land cover) of the entire lease area is furnished on 21/09/2021. This map is to be submitted once in five years as per given condition. The Map is Attached as **ANNEXURE XLVII.**
57	The Project Authorities should inform to the Regional Office regarding date of financial closures and final approval of the project by the concerned authorities and the date of start of land development work.	Agreed to comply	Since Narayanposhi Iron & Manganese Ore Mines is a brown field project as JSW Steel Limited has got the lease during May 2020 through auction process and the EC granted to ex-lessee vide MoEF&CC (GoI) letter no. J-11015/288 /2008-IA-II(M), dated 18.06.2019 which is vested to JSW Steel Limited vide extant rules. At the time of vesting, the project was in operation at the permitted capacity. Accordingly financial closure and start of land development work was started by erstwhile lessee prior to our acquisition.
58	The Project Proponent shall submit six monthly compliance reports on the status of the implementation of the stipulated environmental safeguards to the MOEFCC & its concerned Regional Office, Central Pollution Control Board and State Pollution Control Board.	COMPLIED	Six monthly EC Compliance report is submitted to the MOEFCC & its concerned Regional Office, Central Pollution Control Board and State Pollution Control Board vide No. JSW/S/CO/2025/561 dated 28/11/2025 for the period April 2025 – September 2025.
59	A separate Environmental Management Cell' with suitable qualified manpower should be set-up under the control of a Senior Executive. The Senior Executive shall directly report to Head of the Organization. Adequate number of qualified Environmental Scientists and Mining Engineers shall be appointed and submit a report to RO, MoEF&CC.	COMPLIED	Environment Management Cell (EMC) structure has been attached as **ANNEXURE XLVIII.**
60	The concerned Regional Office of the MoEF&CC shall randomly monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the MoEF& CC officer(s) by furnishing the requisite data / information /monitoring reports.	Agreed Upon	Agreed to comply

ANNEXURE I

N.R SI. No 12314
Date 04-08-2023

AFFIDAVIT

I Biswaranjan Kumar Padhi, working as Vice-President (Operation) of JSW Steel Ltd having its registered office JSW Centre, Bandra Kurla Complex, Bandra (East), Mumbai – 400051 and Mining Office Singhania Tower, Bhusugaon, Bhadrasahi, PO-Barbil, Dist-Keonjhar, Odisha do solemnly affirm and declare as under:

1. That, I am Vice-President and Agent of Narayanposhi Iron & Mn. Mines of JSW Steel Ltd and hence, competent to swear this affidavit.

2. That, I undertake to comply with all the conditions as prescribed in Environment Clearance accorded to Narayanposhi Iron and Manganese Ore Mine of M/s. JSW Steel Ltd. vide EC No. J-11015/288/2008-IA. II (M).

3. That the facts stated in the accompanying information sheet with annexures are based on available records and true to the best of my knowledge and belief.

DEPONENT

The above named deponent solemnly affirmed and declared before me.

04-08-2023

Nayananda Tripathy
ADVOCATE & NOTARY
Regd. No. ON/03/2013
Barbil, Dist. Keonjhar (Odisha)

NOTARY
Nayananda Tripathy
Regd. No. ON/03/2013
Expiry Date 28-01-2028
BARBIL
GOVT. OF ODISHA

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ANNEXURE II

Steel Limited

Regd. Office: JSW CentreBandra
Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925Phone :
+91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

No. JSW/S/CO/2026/301

Date: 25/05/2026

To,
The Member Secretary
State Pollution Control Board, Odisha,
Paribesh Bhawan, A/118, Nilakantha Nagar, Unit-8,
BHUBANESWAR- 751012

Sub: - Submission of 9 Points NEERI Compliance Status Report of FY 2025-26 for **Narayanposhi Iron & Manganese Ore Mine of M/s JSW Steel Ltd.**

Ref: - 1. Vested Consent Order No 1008 vide letter no 6785/IND-I-CON-2258, dated 08.07.2019
2. New Consent Order No 2944 vide letter no 3791/IND-I-CON-2258 dated 23.03.2026.

Dear Sir,

With reference to aforesaid subject, please find enclosed herewith the 9 Points NEERI Compliance Status Report of FY 2025-26 for **Narayanposhi Iron & Manganese Ore Mine ofM/s JSW Steel Ltd**.

Seeking your co-operation as always.

Thanking you, Yours

Faithfully
For JSW Steel Ltd

Vijay Kumar 25/5/26

Vijay Kumar
(Authorized Signatory)

Encl: As above

Copy to- The Regional Officer, Regional Office, Rourkela, Office of the State Pollution ControlBoard, At- Near Panposh Hockey Chowk, AT/PO. - Panposh, Rourkela – 769 004, Dist – Sundargarh, Odisha.

NEERI REPORT COMPLIANCE STATUS – NARAYANPOSHI IRON AND MANGANESE MINE

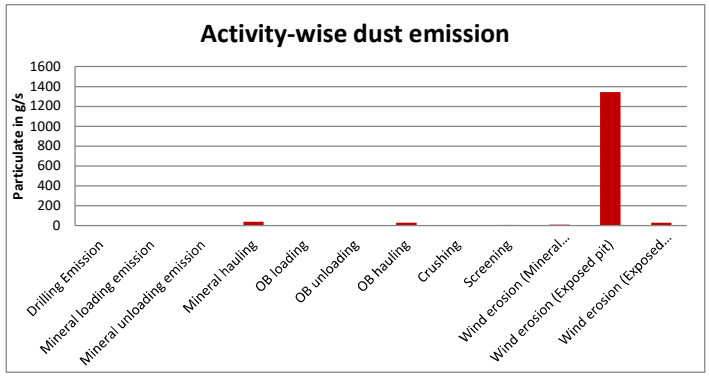
Sl. No.	Recommendation by CSIR-NEERI	Action Taken
1	The individual lease **holders shall make assessment and quantification of emission load generation (in terms of air pollution, noise, wastewater and** solid waste) from each of the mining activity (including transportation) forthe period starting from 1st April to 31st March and submit report by June of every year. Efforts should be made to further eliminate/ minimize generation of air pollution/ dust, noise, wastewater,solid waste generation in successive years through use of better technology.Necessary guidance many be sought from Regional Officer, SPCB on load calculation.	The project has already been practicing different environmental safeguard measures for pollution prevention The measures are- Mobile water sprinkling arrangement has been provided for the haul roads, processing area and loading / unloading points to minimize dispersion of air borne dust particles. Fixed water sprinkling being maintained and operated. Wet drilling arrangement with acoustic enclosure is in practice to control dust right at the source. Dust Suppression System (Dry fog system) being provided at all appropriate places of mineral handling plants (crusher & screening plant) and other areas. Same are being maintained for proper dust control. No process water being discharged from the mine. Noise producing equipment's are covered as far as practicable. Workers engaged in Operations are provided with ear plugs / muffs. Besides this, acoustic enclosures are provided for all machines operating within the mines. The overburden generated as solid waste is stacked at the earmarked areas and are covered by Coir matting followed by tree plantation. The vehicles carrying the loaded materials are being covered with tarpaulin. Annual Assessment and quantification of emission load generation is enclosed as Annexure I.
2	Monitoring of ambient air and fugitive emission in core zone shall be carried out on daily basis. Minimum four ambient air quality monitoring stationsshall be installed in the core zone. Out of four, at least one on-line monitoring station shall be installed in case of mines having EC capacity of 3 MTPA of more. Moreover, one station should be located near the ore carrying truck entry and exit gate of mine. A letter in this regard has already been communicated to individual leaseholder of capacity 3 MTPA and above vide Board's Letter no-7807, dt. 30.06.2018.	Three Continuous Ambient Air Quality Monitoring Stations (CAAQMS) are installed at the site in consultation with Regional Officer, Rourkela. All 3 CAAQMS are equipped with data transfer facility to OSPCB. In addition, regular environmental monitoring is conducted through a third-party NABL-accredited laboratory, Visiontek Consultancy Services Private Limited.

3	Monitoring in buffer zone shall be carried out by through NABET accredited agency preferably, at locations of nearest human habitation including schools and other public amenities located nearest to source of dust generation as applicable. The monitoring station shall be installed in core and buffer zone in consultation with Regional Officer, SPCB.	Monitoring in buffer zone (in consultation with RO, SPCB) is also carried out by M/s Visiontek Consultancy Services Private Limited (NABL & NABET Accredited Laboratory).
4	Monitoring stations shall be facilated for measurement of CO as an additional parameter to the other parameters SPM, PM10, PM2.5, SO_2 and NO_2. The monitoring result shall be compiled and submitted to Board on annual basis.	CO is also measured along with PM10, PM2.5, SO_2 and NO_2. Monitoring reports of FY 2025-26 were submitted in your good office vide letter No. JSW/S/CO/2026/301 on dated 25.05.2026.
5	All the vehicles engaged in mining and transporting activity in the mine shall have Pollution under Control (PUC) certificate. A record of the same shall be maintained for verification of inspecting agency.	Transportation vehicles without a valid PUC is not permitted inside the mines. Mineral carrying trucks are not allowed to leave the lease area without tarpaulin cover and is being monitored by security personnel at the exit gate.
6	Noise level should be monitored near the major sources of noise generationwithin the core zone once in week and submit the report annually. Further, date, time and distance of measurementshall also be indicated with the noise levels in the report. The data shall be used to map the noise generation from different activities and efforts should be made to maintain the noise levels with the acceptable limits of CPCB. The monitoring schedule shall be informed to Regional Officer, SPCB in order to ensure his presence 25% of the monitoring program.	Noise level is monitored weekly near the major sources like the crushing and screening unit, loading and unloading areas, haul roads, drilling units, excavator, dumper etc. It is carried out through M/s Visiontek Consultancy Services Private Limited (NABL Accredited Laboratory). Consolidated monitoring report for FY 2025-26 is submitted to the Regional Officer, SPCB vide letter No. JSW/S/CO/2026/301 on dated 25.05.2026.
7	Measurement of flow rate of the springs and perennial nallah passing through the mining lease area shall be done on monthly basis. Identification of the perennial streams to be brought under the monitoring program and the location the flow measurement shall be determined in consultation with Regional Officer, SPCB. The consolidated report shall be submitted to Board on annual basis.	Flowrate of nearby surface water bodies are monitored on a monthly basis. Consolidated monitoring report for FY 2025-26 is submitted to the Regional Officer, SPCB vide letter No. JSW/S/CO/2026/301 on dated 25.05.2026.
8	Effort shall be made to recycle or reuse the treated wastewater from ETP of work shop and STP of residential colony instead of discharging to outside.	A 50 KLD STP is installed in the colony to treat domestic wastewater. The treated water is reused for plantation. An ETP with an Oil & Grease trap is also provided to treat wastewater from washing machineries, and the treated water is recirculated and is used for washing

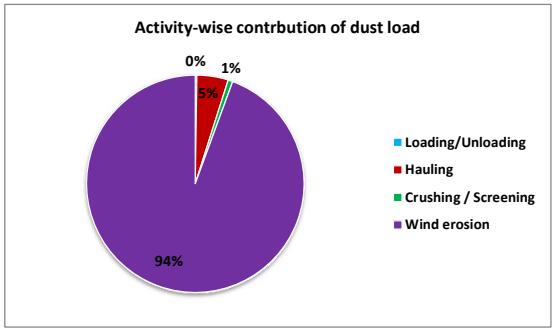
9	Annual environmental sustainability report (ESR) shall be made highlighting the efforts made towards environmental protection with respect to different environmental components vis-à- vis production performance of the mine on monthly basis. The data collected as per EC and CTE/CTO conditions should be utilized to prepare the annual sustainability report. The report shall be submitted to SPCB and RO, MoEF&CC by June of every year.	Annual environmental sustainability report (ESR) is enclosed as **Annexure II.**

RESULTS OF DUST LOAD CALCULATIONS

	Particulate matter in (g/s)	Particulate matter in (kg/d)	Particulate matter (kg per ton of ore)
Drilling Emission	0.06679882	5.771418206	0.000504539
Mineral loading emission	1.75785308	151.8785065	0.013277254
Mineral unloading emission	0.43629357	37.6957648	0.003295372
Mineral hauling	38.4323932	3320.558774	0.290284009
OB loading	0.70290758	60.73121467	0.005309137
OB unloading	0.46745375	40.38800417	0.003530729
OB hauling	29.6218769	2559.330164	0.223737229
Crushing	4.07407407	352	0.030771921
Screening	6.66666667	576	0.050354052
Wind erosion (Mineral stack)	10.8238828	935.1834701	0.081753953
Wind erosion (Exposed pit)	1344.93222	116202.1437	10.15841802
Wind erosion (Exposed OB dump)	27.8915593	2409.83072	0.210667954
Total	**1465.87**	**126651.51**	**11.0719**



Major Activity	Dust load (kg/day)
Loading/Unloading	290.69349
Hauling	5879.88894
Crushing / Screening	928
Wind erosion	119547.158



GO TO MAIN PAGE

GO TO DATA ENTRY PAGE

GASEOUS LOAD CALCULATIONS FOR NARAYANPOSHI IRON & MANGANESE ORE MINES

During the field study, it was observed that dust is the major source of emission from various surface mining activities, whereas emission of SO_2 and NOx were negligible in comparison to the NAAQS protocol. Therefore, SO_2 and NOx emissions were measured considering mine as a whole and not for each activity of the mine. And the CO emission measured is insignificant to calculate the load in the iron ore mines.

Formulae for SO_2 and NO_x emission rates of overall mine.

Activity	Parameter			Equation
	Symbol	Name	Unit	
Overall mine	u	Wind speed	m s^{-1}	For SO_2
	c	Iron ore production	Mt $year^{-1}$	$E = a^{0.1}\{u/(11 + 4.4u)\}[\{c/(9.9 + 1.6c)\} + \{b/(3.3 + 19.9b)\}]$
	b	Waste handling	Mm^3 $year^{-1}$	
	a	Leasehold area	km^2	For NO_x
	E	Emission rate	g s^{-1}	$E = 0.01au[\{c/(1.38 + 0.26c)\} + b^{1.1}]$

Source: S.K. Chaulya / Emission rate formulae for surface iron ore mining activities

Input data

1. u = wind-speed = 2.5 m/s
2. c = Iron ore production = 4.18 Mt/year
3. b = Waste handling = 0.43 Mm^3 /year
4. a = leasehold area = 3.47 km^2
5. E = Emission rate = g/s

Results of gaseous load

S. No.	Parameter	Value (g/s)	Kg/Day	Ton/Year
1	SO_2	0.037	3.2	1.17
2	NO_x	0.181	15.64	5.71

Annual Environmental Sustainability Report (ESR) for Narayanposhi Iron & Manganese Ore Mine of M/s JSW Steel Ltd.

Introduction-

The Narayanposhi Iron and Manganese Ore mine (erstwhile lessee M/s Aryan Mining & Trading Corporation Pvt. Limited) was one of the mines whose lease expired on 31.03.2020. The lease area is located in villages Harischandrapur, Koira, Kashira, Kusumdihi and Kathamala RF villages under Koira tehsil of Sundergarh district, Odisha state.

In pursuant to the Mines and Minerals (Development and Regulation) Act, 1957 and the Mineral (Auction) Rules, 2015, Govt. of Odisha issued the notice inviting tender dated December, 2019 for commencement of the auction process to grant the mining lease in respectof Narayanposhi Iron & Manganese Ore Block over an area of 349.254 Ha as per ROR (347.008 Ha as per DGPS computation) in villages Harischandrapur, Koira, Kashira, Kusumdihi and Kathamala RF of Sundargarh District, Odisha for a resource size of about 186.05 Million tonnes (Mt). The e-auction process was conducted in accordance withthe tender document and the mineral auction rule, 2015 for the said mineral block and M/s JSW Steel Limited was declared as the preferred bidder under Rule 9(9)(iii) of Mineral (Auction) Rules 2015.

Without prejudice to the generality of the provisions of section 8B(2) of the MMDR Act, 1957, the details of the valid rights, approvals, clearances, licenses and the like held by the previous lessee are vested in favor of M/S JSW Steel Ltd by the Govt. of Odisha for a period of 2 years from the date of execution of lease deed or till the date of getting fresh approvals, clearances, licenses, permits, and the like, whichever is earlier vide order No-4212/SM, dated **30.05.2020**. M/s JSW Steel Limited being successful bidder upon execution of mining lease deed, the successful bidder shall immediately, but not later than one hundred twenty days from the dateof execution of mining lease, apply afresh for all necessary rights, approvals, clearances, licenses and the like under the applicable statutes, rules or regulations, as the case may be, forobtaining the necessary clearances to enable further continuance of the mining operations beyond two years and vesting order shall be valid for a period of two years from the date of execution of new lease deed or till the date of getting all fresh approvals, clearances, licenses, permits, and the like, whichever is earlier.

On 10.06.2020, JSW has deposited INR 19,30,88,250/- towards the Advance Net Present Value [NPV] in CAMPA against the demand note raised by DFO, Bonai, Sundargarh District. The Mining Lease was granted in favor of M/s JSW Steel Limited for a period of 50 years w.e.f 26.06.2020. Subsequent to signing of the MDPA with the Collector, Sundargarh**, M/s JSW Steel Limited** has made payment of the third installment being the eighty percent of the upfront value and executed and registered the mining lease with the Government of Odisha on 27.06.2020.

Indicative Coordinates Range of the Narayanposhi Iron & Manganese Ore Mine

Latitudes : 21°54’46.07” N - 21°56’23.13” N
Longitudes : 85°13’41.16” E - 85°14’56.56” E

Fully mechanized open cast method of mining by drilling and blasting and by deploying HEMM equipment’s like hydraulic drills and excavators, wheel loaders, dumpers, will be undertaken. The height and width of the benches for iron ore will be kept at 9 m and 15 m

respectively. The working of benches will be commenced from top and extended to bottom benches. The excavated ROM ore is proposed to be processed in the crushing and screening plants to obtain the lump and fine ore as product mix. The iron ore lumps and iron ore fines extracted from the mine will be transported through railway/port/road to JSW Steel Plants.

Production in FY 2025-26

Narayanposhi mining operations started from 01.07.2020 based on the vested approvals. During the financial year of 2025-26 (April 2025 to March 2026), Narayanposhi Mine has produced 4174880 MT Iron Ore (ROM)& 2185 Tonnes Manganese Ore and same are dispatched to steel plants.

Environment Management in Narayanposhi Mine Air

Management-

Blasting Operation

- Controlled blasting method is in practice by restriction of explosive charge in the holes.
- Well-designed blast by effective stemming and use of milli second delay detonators, blasting designing to see that the optimum breakage occurs.
- To control ground vibrations and arrest fly rocks, advanced initiation system is being used for blasting
- Ground vibrations are also being monitored and the results are well within limits.

Excavation, Hauling and Crushing & Screening

- Dry fog system for crusher & screen plants are provided.
- Proper maintenance of HEMM
- Using sharp teeth for shovels and other soil excavation equipment and their periodical replacements.
- Acoustic enclosures for operator cabin.
- Avoiding overloading of dumpers
- Provision of dust filters / masks to workers working at highly dust prone and affected areas
- Imparting sufficient training to operators on safety and Environmental parameters.

Transportation

- Regular water sprinkling is being carried out by engaging mobile water tankers on the mine benches, mine haul, loading and unloading points and transfer points for dust suppressions.
- Maintenance of haul road by regular grading is carried out through grader, dozer.
- Ensuring that all mineral trucks are covered by tarpaulin.
- Vehicular emissions controlled through regular and proper preventive maintenance schedules.
- It is ensured that there is no overloading of trucks by having Quick Dispatch system at the weigh bridge near the dispatch gate.
- Regular water sprinkling arrangements have been made on the transportation roads/public road through mobile water tankers.





Wet Drilling and Dust Extractor System in Drilling Operation



Quick Dispatch System Existing



Fixed Sprinkling System





16 KL and 50 KL Water Tanker Arrangement or Haul Road Dust Suppression





Dry Fog System in Mineral Handling Plants

Consolidated Air Quality Monitoring Data of FY 2025–2026

Narayanposhi Iron & Mn Ore Mines

Location	PM10 (µg/m³) Max	PM10 (µg/m³) Min	PM2.5 (µg/m³) Max	PM2.5 (µg/m³) Min	SO_2 (µg/m³) Max	SO_2 (µg/m³) Min	NO_2 (µg/m³) Max	NO_2 (µg/m³) Min	CO (µg/m³) Max	CO (µg/m³ Min
CORE ZONE										
Gate No-1	83.2	65.2	46.2	30.8	19.8	13.9	25.6	16.8	0.83	0.51
Near Babamath Area	69.1	51.3	38.9	28.6	16.3	11.7	21.6	15.2	0.73	0.46
Near Mines Office	80.7	60.9	45.6	31.2	24.3	14.8	27.2	16.9	0.77	0.58
Rest Shelter	72.1	60.7	41	29.7	20.4	13.5	23.4	14.9	0.73	0.48
BUFFER ZONE										
Koira Basti	60.2	47.6	33.2	25.6	15.4	11.8	17.2	13.8	0.60	0.41
Kasira Basti	57.8	43.2	31	20.9	15.6	10.7	17.1	12.6	0.68	0.42
Bhanjpali Village	67.3	57.4	38.2	21.3	21.3	13.6	25.6	13.9	0.72	0.52
Segasahi Village	61.5	49.6	34.2	21.3	15.8	10.7	18.2	13.4	0.68	0.44

Water & OB Dump Management

- Garland drains maintained of suitable size around mine area and dump with propergradients to prevent rain water descent into active mine area.
- Settling ponds maintained to prevent flow of fine particles from OB / Waste dumps,check dams, parapet / retaining walls & garland drains.
- Usage of stored water in the settling ponds for watering of haul roads, vehicle washingand green belt development etc.
- De- silting of garland drains & settling ponds are being carried out at regular intervals.
- Maintenance of all the runoff management structures





Retaining Wall





Settling Pond





Dump Plantation

Consolidated Ground Water Quality Monitoring Data of FY 2025-2026					
Narayanposhi Iron & Mn Ore Mines					
Dug Well at Koira Basti					
Parameter	**Units**	**Max**	**Min**	**Acceptable Limits**	**Permissible Limits**
pH		7.03	6.92	6.5-8.5	No Relaxation
Total Hardness	mg/l	42.3	38.9	200	600
Iron	mg/l	0.73	0.18	1	No Relaxation
Chloride	mg/l	3.80	2.9	250	1000
Total Dissolved Solids	PPM	97	59	500	2000
Sulphates	mg/l	0.21	0.11	200	400
Fluoride	mg/l	0.29	0.23	1	1.5
Dug Well at Kasira Basti					
Parameter	**Units**	**Max**	**Min**	**Acceptable Limits**	**Permissible Limits**
pH		7.21	7.11	6.5-8.5	No Relaxation
Total Hardness	mg/l	40.2	39.8	200	600
Iron	mg/l	0.8	0.12	1	No Relaxation
Chloride	mg/l	3.20	2.9	250	1000
Total Dissolved Solids	PPM	105	92	500	2000
Sulphates	mg/l	0.16	0.13	200	400
Fluoride	mg/l	0.30	0.25	1	1.5
Borewell Quarry-4					

Parameter	Units	Max	Min	Acceptable Limits	Permissible Limits
pH		7.21	7.19	6.5-8.5	No Relaxation
Total Hardness	mg/l	40.4	27.6	200	600
Iron	mg/l	0.9	0.62	1	No Relaxation
Chloride	mg/l	3.50	3.5	250	1000
Total Dissolved Solids	PPM	77	68	500	2000
Sulphates	mg/l	0.13	0.11	200	400
Fluoride	mg/l	0.34	0.33	1	1.5
Borewell Near Gate-01					
Parameter	**Units**	**Max**	**Min**	**Acceptable Limits**	**Permissible Limits**
pH		7.25	7.18	6.5-8.5	No Relaxation
Total Hardness	mg/l	32.8	31.2	200	600
Iron	mg/l	0.7	0.56	1	No Relaxation
Chloride	mg/l	4.20	4.1	250	1000
Total Dissolved Solids	PPM	101	81	500	2000
Sulphates	mg/l	0.14	0.11	200	400
Fluoride	mg/l	0.28	0.25	1	1.5
Operator Colony (Borewell)					
Parameter	**Units**	**Max**	**Min**	**Acceptable Limits**	**Permissible Limits**
pH		6.95	6.59	6.5-8.5	No Relaxation
Total Hardness	mg/l	45.9	45.4	200	600
Iron	mg/l	0.9	0.76	1	No Relaxation
Chloride	mg/l	3.1	3.0	250	1000
Total Dissolved Solids	PPM	7.0	6.0	500	2000
Sulphates	mg/l	0.16	0.14	200	400
Fluoride	mg/l	0.30	0.21	1	1.5

Consolidated Surface Water Quality Monitoring Data of FY 2025–2026				
Narayanposhi Iron & Mn Ore Mines				
Orahari Nala Up-stream				
Parameter	**Units**	**Max**	**Min**	**Limits for Stream Water Standards**
pH		7.28	6.95	6.5-8.5
Total Dissolved Solids (TDS)	PPM	82.1	72.8	1500
Chloride	mg/l	2.1	1.7	3
Iron	mg/l	6.2	5.5	50
Fluoride	mg/l	22.9	19.6	600
BOD	mg/l	0.18	0.12	1.5
Dissolved Oxygen	mg/l	2.38	0.82	50

Orahari Nala Down-stream				
Parameter	**Units**	**Max**	**Min**	**Limits for Stream Water Standards**
pH		7.18	6.78	6.5-8.5
Total Dissolved Solids (TDS)	PPM	89.9	70.2	1500
Chloride	mg/l	2.5	1.6	3
Iron	mg/l	5.8	5.2	50
Fluoride	mg/l	29.8	19.6	600
BOD	mg/l	0.23	0.15	1.5
Dissolved Oxygen	mg/l	2.41	0.98	50
Karo River Up-stream				
Parameter	**Units**	**Max**	**Min**	**Limits for Stream Water Standards**
pH		7.19	7.13	6.5-8.5
Total Dissolved Solids (TDS)	PPM	86.8	71.5	1500
Chloride	mg/l	2.3	1.6	3
Iron	mg/l	5.6	5.1	50
Fluoride	mg/l	23.2	21.8	600
BOD	mg/l	0.24	0.18	1.5
Dissolved Oxygen	mg/l	2.05	1.09	50
Karo River Down-stream				
Parameter	**Units**	**Max**	**Min**	**Limits for Stream Water Standards**
pH		7.26	7.02	6.5-8.5
Total Dissolved Solids (TDS)	PPM	93.4	65.9	1500
Chloride	mg/l	2	1.5	3
Iron	mg/l	5.2	4.6	50
Fluoride	mg/l	25.1	19.7	600
BOD	mg/l	0.23	0.18	1.5
Dissolved Oxygen	mg/l	2.16	0.98	50
Kasira Nala Up-stream				
Parameter	**Units**	**Max**	**Min**	**Limits for Stream Water Standards**
pH		7.35	7.14	6.5-8.5
Total Dissolved Solids (TDS)	PPM	71.2	61.2	1500

Chloride	mg/l	2.1	1.6	3
Iron	mg/l	5.2	4.8	50
Fluoride	mg/l	27.1	21.6	600
BOD	mg/l	0.26	0.16	1.5
Dissolved Oxygen	mg/l	2.03	1.16	50
Kasira Nala Down-stream				
Parameter	**Units**	**Max**	**Min**	**Limits for Stream Water Standards**
pH		7.19	7.03	6.5-8.5
Total Dissolved Solids (TDS)	PPM	80.2	59.8	1500
Chloride	mg/l	2.2	1.6	3
Iron	mg/l	5.6	4.8	50
Fluoride	mg/l	23.6	21.4	600
BOD	mg/l	0.28	0.13	1.5
Dissolved Oxygen	mg/l	2.08	1.35	50

Noise Management

- Providing sound proof operator's cabin for equipment like dumpers, shovel, tippers, etc.
- Planting trees at various places within the lease area to act as acoustic barriers.
- Proper and regular maintenance of vehicles, machinery and other equipment. All HEMMs are monitored for any abnormal sound and rectified with due precaution by maintenance personnel.
- Providing workers with ear muffs & earplugs against high noise levels.
- Conducting regular health check-ups of workers including Audiometry test
- Controlling the time of exposure of workers towards high noise areas.

Consolidated Noise Quality Monitoring Data FY 2025–2026			
Core Zone			
Location	**Maximum**	**Minimum**	**Standards**
Loader	73.2	52.8	85 dB
Loading Point	72.1	57.9	
Crusher Plant	73.2	51.7	
Screen Plant	72.2	40.2	
Dumper	72.5	38.9	
Excavator	73.2	39.8	
Drill Machine	76.1	38.6	
Haulage Road	73.5	38.6	

Buffer Zone						
Location	**Leq Day Max**	**Leq Day Min**	**Leq Night Max**	**Leq Night Min**	**Standard Day**	**Standard Night**
East Boundary	73.7	70.8	50.8	40.6	75	70
West Boundary	63.9	62.8	49.6	41.3	75	70
North Boundary	71.5	69.5	58.2	45.2	75	70
South Boundary	72.7	66.8	51.2	43.9	75	70

Electronic Digital Display Board at Narayanposhi Mine Gate



Narayanposhi Environmental Protection Measures Expenditure (head wise breakup)incurred from April 2025 to March 2026

Expenditure Incurred on Environmental Protection Measures for the Financial Year 2025-26		
Sl No	Expenditure head -Particulars	Cost incurred in INR
		Narayanposhi
1	Construction of Retaining walls	-
2	Construction of Garland drains, desiltation of settling ponds	278880
3	Geotextile works for dump stabilization	836625
5	Greenbelt development- Pit digging, plantation and maintenance	3680000
6	Operation of Road sweeping machines	1095000
7	Operation of fixed sprinklers	75000
8	Operation of mobile sprinklers	12486120.00
9	Use of chemical dust suppresants in sprinkling	472000
10	Online air quality monitoring	728305.02
11	Environment monitoring through NABL Accredited third party	1083840
12	Operation of Sewage treatment Plant	336000
13	Study conducted on hydrogeology from CGWA Accredited Agency	410000
14	Nursery Development, Biocomposting	4130641
15	Landscape development	260100
16	Environmental Awareness Programmes	400000
17	Flowmeter calibration and stamping	105000
18	Drip irrigation for plantation	45600
19	Life Cycle Assessment Study	500000
20	Third Party hazardous waste audit	40000
Total		**26923111.02**

ANNEXURE III

Concrete Road at Entrance and Exit of Gate No.2



Concrete Road from Gate No.1 to NH to Manganese Pit




27 Nov 2025 11:59:53 am
21°54'59.226"N 85°14'2.586"E
Segasahi
Northern Division
Odisha


27 Nov 2025 12:01:11 pm
21°54'56.682"N 85°13'57.042"E
Segasahi
Northern Division
Odisha


27 Nov 2025 12:02:32 pm
21°54'55.188"N 85°13'51.906"E
Rajamunda - Rimuli Road
Kasira
Northern Division
Odisha


Village Road Length 350 Mtr
26
27
50
51
18
20
21
22
25
28
29
30
31
1850
1851
1884

ANNEXURE IV

ROAD SWEEPING MACHINE





ANNEXURE V

SUMMARY

OF

ENVIRONMENTAL MONITORING REPORT
(October 2025 to March 2026)

FOR

NARAYANPOSHI IRON & MANGANESE ORE MINE

DISTRICT—SUNDARGARH, ODISHA

OF

M/S JSW STEEL LIMITED, ODISHA

ENV MONITORING CARRIED OUT BY

Visiontek Consultancy Services Pvt. Ltd.

(Committed For Better Environment)

Plot No.-M-22&23, Chandaka Industrial Estate, Patia, Bhubaneswar-751024,
Dist-Khurda, Odisha

Environmental Monitoring Report- Narayanposhi Iron & Manganese Ore Mine of M/s JSW Steel Limited, Odisha during the period (October 2026 to March 2026)

1. Ambient Air Quality Lease Area

Si. No.	Location	Month	Concentration	PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³
1.	Gate No-1	October'25	Maximum	71.1	32.4	18.7	20.2	0.6
			Minimum	63.9	23.7	15.1	16.4	0.53
			Average	68.3	28.1	16.5	18.3	0.56
		November'25	Maximum	73.2	40.4	17.2	21.5	0.56
			Minimum	65.2	30.8	13.9	16.8	0.51
			Average	70.1	36.3	15.2	19.3	0.54
		December'25	Maximum	77.2	43.9	17.2	23.5	0.73
			Minimum	69.8	38.2	14.9	19.5	0.58
			Average	73.8	41.2	15.9	21.1	0.65
		January'26	Maximum	79.8	45.1	16.9	23.9	0.76
			Minimum	71.8	39.8	14.5	20.6	0.61
			Average	76.1	42.1	15.8	22.0	0.70
		February'26	Maximum	81.4	46.2	17.2	24.6	0.77
			Minimum	72.9	40.6	14.8	21.4	0.63
			Average	76.9	43.0	16.1	22.7	0.71
		March'26	Maximum	83.2	45.2	19.8	25.6	0.83
			Minimum	71.9	38.6	16.9	21.8	0.69
			Average	76.9	42.6	18.4	24.0	0.77
		Oct'25	Maximum	67.1	28.8	17.5	20.1	0.58
			Minimum	57.2	23.1	14.2	16.8	0.48
			Average	63.6	26.2	15.5	17.5	0.54

Si. No.	Location	Month	Concentration	PIlio µg/m³	PM2.5 µg/m³	SO2 µg/m³	NO2 µg/m³	CO mg/m³
2.	Near Babamath Area	Nov'25	Maximum	62.7	32.1	15.2	20.5	0.53
			Minimum	51.3	28.6	11.7	15.3	0.46
			Average	57.5	30.5	13.5	17.9	0.50
		Dec'25	Maximum	68.3	37.2	16.3	21.6	0.63
			Minimum	59.6	31.8	12.9	16.4	0.55
			Average	62.9	34.5	15.1	18.6	0.59
		Jan'26	Maximum	66.9	36.5	15.3	18.4	0.72
			Minimum	60.2	31.2	13.8	15.2	0.56
			Average	63.3	34.2	14.7	16.7	0.64
		Feb'26	Maximum	68.3	37.4	15.6	19.1	0.73
			Minimum	60.9	32.5	14.1	15.8	0.58
			Average	64.3	35.2	15.0	17.3	0.66
		Mar'26	Maximum	69.1	38.9	15.9	19.3	0.65
			Minimum	59.8	30.8	14.2	16.5	0.55
			Average	64.0	34.1	15.2	17.9	0.62
3.	Near Mines office	Oct'25	Maximum	71.6	33.1	19.2	21.3	0.62
			Minimum	62.2	25.7	16.5	17.7	0.55
			Average	68.4	29.3	18.2	19.1	0.59
		Nov'25	Maximum	73.5	41.7	22.7	25.1	0.75
			Minimum	60.9	31.2	18.6	20.9	0.59
			Average	68.2	37.7	20.4	23.4	0.68
		Dec'25	Maximum	78.5	43.5	23.5	27.2	0.76
			Minimum	69.8	38.2	20.8	23.9	0.61
			Average	74.3	41.0	22.5	25.2	0.70
		Jan'26	Maximum	79.2	44.1	23.6	24.2	0.75
			Minimum	70.7	35.9	19.6	20.9	0.68
			Average	75.9	41.3	21.3	23.1	0.71

Sl. No.	Location	Month	Concentration	PM10 µg/m3	PM2.5 µg/m3	SO2 µg/m3	NO2 µg/m3	CO mg/m3
		Feb'26	Maximum	80.7	45.6	24.3	25.3	0.77
			Minimum	72.5	37.4	20.3	21.7	0.70
			Average	77.2	42.7	22.0	23.9	0.73
		Mar'26	Maximum	79.5	45.5	17.6	20.5	0.73
			Minimum	62.9	32.9	14.8	16.9	0.58
			Average	73.7	39.8	16.0	18.1	0.66
4.	Rest Shelter	Oct'25	Maximum	70.6	32.1	20.7	21.8	0.65
			Minimum	62.3	24.7	16.2	16.5	0.54
			Average	65	27.1	18.3	18.5	0.58
		Nov'25	Maximum	68.2	37.7	20.4	23.4	0.68
			Minimum	68.2	37.7	20.4	23.4	0.68
			Average	60.7	29.7	13.9	18.3	0.48
		Dec'25	Maximum	68.2	36.9	15.2	20.6	0.63
			Minimum	60.9	31.2	13.7	15.4	0.51
			Average	64.3	34.8	14.3	18.6	0.57
		Jan'26	Maximum	70.4	39.8	15.2	16.9	0.65
			Minimum	62.9	33.8	13.8	14.9	0.57
			Average	65.7	36.3	14.3	16.0	0.61
		Feb'26	Maximum	72.1	41.0	15.6	17.5	0.67
			Minimum	63.8	34.9	14.2	15.4	0.59
			Average	67.0	37.3	14.7	16.6	0.63
		Mar'26	Maximum	70.4	38.4	14.5	17.8	0.73
			Minimum	60.9	30.8	13.5	15.9	0.58
			Average	64.9	34.1	14.0	16.8	0.67
CPCB Standard			**24 Hrly**	**100**	**60**	**80**	**80**	**2 (8 Hrly)**
			Annual Average	**60**	**40**	**40**	**50**	**--**

2. Ambient Air Quality Buffer Area

Si. No.	Location	Month	Concentration	PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³
1.	Koira Basti	Oct'25	Maximum	47.2	22.7	14.3	15.4	0.48
			Minimum	40	17.2	12.6	12.3	0.38
			Average	44.5	20.4	13.5	14.1	0.43
		Nov'25	Maximum	53.9	31.5	15.1	17.2	0.52
			Minimum	47.6	26.9	13.5	14.2	0.41
			Average	51.1	28.5	14.2	16.1	0.48
		Dec'25	Maximum	58.2	33.2	15.4	16.9	0.53
			Minimum	50.2	26.5	13.2	15.1	0.46
			Average	54.3	30.3	14.3	15.9	0.50
		Jan'26	Maximum	58.4	31.4	14.9	16.5	0.58
			Minimum	50.9	25.6	12.7	14.2	0.49
			Average	55.6	28.4	14.0	15.6	0.54
		Feb'26	Maximum	60.1	32.6	15.2	17.1	0.60
			Minimum	52.4	26.9	13.0	14.8	0.51
			Average	57.1	29.6	14.3	16.1	0.56
		Mar'26	Maximum	60.2	33.2	13.6	15.6	0.59
			Minimum	51.9	26.9	11.8	13.8	0.46
			Average	55.7	30.5	12.7	14.6	0.52
		Oct'25	Maximum	47.8	21.6	14.5	15.3	0.47
			Minimum	39.2	16	11.5	12	0.37
			Average	43.5	19.1	13	13.5	0.42

NARAYANPOSHI IRON & MANGANESE ORE MINE

Si. No.	Location	Month	Concentration	PM10 µg/m³	PM2.5 µg/m³	SO2 µg/m³	NO2 µg/m³	CO mg/m³
2.	Kashira Basti	Nov'25	Maximum	53.2	27.1	15.2	17.1	0.53
			Minimum	43.2	20.9	12.6	14.3	0.42
			Average	49.1	24.0	13.9	15.6	0.50
		Dec'25	Maximum	53.6	29.6	15.2	16.3	0.59
			Minimum	47.2	26.2	12.9	14.6	0.46
			Average	50.6	27.6	14.1	15.6	0.53
		Jan'26	Maximum	56.4	30.2	15.2	16.3	0.66
			Minimum	50.2	21.7	13.2	14.9	0.53
			Average	52.5	27.1	14.0	15.7	0.59
		Feb'26	Maximum	57.8	31.0	15.6	16.9	0.68
			Minimum	51.4	22.5	13.6	15.3	0.55
			Average	53.9	28.0	14.4	16.2	0.61
		Mar'26	Maximum	55.8	30.5	12.7	15.7	0.60
			Minimum	48.9	23.8	10.7	12.6	0.49
			Average	52.2	27.3	11.5	14.3	0.53
3.	Bhanjpali Village	Oct'25	Maximum	47.3	22.7	14.4	17	0.5
			Minimum	40	16.6	12.1	13.5	0.41
			Average	44.1	19	13.6	15.5	0.46
		Nov'25	Maximum	63.6	36.3	21.3	25.6	0.67
			Minimum	57.8	30.7	17.2	21.8	0.56
			Average	60.4	33.4	19.8	23.8	0.62
		Dec'25	Maximum	63.5	38.2	20.5	25.6	0.66
			Minimum	57.4	30.8	16.9	20.5	0.53
			Average	61.2	35.5	17.9	23.0	0.61
		Jan'26	Maximum	65.2	35.6	16.9	21.2	0.63
			Minimum	58.9	31.2	14.2	16.9	0.52
			Average	61.7	33.6	15.6	19.7	0.59

Sl. No.	Location	Month	Concentration	PM10 µg/m3	PM2.5 µg/m3	SO2 µg/m3	NO2 µg/m3	CO mg/m3
		Feb'26	Maximum	67.3	36.5	17.3	22.1	0.65
			Minimum	60.2	32.4	14.6	17.6	0.54
			Average	63.4	34.8	16.0	20.4	0.61
		Mar'26	Maximum	65.3	36.9	16.8	20.1	0.72
			Minimum	59.8	31.7	13.6	13.9	0.59
			Average	62.5	33.7	15.2	17.4	0.66
4.	Segasahi village	Oct'25	Maximum	49.5	22.9	14.7	15.4	0.5
			Minimum	41.2	16	12	11.1	0.38
			Average	46.6	19.3	13.4	13.2	0.44
		Nov'25	Maximum	57.5	30.1	15.5	18.1	0.53
			Minimum	52.8	21.3	13.8	14.9	0.46
			Average	55.0	25.0	14.4	16.5	0.50
		Dec'25	Maximum	60.2	34.2	15.6	18.2	0.58
			Minimum	50.6	26.8	14.2	15.2	0.44
			Average	55.9	30.7	14.8	16.7	0.53
		Jan'26	Maximum	60.2	31.2	15.3	16.4	0.66
			Minimum	51.9	24.2	13.5	14.6	0.51
			Average	55.3	27.8	14.1	15.8	0.57
		Feb'26	Maximum	61.5	32.4	15.8	16.9	0.68
			Minimum	53.2	25.4	13.9	15.2	0.53
			Average	56.7	29.0	14.5	16.3	0.59
		Mar'26	Maximum	55.3	31.3	13.4	16.9	0.59
			Minimum	49.6	27.8	10.7	13.4	0.48
			Average	51.8	29.7	12.3	15.0	0.54
CPCB Standard			**24 Hrly**	**100**	**60**	**80**	**80**	**2 (8 Hrly)**
			Annual Average	**60**	**40**	**40**	**50**	**--**

3. Fugitive Emission Monitoring (µg/m³)

Sl. No.	Month	Screen Plant		Crusher Plant		Ore Storage & Loading Point	
		Max	Min	Max	Min	Max	Min
1.	Oct'25	682	654	717	644	619	544
2.	Nov'25	642	539	684	573	516	438
3.	Dec'25	694	598	698	612	540	469
4.	Jan'26	742	631	745	698	603	536
5.	Feb'26	758	648	759	715	618	552
6.	Mar'26	789	739	719	685	591	542

Sl. No.	Month	Mines Haulage Road		Mines Face Bench		Waste Dump	
		Max	Min	Max	Min	Max	Min
1.	Oct'25	714	631	617	549	621	547
2.	Nov'25	716	598	563	469	563	479

3.	Dec'25	742	681	632	542	602	526
4.	Jan'26	802	735	642	598	636	596
5.	Feb'26	823	754	656	606	652	604
6.	Mar'26	751	716	612	574	692	658

4. ILLUMINATION MONITORING (Lux)

	OCT 25		NOV 25		DEC 25	
LOCATION	**Horizontal**	**Vertical**	**Horizontal**	**Vertical**	**Horizontal**	**Vertical**
Workshop Area	**120**	**88**	**116**	**88**	**124**	**76**
Screen Plant	**118**	**100**	**120**	**106**	**116**	**98**
Haul Road	**80**	**92**	**91**	**101**	**98**	**100**
Loading Point	**84**	**106**	**76**	**112**	**78**	**105**
Crusher Plant	**95**	**88**	**108**	**90**	**112**	**96**
Parking Yard	**93**	**108**	**102**	**114**	**109**	**102**
Permanent Path	**92**	**100**	**90**	**101**	**96**	**85**
Electric Substation	**142**	**88**	**135**	**82**	**145**	**112**
Rest Shelter	**80**	**68**	**86**	**71**	**76**	**65**
Mines Bench Foot Path	**90**	**82**	**109**	**92**	**102**	**90**
	JAN 26		**FEB 26**		**MAR 26**	
LOCATION	**Horizontal**	**Vertical**	**Horizontal**	**Vertical**	**Horizontal**	**Vertical**
Workshop Area	**115**	**90**	**121**	**94**	**108**	**114**
Screen Plant	**136**	**104**	**142**	**110**	**156**	**121**
Haul Road	**102**	**109**	**135**	**120**	**130**	**118**
Loading Point	**97**	**100**	**92**	**98**	**98**	**85**
Crusher Plant	**92**	**92**	**85**	**92**	**80**	**102**
Parking Yard	**113**	**98**	**124**	**116**	**135**	**112**
Permanent Path	**98**	**87**	**90**	**95**	**86**	**92**
Electric Substation	**133**	**102**	**124**	**109**	**135**	**110**
Rest Shelter	**87**	**62**	**85**	**60**	**89**	**56**
Mines Bench Foot Path	**106**	**93**	**100**	**115**	**113**	**142**

5. Noise Level {dB(A)}

A. Ambient Noise Monitoring

Location	OCT 25		NOV 25		DEC 25		Standards	
	Leq Day	Leq Night	Leq Day	Leq Night	Leq Day	Leq Night	Leq Day	Leq Night
EAST BOUNDARY	65	50	71.5	41.1	73.7	40.6	75 dB(A)	70 dB(A)
WEST BOUNDARY	63	52	62.8	49.6	63.9	43.9	75 dB(A)	70 dB(A)
NORTH BOUNDARY	64	52	69.7	45.2	70.9	47.5	75 dB(A)	70 dB(A)
SOUTH BOUNDARY	64	52	70.2	50.8	71.5	51.2	75 dB(A)	70 dB(A)
Location	**JAN 26**		**FEB 26**		**MAR 26**		**Standards**	
	Leq Day	Leq Night	Leq Day	Leq Night	Leq Day	Leq Night	Leq Day	Leq Night
EAST BOUNDARY	70.8	48.6	71.2	50.1	70.9	50.8	75 dB(A)	70 dB(A)
WEST BOUNDARY	63.4	42.7	62.8	44.7	63.8	41.3	75 dB(A)	70 dB(A)
NORTH BOUNDARY	69.5	50.1	70.4	58.2	71.5	57.1	75 dB(A)	70 dB(A)
SOUTH BOUNDARY	72.7	44.9	66.8	43.9	67.1	44.9	75 dB(A)	70 dB(A)

B. Source Noise Monitoring

CORE ZONE	OCT 25				NOV 25			
	Week-1	Week-2	Week-3	Week-4	Week-1	Week-2	Week-3	Week-4
	Leq				Leq			
Loader	71.4	70.5	70.2	71.2	68.3	70.4	67.9	70.1
Loading Point	70.6	69.8	73.8	68.9	70.7	71.1	72.1	65.8
Crusher Plant	68.9	71.1	71.4	69.3	73.2	68.9	62.8	69.2
Screen Plant	67.8	70.8	68.6	70.2	62.9	63.8	69.7	70.7
Dumper	70.3	68.9	69.5	64.3	68.3	70.7	71.3	70.5
Excavator	65.8	69.2	70.2	63.9	70.4	69.2	70.4	66.9
Drill Machine	69.3	70.4	72.6	71.5	72.8	71.7	68.5	69.8
Haulage Road	70.2	68.6	68.9	68.5	68.5	70.1	70.7	70.2

CORE ZONE	DEC 25				JAN 26			
	Week-1	Week-2	Week-3	Week-4	Week-1	Week-2	Week-3	Week-4
	Leq				Leq			
Loader	52.8	58.5	60.1	59.3	69.8	69.5	71.6	73.1
Loading Point	63.5	60.2	57.9	60.6	70.2	70.9	70.2	65.9
Crusher Plant	60.1	56.9	55.2	51.7	70.6	70.4	70.9	69.8
Screen Plant	54.2	50.7	46.9	40.2	65.3	69.8	65.3	72.2
Dumper	46.9	44.3	40.1	38.9	69.8	72.5	69.8	70.5
Excavator	50.3	50.1	39.8	41.3	73.2	70.1	73.2	66.3
Drill Machine	44.8	40.9	42.2	38.6	70.4	73.8	70.8	70.4
Haulage Road	42.6	38.6	40.7	40.1	64.2	70.4	71.4	70.2
CORE ZONE	FEB 26				MAR 26			
	Week-1	Week-2	Week-3	Week-4	Week-1	Week-2	Week-3	Week-4
	Leq				Leq			
Loader	73.2	68.9	66.1	66.1	69.8	70.4	71.5	70.4
Loading Point	62.9	70.7	70.7	69.8	71.5	70.9	68.5	62.9
Crusher Plant	70.8	69.2	68.3	62.8	73.2	68.9	69.8	68.9
Screen Plant	65.4	63.8	62.9	71.3	68.9	69.5	70.5	70.1
Dumper	71.3	70.7	72.1	65.8	69.5	70.1	62.8	66.3
Excavator	70.8	69.3	70.9	70.7	71.5	72.5	69.1	69.8
Drill Machine	70.1	65.2	61.2	76.1	66.2	62.5	67.8	71.2
Haulage Road	66.9	73.2	73.5	70.2	68.5	68.9	70.2	70.8

6. Surface Water Quality

NARAYANPOSHI IRON ORE MINE								
Karo River Up Stream								
Parameter	**Units**	**OCT-25**	**NOV-25**	**DEC-25**	**JAN-26**	**FEB-26**	**MAR-26**	**Limits for Stream Water Standards**
PH	-	7.09	7.18	7.13	7.19	7.14	7.17	6.5-8.5
Total Dissolved Solids	mg/l	81.4	77.5	71.5	82.6	80.9	86.8	1500
BOD	mg/l	2.2	2.3	1.9	1.8	1.9	1.6	3
DO	mg/l	4.7	5.1	5.5	5.2	5.4	5.6	4
Chlorides	mg/l	19.5	22.9	21.8	22.4	21.8	23.2	600
Fluorides	mg/l	0.27	0.23	0.21	0.23	0.24	0.18	1.5
Iron	mg/l	1.14	1.85	1.75	1.98	2.05	1.09	50
Karo River Down Stream								
Parameter	**Units**	**OCT-25**	**NOV-25**	**DEC-25**	**JAN-26**	**FEB-26**	**MAR-26**	**Limits for Stream**

								Water Standards
PH	**-**	**7.11**	**7.02**	**7.19**	**7.21**	**7.26**	**7.21**	6.5-8.5
Total Dissolved Solids	**mg/l**	**85.2**	**70.9**	**65.9**	**91.0**	**93.4**	**90.2**	1500
BOD	**mg/l**	**2.4**	**1.9**	**1.5**	**1.9**	**2.0**	**1.9**	3
DO	**mg/l**	**5.1**	**4.6**	**4.9**	**5.0**	**5.2**	**5.1**	4
Chlorides	**mg/l**	**21.7**	**25.1**	**20.9**	**20.1**	**19.7**	**20.9**	600
Fluorides	**mg/l**	**0.21**	**0.19**	**0.18**	**0.19**	**0.21**	**0.23**	1.5
Iron	**mg/l**	**1.19**	**2.03**	**2.02**	**2.16**	**2.11**	**0.98**	50
Orhari Nala Upstream								
Parameter	**Units**	**OCT-25**	**NOV-25**	**DEC-25**	**JAN-26**	**FEB-26**	**MAR-26**	**Limits for Stream Water Standards**
PH	**-**	**7.21**	**7.28**	**7.25**	**7.06**	**7.02**	**6.95**	6.5-8.5
Total Dissolved Solids	**mg/l**	**71.2**	**82.1**	**72.8**	**77.8**	**79.1**	**81.2**	1500
BOD	**mg/l**	**1.8**	**2.1**	**2.0**	**2.0**	**1.8**	**1.7**	3
DO	**mg/l**	**5**	**5.9**	**6.2**	**5.8**	**5.6**	**5.5**	4
Chlorides	**mg/l**	**23.1**	**22.9**	**19.6**	**20.9**	**21.5**	**21.8**	600
Fluorides	**mg/l**	**0.26**	**0.12**	**0.15**	**0.16**	**0.18**	**0.15**	1.5
Iron	**mg/l**	**2.02**	**2.27**	**2.16**	**2.38**	**2.29**	**0.82**	50
Orhari Nala Downstream								
Parameter	**Units**	**OCT-25**	**NOV-25**	**DEC-25**	**JAN-26**	**FEB-26**	**MAR-26**	**Limits for Stream Water Standards**
PH	**-**	**7.16**	**7.11**	**7.14**	**7.15**	**7.18**	**6.78**	6.5-8.5
Total Dissolved Solids	**mg/l**	**88**	**70.2**	**77.2**	**84.2**	**82.7**	**89.9**	1500
BOD	**mg/l**	**2.8**	**2.5**	**1.8**	**1.6**	**1.7**	**1.8**	3
DO	**mg/l**	**5.4**	**5.2**	**5.6**	**5.3**	**5.5**	**5.8**	4
Chlorides	**mg/l**	**10**	**29.8**	**23.5**	**23.8**	**24.6**	**19.6**	600
Fluorides	**mg/l**	**0.26**	**0.15**	**0.15**	**0.21**	**0.23**	**0.19**	1.5
Iron	**mg/l**	**1.96**	**2.16**	**2.16**	**2.41**	**2.36**	**0.98**	50
Manganese Quarry								
Parameter	**Units**	**OCT-25**	**NOV-25**	**DEC-25**	**JAN-26**	**FEB-26**	**MAR-26**	**Limits for Stream Water Standards**
PH	**-**	**7.05**	**6.92**	**6.84**	**6.98**	**7.04**	**7.15**	6.5-8.5
Total Dissolved Solids	**mg/l**	**82.3**	**80.1**	**76.5**	**80.4**	**78.9**	**77.8**	1500
BOD	**mg/l**	**1.9**	**2.6**	**2.4**	**2.1**	**2.2**	**1.6**	3
DO	**mg/l**	**5.6**	**4.6**	**5.3**	**5.0**	**5.2**	**5.2**	4
Chlorides	**mg/l**	**24.2**	**25.8**	**22.9**	**16.9**	**17.5**	**16.9**	600
Fluorides	**mg/l**	**0.15**	**0.24**	**0.31**	**0.31**	**0.29**	**0.16**	1.5

Iron	**mg/l**	-	-	-	-	-	-	50
Kashira Nala upstream								
Parameter	**Units**	**OCT-25**	**NOV-25**	**DEC-25**	**JAN-26**	**FEB-26**	**MAR-26**	**Limits for Stream Water Standards**
PH	**-**	**7.19**	**7.35**	**7.26**	**7.24**	**7.21**	**7.14**	6.5-8.5
Total Dissolved Solids	**mg/l**	**78.4**	**67.8**	**61.2**	**69.6**	**71.2**	**69.8**	1500
BOD	**mg/l**	**2.2**	**2.0**	**2.1**	**1.7**	**1.8**	**1.6**	3
DO	**mg/l**	**4.6**	**4.8**	**5.2**	**5.1**	**5.0**	**4.9**	4
Chlorides	**mg/l**	**18.9**	**27.1**	**22.8**	**22.5**	**23.1**	**21.6**	600
Fluorides	**mg/l**	**0.23**	**0.21**	**0.23**	**0.25**	**0.26**	**0.16**	1.5
Iron	**mg/l**	**1.09**	**2.03**	**1.96**	**1.99**	**2.02**	**1.16**	50
Kashira Nala downStream								
Parameter	**Units**	**OCT-25**	**NOV-25**	**DEC-25**	**JAN-26**	**FEB-26**	**MAR-26**	**Limits for Stream Water Standards**
PH	**-**	**7.09**	**7.17**	**7.19**	**7.16**	**7.1**	**7.03**	6.5-8.5
Total Dissolved Solids	**mg/l**	**90.1**	**65.3**	**59.8**	**70.2**	**72.6**	**80.2**	1500
BOD	**mg/l**	**2.4**	**2.2**	**1.8**	**1.6**	**1.7**	**2.0**	3
DO	**mg/l**	**5**	**5.0**	**4.8**	**4.9**	**5.1**	**5.6**	4
Chlorides	**mg/l**	**19.3**	**23.6**	**21.7**	**22.1**	**21.4**	**22.8**	600
Fluorides	**mg/l**	**0.23**	**0.26**	**0.28**	**0.23**	**0.24**	**0.13**	1.5
Iron	**mg/l**	**1.8**	**1.92**	**1.75**	**2.03**	**2.08**	**1.35**	50
Narayanposhi Nalla								
Parameter	**Units**	**OCT-25**	**NOV-25**	**DEC-25**	**JAN-26**	**FEB-26**	**MAR-26**	**Limits for Stream Water Standards**
PH	**-**	**7.16**	**6.87**	**7.03**	**7.07**	**7.09**	**7.05**	6.5-8.5
Total Dissolved Solids	**mg/l**	**90.8**	**76.9**	**70.2**	**76.2**	**77.5**	**82.3**	1500
BOD	**mg/l**	**2.1**	**2.4**	**2.2**	**2.0**	**2.1**	**1.9**	3
DO	**mg/l**	**4.3**	**9.2**	**5.5**	**5.4**	**5.6**	**5.6**	4
Chlorides	**mg/l**	**22.7**	**27.2**	**23.8**	**23.8**	**22.9**	**24.2**	600
Fluorides	**mg/l**	**0.32**	**0.19**	**0.15**	**0.25**	**0.27**	**0.15**	1.5
Iron	**mg/l**	**1.78**	**2.31**	**2.24**	**2.27**	**2.21**	**1.17**	50

7. Surface Water Flow Rate

LOCATION NAME	OCT-25	NOV-25	DEC-25	JAN-26	FEB-26	MAR-26
Karo Nala	0.80	0.85	0.93	0.98	1.01	0.95
Orahari Nalla	0.71	0.82	0.83	0.77	0.80	0.82
Kashira Nalla	0.66	0.70	0.75	0.82	0.85	0.83
Narayanposhi Nalla	0.75	0.88	0.93	0.88	0.90	0.85

8. Ground Water Quality

Location		Gate No-1 (Security Barrack)	Quarry-1 (Borewell)	Operator Colony (Borewell)	Koira Basti	Kashira Village
Parameter	Units	NOV-25				
PH	-	7.18	7.21	6.59	6.92	7.11
Total Dissolved Solids	mg/l	31.2	27.6	45.4	38.9	40.2
Total Hardness	mg/l	40.9	51.2	57.6	39.8	42.1
Sulphates	mg/l	4.1	3.5	3.1	2.9	3.2
Chlorides	mg/l	8.1	7.7	6.0	5.9	6.2
Fluoride	mg/l	0.14	0.11	0.16	0.11	0.13
Iron	mg/l	0.28	0.34	0.30	0.23	0.25
Location		Gate No-1 (Security Barrack)	Quarry-1 (Borewell)	Operator Colony (Borewell)	Koira Basti	Kashira Village
Parameter	Units	JAN-26				
PH	-	7.25	7.19	6.95	7.03	7.21
Total Dissolved Solids	mg/l	32.8	40.4	45.9	42.3	39.8
Total Hardness	mg/l	53.7	60.2	61.9	56.3	49.8
Sulphates	mg/l	4.2	3.5	3.0	3.8	2.9
Chlorides	mg/l	10.1	6.8	7.0	7.1	7.8
Fluoride	mg/l	0.11	0.13	0.14	0.21	0.16
Iron	mg/l	0.25	0.33	0.21	0.29	0.30

NARAYANPOSHI IRON & MANGANESE ORE MINE

9. Drinking Water Quality

Near Mines Office									
Parameter	**Units**	**OCT-25**	**NOV-25**	**DEC-25**	**JAN-26**	**FEB-26**	**MAR-26**	**Acceptable Limits**	**Permissible Limits**
PH	-	7.11	7.25	7.19	7.24	7.41	7.29	6.5-8.5	No Relaxation
Total Dissolved Solids	mg/l	181	184.0	180.0	192.0	196.8	190.5	500	2000
Total Hardness	mg/l	94.2	102.4	100.6	118.0	121.4	109.4	200	600
Sulphates	mg/l	10.9	11.9	10.2	8.2	8.4	5.2	200	400
Chlorides	mg/l	19.6	21.5	19.6	19.2	19.6	18.2	260	1000
Fluoride	mg/l	0.15	0.16	0.14	0.11	0.11	0.13	1	1.5
Iron	mg/l	0.27	0.35	0.31	0.29	0.30	0.28	1	No Relaxation
Near View Point									
Parameter	**Units**	**OCT-25**	**NOV-25**	**DEC-25**	**JAN-26**	**FEB-26**	**MAR-26**	**Acceptable Limits**	**Permissible Limits**
PH	-	6.95	7.06	7.02	7.15	7.36	7.05	6.5-8.5	No Relaxation
Total Dissolved Solids	mg/l	181	193	196.2	204.0	209.1	204.8	500	2000
Total Hardness	mg/l	80.6	93.8	90.8	96.2	98.9	92.0	200	600
Sulphates	mg/l	7.59	8.2	7.5	7.9	8.1	7.9	200	400
Chlorides	mg/l	15.5	19.6	20.4	20.8	21.4	20.6	260	1000
Fluoride	mg/l	0.12	0.13	0.11	0.15	0.15	0.11	1	1.5
Iron	mg/l	0.15	0.22	0.25	0.34	0.35	0.31	1	No Relaxation
Operator Colony									
Parameter	**Units**	**OCT-25**	**NOV-25**	**DEC-25**	**JAN-26**	**FEB-26**	**MAR-26**	**Acceptable Limits**	**Permissible Limits**
PH	-	7.14	7.31	7.25	7.21	7.39	7.41	6.5-8.5	No Relaxation
Total Dissolved Solids	mg/l	182	202	187.0	188.0	192.6	167.8	500	2000
Total Hardness	mg/l	89.4	97.5	94.2	104.0	106.0	100.8	200	600
Sulphates	mg/l	8.56	9.5	9.1	9.5	9.8	6.7	200	400
Chlorides	mg/l	17.4	22.7	20.9	17.6	18.1	16.8	260	1000
Fluoride	mg/l	0.17	0.21	0.19	0.13	0.13	0.15	1	1.5
Iron	mg/l	0.24	0.31	0.20	0.31	0.32	0.26	1	No Relaxation

10. ETP Monitoring (Inlet & Outlet)

Parameter	Units	OCT-25	NOV-25	DEC-25	JAN-26	FEB-26	MAR-26	Acceptable Limits
ETP Inlet								
pH	-	6.80	6.82	6.75	6.92	7.1	7.19	6.5-9.0
Total Suspended Solid as TSS	mg/l	89.4	92	95	90	92.5	90.8	100.0
Total Dissolved Solids as TDS	mg/l	571	612	594	560	575	516	-
Biochemical Oxygen Demand as BOD 3days at 27^0C	mg/l	53	68	65	59	61	60	30.0
Chemical Oxygen Demand as COD	mg/l	193	186	174	186	190	176	260.0
Oil & Grease as O & G	mg/l	7.1	6.2	5.9	6.3	6.5	6.1	10.0
Parameter	**Units**	**OCT-25**	**NOV-25**	**DEC-25**	**JAN-26**	**FEB-26**	**MAR-26**	**Acceptable Limits**
ETP Outlet								
pH	-	7.23	7.17	7.13	7.48	7.65	7.74	6.5-9.0
Total Suspended Solid as TSS	mg/l	29.8	27.6	28.6	26.2	27.0	23.0	100.0
Total Dissolved Solids as TDS	mg/l	136	145	132	124	128	118	-
Biochemical Oxygen Demand as BOD 3days at 27^0C	mg/l	18	12	11	10	10.5	10.2	30.0
Chemical Oxygen Demand as COD	mg/l	47	50	42	45	46	42	260.0
Oil & Grease as O & G	mg/l	4.1	<5.0	<5.0	<5.0	<5.0	<5.0	10.0

NARAYANPOSHI IRON & MANGANESE ORE MINE

11. STP Monitoring (Inlet & Outlet)

Parameter	Units	OCT-25	NOV-25	DEC-25	JAN-26	FEB-26	MAR-26	Detection Range
STP Inlet								
pH	-	7.15	7.31	7.24	7.38	7.42	7.25	2.0 -12
Total Suspended Solid as TSS	mg/l	265	246	229	235	248	236	5 - 5000
Total Dissolved Solids as TDS	mg/l	374	563	543	496	472	426	10-10000
Biochemical Oxygen Demand as BOD 3days at 27^0C	mg/l	113	108	102	98	92	90	5-10000
Chemical Oxygen Demand as COD	mg/l	356	452	395	350	338	352	5-50000
Oil & Grease as O & G	mg/l	5.6	5.4	5.7	5.5	5.8	5.6	5-600
Parameter	**Units**	**OCT-25**	**NOV-25**	**DEC-25**	**JAN-26**	**FEB-26**	**MAR-26**	**Acceptable Limits**
STP Outlet								
pH	-	7.38	7.75	7.68	7.92	7.85	7.79	6.5-9.0
Total Suspended Solid as TSS	mg/l	95	120	114	112	118	105	100.0
Total Dissolved Solids as TDS	mg/l	96	74	70	65	58	52	-
Biochemical Oxygen Demand as BOD 3days at 27^0C	mg/l	25	20	16	14	12	14	30.0
Chemical Oxygen Demand as COD	mg/l	152	86	60	62	55	48	260.0
Oil & Grease as O & G	mg/l	4.4	<5.0	<5.0	<5.0	<5.0	<5.0	10.0

12. Vibration Monitoring

Sl no.	Station Name	Instrument location	Season (Summer/Winter/ Monsoon/post monsoon	Peak particle velocity	Air Over pressure	Remark
1	RF Quarry (RL-617)	Mines View point	**Post Monsoon**	2.1 mm/s	97.2 dB at 21.5Hz	Permisible limit
2	RF Quarry (RL-621)	Mines View point	**Post Monsoon**	1.94 mm/s	101.7 dB at 18.2Hz	Permisible limit

ANNEXURE VI

Avenue Plantation at Narayanposhi Mines





Avenue Plantation at NH-520 road side





Avenue Plantation at Gate No.1 road side

ANNEXURE VII

Parking Plaza with separate Entry and Exit with basic amenities






27 Nov 2025 12:46:07 pm
21°55'53.412"N 85°14'10.8"E
Koira
Northern Division
Odisha

ANNEXURE VIII

Avenue plantations in road side of NH-520









ANNEXURE IX

Washing and Desliming of Iron Ore Fines of Nuagaon and Narayanposhi Mines

Submitted to

M/s. JSW Steel Ltd.
Mines Division
Odisha

Prepared by

Mineral Processing Dept.
CSIR-Institute of Minerals & Materials Technology
Bhubaneswar-751013

Foreword

I am happy to forward the report on "Washing and Desliming of Iron Ore Fines of Nuagaon and Narayanposhi Mines" prepared for M/s. JSW Steel Ltd., Mines Division, Odisha. This report includes the mineralogical, physical and chemical characteristics of two iron ore samples as well as physical beneficiation, settling and filtration studies of finer size range of particles to generate the concentrate as sinter and pellet feed material. Mineralogical, physical and chemical studies provide the valuable information to develop the conceptual process flowsheet. Suitable washing and desliming process flowsheet was developed to utilize this low grade iron ores with predominant association with clay minerals. It is possible to get concentrate having more than 62.5% Fe with around more than 82% yield and less than 2.5% alumina in combination of scrubbing, classification and beneficiation of fine range particles using high intensity magnetic separator.

I wish that these findings can be utilised by M/s. JSW Steel Ltd., Mines Division, Odisha for utilization of low grade iron ore fines.

Director
CSIR-Institute of Minerals and Materials Technology
Bhubaneswar

प्रस्तावना

मैसर्स जे.एस.डब्ल्यू स्टील लिमिटेड, खान प्रभाग, ओडिशा के लिए तैयार "नुआगांव और नारायणपोशी खानों के लौह अयस्क फाइन्स की धुलाई और डीस्लिमिंग" पर रिपोर्ट को अग्रेषित करते हुए मुझे खुशी हो रही है। । इस रिपोर्ट में दो लौह अयस्क नमूनों की खनिज, भौतिक और रासायनिक विशेषताओं के साथ-साथ भौतिक लाभकारी, कणों के महीन आकार की सीमा के निपटान और निस्पंदन अध्ययन शामिल हैं ताकि सिंटर और पेलेट फीड सामग्री के रूप में ध्यान केंद्रित किया जा सके। खनिज, भौतिक और रासायनिक अध्ययन वैचारिक प्रक्रिया फ्लोशीट विकसित करने के लिए बहुमूल्य जानकारी प्रदान करते हैं। क्ले मिनरल्स खनिजों के साथ प्रमुख सहयोग के निम्न श्रेणी के लौह अयस्कों का उपयोग करने के लिए उपयुक्त धुलाई और डीस्लिमिंग प्रक्रिया फ्लोशीट विकसित की गई। उच्च तीव्रता वाले चुंबकीय विभाजक का उपयोग करके महीन श्रेणी के कणों के स्क्रबिंग, वर्गीकरण और लाभकारी के संयोजन में लगभग 82% से अधिक उत्पादकता और 2.5% से कम एल्यूमिना के साथ 62.5% Fe से अधिक सांद्रता प्राप्त करना संभव हो पाया।

मेरी इच्छा है कि इन निष्कर्षों का उपयोग मैसर्स जेएसडब्ल्यू स्टील लिमिटेड, खान प्रभाग, ओडिशा द्वारा निम्न ग्रेड लौह अयस्क फाइन के उपयोग के लिए किया जा सकता है। ।

निदेशक

सीएसआईआर-खनिज और पदार्थ प्रौद्योगिकी संस्थान, भुवनेश्वर

Washing and Desliming of Iron Ore Fines of Nuagaon and Narayanposhi Mines

Submitted to

M/s. JSW Steel Ltd.
Mines Division
Odisha

Prepared by

CSIR-Institute of Minerals and Materials Technology
Bhubaneswar-751013, India

Foreword

I am happy to forward the report on "Washing and Desliming of Iron Ore Fines of Nuagaon and Narayanposhi Mines" prepared for M/s. JSW Steel Ltd., Mines Division, Odisha. This report includes the mineralogical, physical and chemical characteristics of two iron ore samples as well as physical beneficiation, settling and filtration studies of finer size range of particles to generate the concentrate as sinter and pellet feed material. Mineralogical, physical and chemical studies provide the valuable information to develop the conceptual process flowsheet. Suitable washing and desliming process flowsheet was developed to utilize this low grade iron ores with predominant association with clay minerals. It is possible to get concentrate having more than 62.5% Fe with around more than 82% yield and less than 2.5% alumina in combination of scrubbing, classification and beneficiation of fine range particles using high intensity magnetic separator.

I wish that these findings can be utilised by M/s. JSW Steel Ltd., Mines Division, Odisha for utilization of low grade iron ore fines.

Director
CSIR-Institute of Minerals and Materials Technology
Bhubaneswar

Executive Summary

As per the recent National Steel Policy of Govt. of India, steel production will be enhanced to 300 MTPA in 2030 from current production of 115 MTPA to increase per capita consumption from 65kg to 160kg against the world average 218kg. For the production of 300 MTPA, the country needs high-quality ore around 450 MTPA in form of calibrated ore, sinter and pellet to meet the requisite demand. To catering 450 MPTA, around 750-800 MPTA ores are to be mined.

M/s. JSW Steel Ltd. Mines Division, Odisha was interested to carry out the beneficiation studies of iron ores from their captive mines i.e., Nuagaon and Narayanposhi. CSIR-IMMT, Bhubaneswar has taken the responsibility to carry out characteristics and beneficiation studies to achieve the concentrate as sinter and pellet feed material.

The mineralogical and chemical analysis of Nuagaon iron ore mines was carried out. The Fe content in the bulk sample is 60.27%. The alumina, silica and LOI of the sample are 4.46%, 3.36% and 5.31% respectively. The Bond work index was carried out as per the standard procedure. The Bond work index of the bulk sample is 9.7 kWh/tonne. After desliming by using screw scrubber, the Bond work index was enhanced to 11.00 kWh/tonne. The desliming study of ore was carried out using screw scrubber to classify 100 micron particles as screw scrubber overflow. The water and solid ratio was maintained around 7:3. The overflow percentage with respect to feed was 40%. The Fe content of underflow of screw scrubber could be enhanced to 63.61%. The underflow of screw scrubber was also treated in gravity separation process using jig and spiral concentrator to enhance the Fe content. As grinding system is not available in this circuit, the jig and spiral concentrator tailings cannot be rejected due to high Fe content. Hence the screw scrubber underflow product was considered as one of the products. The Fe content in overflow of screw scrubber is 55.31%. The overflow was treated in magnetic separator to recover iron values from slimes. The Fe content in magnetic concentrate is 61.99%. This is the second product of the process. The overall yield of the process is 82.65% with 63.17% Fe, 1.73% Al_2O_3, 2.59% SiO_2 and 4.57% LOI.

The mineralogical and chemical analysis of Narayanposhi iron ore mines was carried out. The Fe content in the bulk sample is 60.76%. The alumina, silica and LOI of the sample are 4.16%, 2.75% and 6.18% respectively. The Bond work index was carried out as per the standard procedure. The Bond work index of the bulk sample is 11.5 kWh/tonne. After desliming by using screw scrubber, the Bond work index was enhanced to 12.40 kWh/tonne. The desliming study of ore was carried out using screw scrubber to classify 100 micron particles as screw scrubber overflow. The water and solid ratio were maintained around 7:3. The overflow percentage with respect to feed was 19.10%. The Fe content of underflow of screw scrubber could be enhanced to 62.47%. Hence it was considered as one of the products. The Fe content in overflow of screw scrubber is 53.61%. The overflow was treated in rougher and scavenger magnetic separators to recover iron values from slimes. The Fe content in rougher magnetic concentrate is 62.15% and 58.66 % Fe in scavenger magnetic concentrate. Magnetic concentrate is the second product of the process. The overall yield of the process is 91.93% with 62.32% Fe, 2.92% Al_2O_3, 1.81% SiO_2 and 5.86% LOI.

In overall study of beneficiation of screw scrubber overflow was done by magnetic separation process but in commercial plant, the hydrocyclone provision should be there to make further classification before magnetic separator in case of the low grade ore contains less than 58% Fe.

The concentrate and tailings of Nuagaon iron ore sample were taken for the settling study to provide the basic data for design of thickeners. A commercial anionic flocculent was used for settling of fine particles in the present study. The settling study of the concentrate was carried out at different solid concentration from 20 to 35% at 5% interval. The settling study of the tailings were carried out at the solid concentration of 5-10%. The pressure filtration of concentrates and the tailings were carried out using pilot scale filter press. During filter press operation, the cycle time was 22 minutes for filtration of concentrate and 35 minutes for the tailings. It is possible to achieve around 16% moisture in the filter cake for the concentrate and around 21-22% moisture for the tailings. Similarly, the settling and filtration studies of Narayanposhi iron ore sample was carried out.

Acknowledgements

Institute of Minerals and Materials Technology (IMMT), Bhubaneswar, has promoted a vision of Mineral Processing in India and abroad that lowers energy cost, reduces economic risk through improved processing, conserves resources and protects the environment. With this vision we took up to carry out research to carry out the beneficiation study of BMQ sample from M/s. JSW Steel Ltd., Mines Division, Odisha. We would like to express our sincere thanks to Mr. Ranjan Kumar Nayak, COO; Mr. James John, AVP; Mr. Swatantra Kumar, Sr. Manager; and Mr. Puneeth Rao Pawar, Manager; and also the Management of M/s. JSW Steel Ltd., Mines Division, Odisha for providing an opportunity to work on this project specially. We thank all the scientists and staff members in MP Dept. of CSIR-IMMT who have supported directly/indirectly to complete this project.

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Chapter 1
Introduction

1.1 Background

Iron ores are valuable natural resources being finite and non-renewable. Iron ore is one of the basic raw materials for iron and steel industries. The production of iron and steel has significantly expanded in recent years, particularly in China and India. It is predicted that the steel production may reach more than 2600 million tonnes in 2030. The recycle in form of iron scrap may meet around 650 million tonnes per annum. The remaining more than 3200 million tonnes per annum will be met through fresh iron ore. This has resulted in a large increase in the demand for iron ore. The quality of iron ore deposits, however, has deteriorated worldwide because of long-term mining, and the existing mines are having increasing difficulty in producing ore with a high grade of iron ore by simple crushing and screening. It is great concern for steel industries to either receive suitable quality iron ore in form of lumpy or sinter/pellet.

Australia and Brazil are among the world's largest iron ore producers and hold a large portion of the world's iron ore reserves. India is the 4th largest iron ore producer next to Australia, Brazil and China. India produced 209 million tonne during 2019-20 financial years. As per the recent National Steel Policy of Govt. of India, steel production will be enhanced to 300 MTPA in 2030 from current production of 115 MTPA to increase per capita consumption from 65kg to 160kg against the world average 218kg. For the production of 300 MTPA, the country needs high-quality ore around 450 MTPA in form of calibrated ore, sinter and pellet to meet the requisite demand. To catering 450 MPTA, around 750-800 MPTA ores are to be mined as shown in Fig.1.1.

1.2 Status of Iron Ore in India

India has 33 billion tonnes of primary iron ore resources like hematite and magnetite based minerals. Out of this, around 10.5 billion tonnes BMQ is available in India as on 1.4.2015 as per Mineral Year Book 2018 published by IBM, Nagpur. Remaining resources comes under hematite category. India's 98% magnetite reserves/resources in form of magnetite or BMQ are located in five States, namely, Karnataka (7,802 million tonnes or 72%) followed by Andhra Pradesh (1,392 million tonnes or 13%), Rajasthan (617 million tonnes or 6%),

Tamil Nadu (507 million tonnes or 5%) and Goa (226 million tonnes or 2%). Similarly, the total reserves/resources of haematitic ore as on 1.4.2015 have been estimated at 22.5 billion tonnes. Major reserves/resources of hematitic ore are located in Odisha (7,559 million tonnes or 34%), Jharkhand (5,286 million tonnes or 23%), Chhattisgarh (4,858 million tonnes or 22%), Karnataka (2,467 million tonnes or 11%) and Goa (1,189 million tonnes or 5%). The threshold value of hematite iron ore is 45% Fe whereas 35% for siliceous hematite ore available in State of Goa.

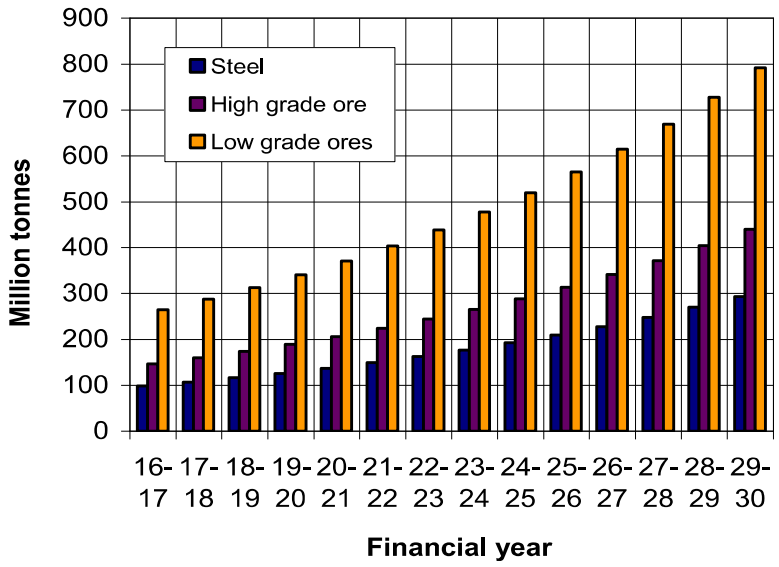


Fig. 1.1 Production of steel, high grade ores and low grade ores for beneficiation

1.3 Characteristics of Indian Ore

Indian hematitic iron ore deposits are soft and friable in nature because it is associated with goethite. During mining, it has been reported that the ratio between fines and lump ores is 2:1. Additionally, generation of fines happens due to mechanised mining and also preparation of sized ores by crushing and screening. Hence 50-70% fines (both high and low grades) are generated during mining and preparation of ore activities. The country is not endowed with high-grade requisite iron ore resources. It is, therefore, imperative to achieve the best use of available low-grade iron ore resources through scientific methods of beneficiation and pelletisation. Challenges and solutions are needed to be focussed for upgradation of Indian low-grade hematite iron ore in association of goethite, kaolinite and gibbsite minerals. The recovery of micro fines of iron phase minerals from slimes/tailings

from iron ore washing/beneficiation plants should be taken seriously to maximize the utilization of these resources for long-term sustainability. Nature of iron phase minerals and associated gangue minerals decide the process flowsheet of iron ore beneficiation to be adopted. Utilization of low-grade iron ores through beneficiation and pelletisation is closely interlinked with the environmental impact on the surrounding of the mines. Both aspects have to be properly coordinated to facilitate and ensure a sustainable development of beneficiation and pelletisation processes for utilization of iron ores in harmony with the environment.

1.4 Problems and Challenges of the Indian Iron Ore

In general, Indian hematite ore contains a good amount of clay minerals, which affects the process fluid dynamics due to their swelling properties. It increases the viscosity of the slurry; hence it affects the grinding as well as separation units. These ores are more fragile in nature due to presence of goethite phase. As a result, the ultra fine generation in the grinding circuit is more and ultimately it increases the Blaine number which has negative impact in the pelletisation plant. Percentage of goethite increases when Fe content of the ore decreases and other gangues minerals increases simultaneously. As per commercial plant observation, below 55% Fe content of ore does not respond well to the conventional beneficiation process.

1.5 Present Practice

At present practice in India, the ROM ore is crushed and classified into different size fractions either in dry or wet process. Most of the mines are operated in a dry process using hard ore by selective mining to cater the calibrated iron ore need of iron and steel industries. It is crushed to below 40/30 mm or 18mm size and classified at 10 mm/5mm size to provide the suitable size of calibrated ore (40/30+10 mm) or (-18+5 mm) to blast furnace/DRI operation respectively if the ore meets requisite metallurgical, physical and chemical properties. Whatever fine ore is generated due to crushing and classification processes, it may be utilized in sintering plant of integrated steel plants if it meets the required specification. The low grade ore is subjected to the physical beneficiation to recover the iron values, otherwise, it is dumped in mine site as rom fine dumps as shown in Fig.1.2. In the same time, percentage of low-grade fines increases day-by-day due to depletion of high-

grade iron ore. It also creates environmental impact in air and water body in the surrounding of the mine. Utilization of these fines is the need of hour to maximize the iron recovery through suitable beneficiation process which should hold up the economic feasibility and environmental sustainability. Some of the iron ore mining industries are still making the washing of coarse particles and putting the slimes in the pond as shown in Fig. 1.3. These slimes also contain good amount of Fe values.



Fig. 1.2 Iron ore low grade dump fines



Fig. 1.3 Iron ore slimes pond

1.6 Appropriate Approach for Iron Ore Beneficiation

- Percentage of goethite increases when Fe content of the ore decreases and simultaneously other gangues minerals increases. When the ore contains less than 55% Fe, it has been noted that goethite percentage is more than 50%. Hence this ore does not respond well to the conventional beneficiation process using gravity and magnetic separation techniques using physical properties. As the Indian hematite ore contains good amount of clay, it should be removed at the beginning of the process

using scrubbing equipment like screw scrubber/screw classifier, reflux classifier or drum scrubber. Hence the effect of slimes in the grinding and separation units in the process can be minimised.

- During grinding of the ore, proper classification unit with closed circuit grinding is very indispensable to reduce the generation of ultra-fine.
- Grinding product and desliming product should be treated separately to avoid the selectivity of the particles during separation process.
- If more goethite presents in the ore or liberated goethite is more, reduction roasting process may be adopted to maximise the recovery of the iron values.

1.7 Objective of the Project

M/s. JSW Steel Ltd., Mines Division, Odisha is planning to set up Washing and Desliming Iron Ore Plant to generate concentrates for sinter and pellet feed material from 58-60% Fe from Nuagaon and Narayanposhi mines.

The scopes of the work involved in this study:

(i) Sample preparation
(ii) Size analysis of as received sample
(iii) Detail chemical analysis of as received sample
(iv) Fe analysis of each size fractions
(v) Washing study by screw scrubber
(vi) Desliming study by hydrocyclone
(vii) Detail chemical analysis of screw scrubber product, hydrocyclone underflow and overflow
(viii) Settling study of cyclone overflow and underflow
(ix) Filtration study of hydrocyclone underflow
(x) Material (solid and water) balance of process
(xi) Report preparation

****

Chapter 3
Characterization, Beneficiation and Dewatering Studies of Narayanposhi Sample

3.1 Introduction

Around 1 tonnes of Iron ore below 10 mm sample was received from Narayanposhi Iron ore mines, Barbil, Odisha to carry out the desliming and beneficiation study to develop the suitable process flowsheet for production of high-grade iron ore concentrate. Around 100 kg representative sample was taken by standard coning and quartering method for size analysis, chemical analysis, bond work index, mineralogical studies and bulk density of bulk sample. The remaining sample was processed for desliming and beneficiation studies.

3.2 Characterisation Study

3.2.1 Size & Fe Analysis of Bulk Sample

The total sample of around 1 tonnes was thoroughly mixed and representative sample was drawn by coning and quartering method for size analysis. Then the size analysis with respective Fe analysis of bulk sample was carried out and the result is given in Table 3.1. The remaining sample was subjected to beneficiation studies.

Table 3.1
Size and Fe analysis of bulk sample

Size, mm	Wt., %	Cum Wt., %	Fe, %	Cum. Fe, %
+10	9.48	9.48	63.05	63.05
+6	20.03	29.51	62.83	62.90
+3	17.30	46.81	61.70	62.46
+2	7.09	53.90	61.51	62.33
+1	13.20	67.09	61.13	62.10
+0.850	5.68	72.77	60.03	61.93
+0.500	3.84	76.62	61.64	61.92
+0.300	3.03	79.65	61.43	61.90
+0.210	2.93	82.58	60.14	61.84
+0.150	1.79	84.37	60.24	61.80
+0.100	1.24	85.61	60.34	61.78
+0.075	0.45	86.06	60.56	61.78
+0.045	0.98	87.04	60.22	61.76
-0.045	12.96	100.00	54.21	60.78
Total	100.00		60.78	
Bulk			60.76	

3.2.2 Detail Chemical Analysis

The detailed chemical analysis, LOI along with the trace elements of the bulk sample was carried out. The result is given in the Table 3.2. The major impurity is quartzite and aluminum oxide. The hematite percent in the ore is about 86.88 %.

Table 3.2
Detail chemical analysis of the bulk sample

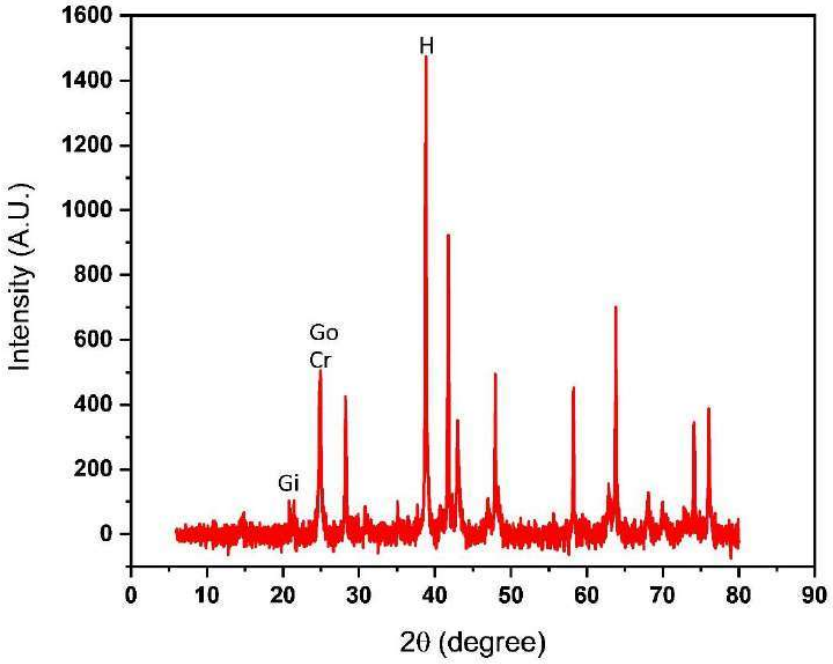
Details	Percentage
Fe (T)	60.76
Fe_2O_3	86.88
SiO_2	2.75
Al_2O_3	4.16
CaO	0.014
Cr_2O_3	0.020
CuO	0.006
K_2O	0.057
MgO	0.048
MnO_2	0.072
Na_2O	0.015
NiO	0.004
P_2O_5	0.004
PbO	0.006
TiO_2	0.004
V_2O_5	0.013
ZnO	0.014
LOI	6.18

3.3 Mineralogical Study

Mineralogical study of the bulk sample was carried out by using X-ray diffraction study. This study gives the qualitative mineralogical identification of different phases present with their textures.

3.3.1 XRD Study

XRD study was carried out on the representative bulk sample to determine the major minerals present in the sample. The XRD result is shown in Fig. 3.1 It indicates that the bulk sample have hematite as the major mineral phase and other minerals are goethite, gibbsite and chromite.



H: Hematite, Go: Goethite, Gi: Gibbsite, Cr: Chromite

Fig. 3.1 XRD study of bulk sample

3.4 Sequential Heating Analysis of Bulk Sample

The sequential heating at different temperature was carried out using muffle furnace for bulk sample to determine the association of minerals like goethite, gibbsite, kaolinite and overall LOI content. The result of sequential heating is given in Table 3.3. Based on weight loss at different temperatures, percentage of goethite, gibbsite and kaolinite were calculated. The percentage of water loss during 108°C to 450°C is used to calculate the percentage of goethite and gibbsite mineral. The percentage of water loss during 450°C 850°C is used to calculate the percentage of kaolinite mineral. The percentage of water loss during 850°C 950°C is used to calculate the percentage of carbonate minerals. Mineralogical characteristion study carried out by using both heating cycle and chemical analysis is given Table 3.4.

Table 3.3
LOI at different temperature by sequential heating cycle of bulk sample

400°C	850°C	950°C	Total LOI, %
5.42	0.71	0.05	6.18

Table 3.4
Mineralogical characteristics study by using heating cycle and chemical analysis

Heating Cycle Analysis	Hematite, %	Goethite, %	Kaolinite, %	Gibbsite, %
	48.16	43.32	5.12	2.97
Chemical Analysis	Fe(T), %	LOI, %	Al_2O_3, %	SiO_2, %
	60.76	6.18	4.16	2.75

3.5. Estimation of Bond Work Index

3.5.1 Sample Preparation

Around 30 kg of representative bulk sample was taken and screened at 4.36 mm size. The +3.36 mm size was crushed to below 3.36 mm size by using roll crusher. Then, it was thoroughly mixed and the representative sample was drawn for grindiability study for determination of Bond Work Index (BWI).

3.5.2 Ball Mill Grindiability Process

Grindiability study was carried out as per the standard procedure described by Bond. The Bond ball mill work index determination is carried out in a standard test mill and under standard conditions. The test mill has an internal diameter of 12 inch and length is also 12 inch. It has a smooth lining with rounded corners, no lifters except for a 4" X 8" hand hole lid for charging.

It has a revolution counter and runs at 70 rpm. The grinding charge consists of 285 iron balls weighing 20.125 kg. It consists of about 43 numbers of 1.45" balls, 67 numbers of 1.17" balls, 10 numbers of 1" balls, 71 numbers of 0.75" balls and 94 numbers 0.61" balls with a calculated surface area of 842 sq inch.

The standard feed was prepared by passing all through 3.36 mm size. It was packed by shaking in a 1000 cc graduated cylinder, and the weight of 700 cc was placed in the mill

and ground dry at 250 percent circulating load. After the first grinding period of 100 revolutions, the mill was dumped; the ball charge was screened out and 700 cc of material was screened on 150 mesh (100 micron) with coarser protecting sieves if necessary. The undersize was weighed and fresh unsorted feed was added to oversize to bring its weight back to that of original charge. Then it was returned on to the balls in the mill and ground for the number of revolutions calculated from the results of the previous period to produce sieve undersize equal to 1/3.5 of the total charge in the mill. The grinding period cycles were continued until the net grams of sieve undersize produced per mill revolution reaches equilibrium and reverses its direction of increase or decrease. Then the undersize product and circulating load were screen analyzed, and the average of the last three net grams per revolution (G_{bp}) was the mill grindiability. When F is the size in microns which 80 percent of the new ball mill feed passes, P is the microns which 80 percent of the last cycle sieve undersize product passes, and P_1 is the opening in microns of sieve size tested (100 micron), then the ball mill work index W_i is calculated from the following revised equation;

$$W.\ I.\ = 44.5\ /\{\ (\ P_i)^{0.23}\ X\ (\ G_{bp})^{0.82}\ X\ 10\ (1\ /\ \sqrt{}\ P\ -\ 1/\sqrt{}F)\} \qquad \textbf{(3.1)}$$

3.5.3 Bond Work Index of Bulk Sample

The representative iron ore bulk sample was taken for grindability study as per Bond's method. The size analysis of the crushed product for grindability study was carried and the results are given in the Table 3.5. It was found that d_{80} of the feed material was 2100 micron. The grindability study was carried for 100 micron test sieve. The weight of the 700 cc of material was 1610 gm. For 250 percent circulating load, 460 gm of -100 micron particles are to be produced at equilibrium revolution. To reach the equilibrium revolution a number of tests were carried out. At the equilibrium stage, G_{bp} was 1.867.

The size analysis of -100 micron product was carried out. The size analysis of product is given in the Table 3.6. The overall grindability result of bulk Sample is given in Table 3.7. The particle size distribution of feed and product is depicted in Fig. 3.2 and 3.3 respectively. The d_{80} of the ball mill product was 79.5 micron. Then according to Equation, W.I. was calculated and it was found 10.2 kWh/short ton. It was converted to normal tonne and WI value is 11.3 kWh/tonne.

$Wi = (44.5)/((P_1)^{0.23} \text{ X } (Gbp)^{0.82} (10/\sqrt{P} - 10/\sqrt{F}))$

$=(44.5)/((100)^{0.23} \text{ X } (1.867)^{0.82} (10/\sqrt{79.5} - 10/\sqrt{2100}))$

= 10.2 kWh/short ton

= 10.2 X 1.1 = **11.5 kWh/tonne**

The bond work index of the sample is determined to be 11.5 kWh/tonne.

Table 3.5
Feed size analysis

Size, micron	Cum. Wt., % Passing
3360	100.00
2000	77.76
1000	52.80
850	40.25
500	31.68
300	25.09
212	17.27
150	12.80
100	9.69

Table 3.6
Size analysis of ground product

Size, micron	Cum Wt., % Passing
100	100.00
75	75.00
63	53.00
45	35.75
38	24.25

Table 3.7
Results of gram per revolution

No. of revolutions	100micron produced (g)	100micron in the feed (g)	Net -100micron produced (g)	Grindability (g/rev.)
100	398	156	242	2.420
174	410	38.6	371	2.130
197	420	39.7	380	1.926
218	448	40.7	407	1.868
223	460	43.4	417	1.866
223	461	44.6	416	1.869
222	460	44.7	415	1.867
223	460	44.6	415	1.865

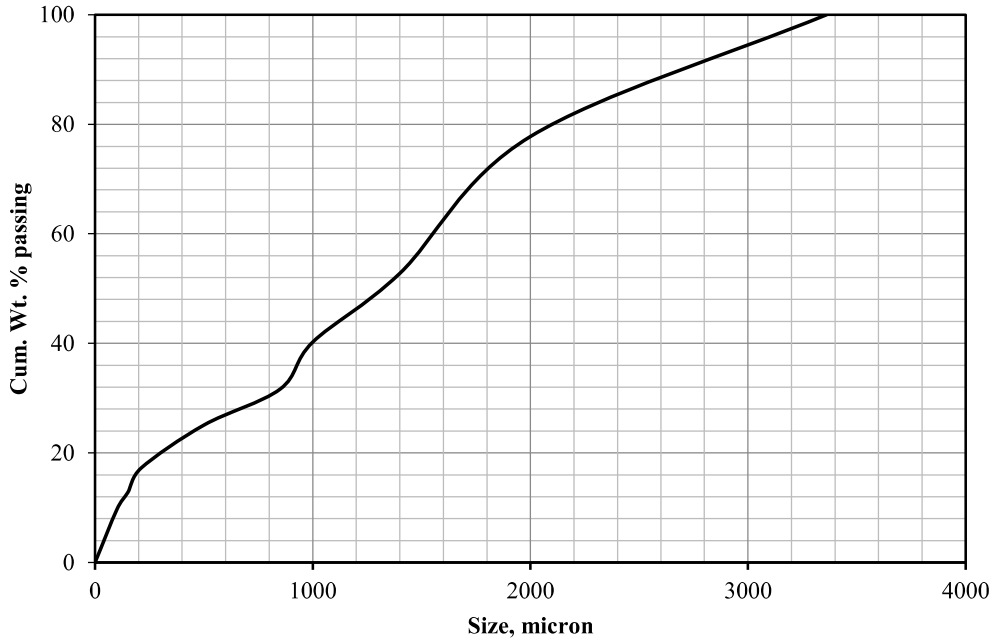


Fig. 3.2 Particle size distribution of feed

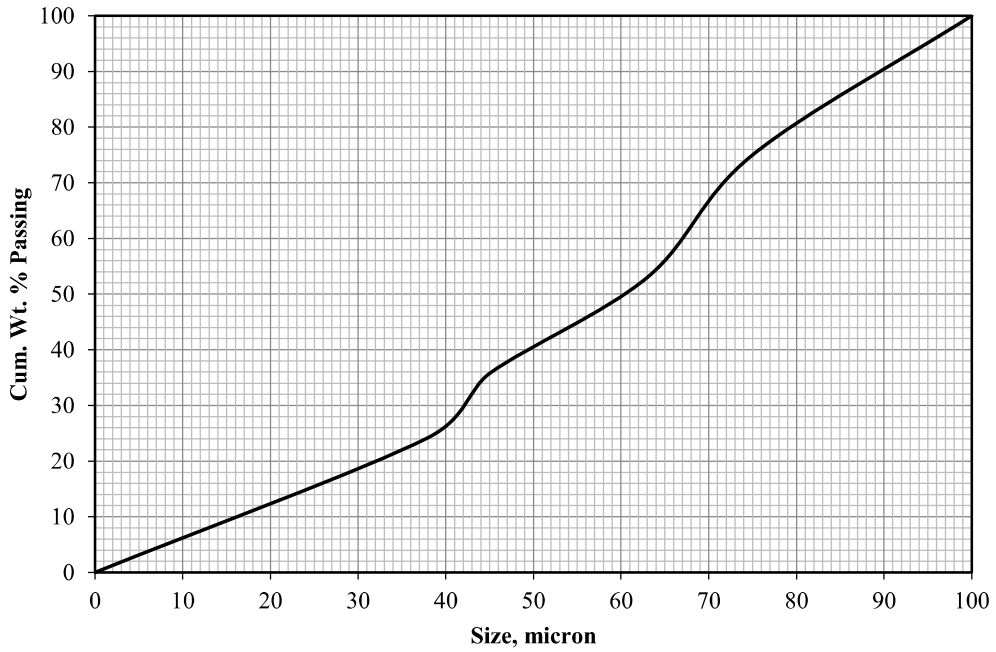


Fig. 3.3 Particle size distribution of product

3.5.4 Bond Work Index of Screw Scrubber Underflow Sample

The representative screw scrubber underflow sample was taken for grindability study as per Bond's method. The size analysis of the crushed product for grindability study was carried and the result is given in the Table 3.8. It was found that d_{80} of the feed material was 2030 micron. The grindability study was carried for 100 micron test sieve. The weight of the 700 cc of material was 1580 gm. For 250 percent circulating load, 452 gm of below 100 micron particles are to be produced at equilibrium revolution. To reach the equilibrium revolution a number of tests were carried out. At the equilibrium stage, G_{bp} was 1.647.

The size analysis of below 100 micron product was carried out. The size analysis of product is given in the Table 3.9. The overall grindability result of screw scrubber underflow is given in Table 3.10. The particle size description of feed and product is depicted in Fig. 3.4 and 3.5 respectively. The d_{80} of the ball mill product was 78.5 micron. Then according to equation, W.I. was calculated and it was found 11.3 kWh/short ton. It was converted to normal tonne and WI value is 12.4 kWh/tonne.

$$Wi = (44.5)/((P_1)^{0.23} \text{ X } (Gbp)^{0.82} (10/\sqrt{P} - 10/\sqrt{F}))$$

$$=(44.5)/((100)^{0.23} \text{ X } (1.647)^{0.82} (10/\sqrt{78.5} - 10/\sqrt{2030}))$$

= 11.3 kWh/short ton = 11.3 X 1.1 = **12.4 kWh/tonne**

The bond work index of the sample is determined to be 12.4 kWh/tonne.

Table 3.8
Feed size analysis

Size, micron	Cum. Wt., % Passing
3360	100.00
2000	79.24
1400	47.59
1000	32.15
850	21.90
500	15.32
212	8.86
150	5.95
100	4.18

Table 3.9
Size analysis of ground product

Size, micron	Cum Wt., % Passing
100	100.00
75	76.00
63	55.50
45	41.00
38	29.50

Table 3.10
Results of gram per revolution

No. of revolutions	100micron produced (g)	100micron in the feed (g)	Net -100micron produced (g)	Grindability (g/rev.)
100	268	66	202	2.020
218	604	11.2	593	2.717
157	488	25.2	463	2.947
146	316	20.4	296	2.019
217	396	13.2	383	1.762
247	428	16.6	411	1.665
261	450	17.9	432	1.658
261	450	18.8	431	1.651
262	451	18.8	432	1.647
263	451	18.9	432	1.644

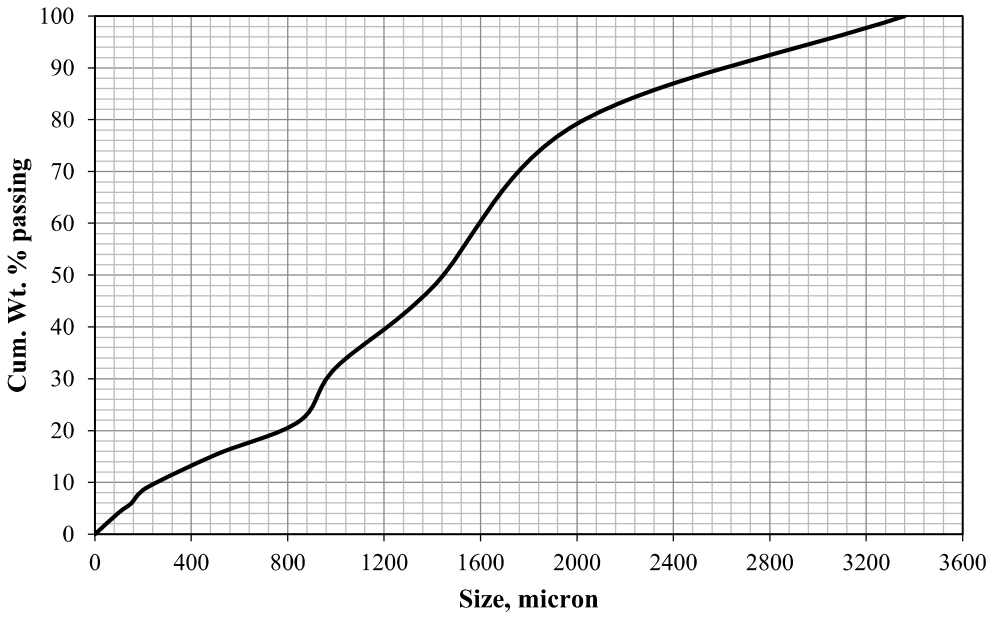


Fig. 3.4 Particle size distribution of feed

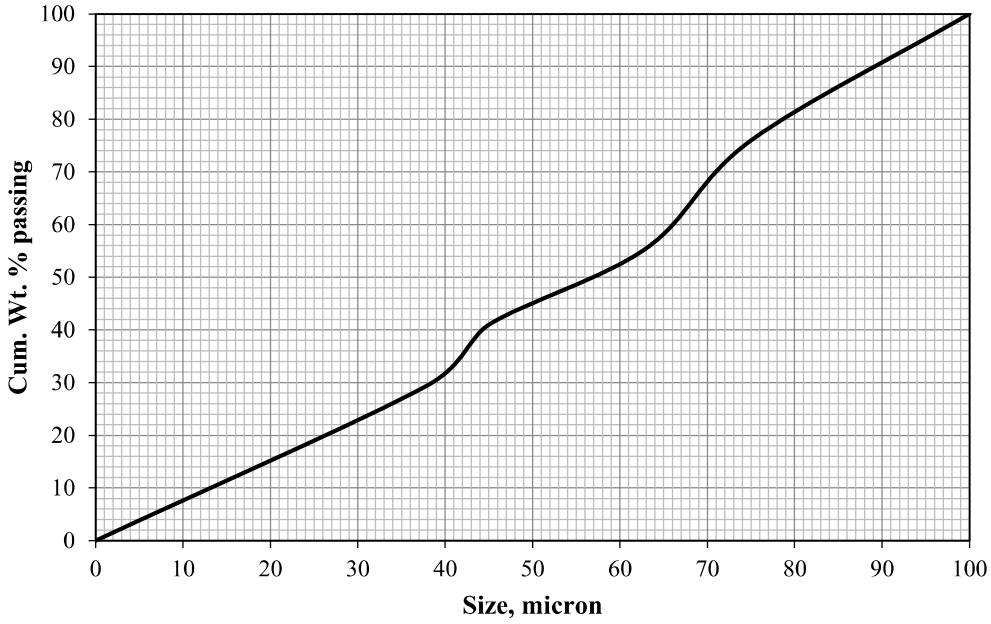


Fig. 3.5 Particle size distribution of product

3.6 Bulk Density

Bulk density is the weight of material in air per unit volume. It is measured by the help of a square sized metal container having length of each side 300 mm. Bulk density is evaluated by weighing a precisely measured known volume of ore sample. Natural moisture content is determined as per IS: 2720 (part 2) -1973. The bulk density of -10 mm sized sample is 1.982 kg/m^3 and its bulk density after being tapped is 3.178 kg/m^3.

3.7 Beneficiation Studies

The beneficiation study of the iron ore sample was carried out based on their mineralogy. According to size analysis studies, it contains good number of fine particles which may be iron phase minerals along with clay particles. In general, the fine clay particles are coated on the surface of the coarse particles. These clay minerals are responsible to increase the viscosity of slurry due to their swelling characteristics during the beneficiation process. Hence, it is essential to remove at the beginning of the process by scrubbing technique and discard as the reject. Hence the remaining materials can be processes smoothly for up-gradation of iron values by physical beneficiation. As it contains 12.96% of below 45

microns and the top size is below 10mm, hence for attrition of particles, screw scrubber process is most suitable. This equipment also classifies simultaneously the fine particles in a single stage. The laboratory screw scrubber was used for desliming the slime particles at the feed rate of 200 kg/hr using water to solid ratio of 70:30. The screw scrubber gives two products i.e., overflow (slimes) and underflow (coarse particles). The sample was fed to the screw scrubber. The Fe content of scrubber underflow could be achieved to 62.47% with overall yield of 80.90% and overflow fraction contained 53.61% Fe with overall yield of 19.10%. The result of screw scrubber is given in the Table 3.11. The result shows that screw scrubber underflow is one of the final product and overflow need to be further processed. Attempt was made to enhance the grade of scrubber underflow by further process.

Table 3.11
Screw scrubber study of bulk sample

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Underflow	80.90	80.90	62.47	62.47
Overflow	19.10	100.00	53.61	60.78
Total	100.00		60.78	

The underflow of screw scrubber was further classified into two different size fractions viz. (-10+1mm, and -1mm). The Fe content of -10+1 mm size could be achieved to 62.64% with overall yield of 59.42%. The Fe content of -1 mm size could be achieved to 62.01% with overall yield of 21.48%. The result of classified sample is given in Table 3.12. The result shows -10+1 mm is having slightly more higher Fe value compared to -1mm size fraction.

Table 3.12
Size classification of screw scrubber underflow

Size, mm	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
-10+1	59.42	59.42	62.64	62.64
-1	21.48	80.90	62.01	62.47
Total	80.90		62.47	

The -10+1 mm size fraction of sample was processed in the batch type laboratory jig (Supplied by All Minerals, Germany). In each batch around 50kg sample was taken during experiment. It is a hydraulic jig operated with pneumatic control pulsating system. The pulse frequency was kept 60 cycle per minute and air flow rate 0.3 to 0.4 bar. The screen

aperture used for bed was 1 mm size. After 30 minutes the material was collected from the chamber in layer by layer from top to bottom at particular thickness. The concentrate (Layer 1, Layer 2 and Layer 3) obtained by jigging of -10+1 mm fraction contains 63.19% Fe with yield of 65.79% and tailings contains 55.40% Fe with yield of 4.94 %. The jigging study of -10+1 mm sample is given in the Table 3.13.

Table 3.13
Jigging study on -10+1 mm size fraction material

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Layer 1	51.93	51.93	64.14	64.14
Layer 2	7.49	59.42	60.23	63.65
Layer 3	6.37	65.79	58.89	63.19
Layer 4	4.94	70.73	55.40	62.64
Total	59.42		62.44	

The -1 mm size samples was processed in the spiral concentrator. Roughing and cleaning operations were carried out to enrich the concentrate grade. In both operations of roughing and scavenging, 30% solid concentration was maintained. The capacity of spiral concentrator is 1 tonne per hour. The Fe content of rougher concentrate could be achieved to 63.22% with overall yield of 18.13%. The Fe contains of scavenging concentrate, scavenging tailings and tailing fines could achieved 60.18%, 59.17% and 52.33% with overall yield of 3.36 %, 2.53 % 0.90% respectively. The result of spiral concentrator is given in the Table 3.14.

Table 3.14
Spiral study of -1mm size fraction material

Details	Wt., %	Cum Wt., %	Fe, %	Cum. Fe, %
Rougher Concentrate	18.13	18.13	63.22	63.22
Scavenging Concentrate	3.36	21.48	60.18	62.75
Scavenging Tailings	2.53	24.01	59.17	62.37
Tailing Fines	0.90	24.91	52.33	62.01
Total	21.48		62.01	

The -10+1 mm size was further classified in two different size fractions viz. (-10+5 mm, and -5+1mm). The Fe content of -10+5 mm size could be achieved to 63.12% with overall yield of 30.17%. The Fe content of -5+1 mm size could be achieved to 62.14% with overall yield of 29.25 %. The result of classified sample is given in Table 3.15.

Table 3.15
Size classification of -10+1 mm fraction

Size, mm	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
-10+5	30.17	30.17	63.12	63.12
-5+1	29.25	59.42	62.14	62.64
Total	59.42		62.64	

The -10+5 mm and -5+1 mm size fraction of samples were processed in the batch type laboratory jig. In each batch around 50kg sample was taken for experiment. The pulse frequency was kept 60 cycle per minute and air flow rate 0.3 to 0.4 bar. The screen aperture used for bed was 1 mm size. After 30 minute the material was collected from the chamber in layers from top to bottom at particular thickness. The concentrate (Layer 1, Layer 2 and Layer 3) obtained by jigging of -10+5 mm fraction contains 62.74% Fe with yield of 28.06% and tailings contains 53.23% Fe with yield of 2.11%. The jigging study of -10+5 mm sample is given in Table 3.16. The concentrates (Layer 1, Layer 2 and Layer 3) obtained by jigging of -5+1 mm fraction contains 62.74 % Fe with yield of 27.41 % and tailings contains 53.23% Fe with yield of 1.84%. The jigging study of -5+1 mm sample is given in Table 3.17.

Table 3.16
Jigging study on -10+5 mm size fraction material

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Layer 1	22.15	22.15	64.12	64.12
Layer 2	3.19	25.35	60.08	63.26
Layer 3	2.72	28.06	59.07	62.74
Layer 4	2.11	30.17	53.23	62.14
Total	30.17		62.14	

Table 3.17
Jigging study on -5+1 mm size fraction material

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Layer 1	18.89	18.89	64.12	64.12
Layer 2	5.09	23.98	60.08	63.26
Layer 3	3.43	27.41	59.07	62.74
Layer 4	1.84	29.25	53.23	62.14
Total	29.25		62.14	

The overflow of screw scrubber is to be deslimed by hydrocyclone to remove the ultrafine gangue minerals directly. The screw scrubber overflow sample was fed to the rougher hydrocyclone. The hydrocyclone gives two products i.e., overflow (very ultrafine slimes particle) and underflow (fine coarse particles). The Fe content of hydrocyclone underflow could be achieved to 57.52% Fe with overall yield of 11.33% and overflow fraction contained 47.90% Fe with overall yield of 7.77%. The rougher hydrocyclone overflow sample was fed to the scavenging hydrocyclone at the density 1040 kg/m^3. The Fe content of scavenger hydrocyclone underflow could be achieved to 54.45% Fe with overall yield of 1.26% and overflow fraction contained 46.63% Fe with overall yield of 6.51%. The rougher and scavenging hydrocyclone study are given in Table 3.18 and 3.19.

Table 3.18
Rougher hydrocyclone study of screw scrubber overflow

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Underflow	11.33	11.33	57.52	57.52
Overflow	7.77	19.10	47.90	53.61
Total	19.10		53.61	

Table 3.19
Scavenging hydrocyclone study

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Underflow	1.26	1.26	54.45	54.45
Overflow	6.51	7.77	46.63	47.90
Total	7.77		47.90	

If the overflow of hydrocyclone contains ultrafine hematite particles and are not the discardable, then the screw scrubber overflow will be beneficiated directly using WHIMS/HGMS.

The rougher and scavenging hydrocyclone underflow were blended together and given in Table 3.20. The blended material fed to LONGI. The intensity of magnetic separator (Longi) having 12000 gauss in pilot scale. The result of rougher LONGI study is given in the Table 3.21. The Fe content of the rougher magnetic fraction could be enhanced to 62.15% Fe with overall yield of 8.22%. The rougher middling could be achieved 57.44% Fe with overall Yield of 1.00 % and non-magnetic fraction from rougher tailings contains 45.10% Fe with overall yield of 3.37%. The rougher tailings of LONGI was further fed to scavenger stage of LONGI. The Fe content of the scavenging magnetic fraction could be

enhanced to 56.39% Fe with overall yield of 1.00%. The scavenging middling contains 44.79% Fe with overall Yield of 0.26% and non-magnetic fraction from scavenging tailings contains 39.79%Fe with overall yield of 2.11%. The result of scavenger LONGI is given in the Table 3.22.

Table 3.20
Blending of hydrocyclone underflows

Details	Wt., %	Cum Wt., %	Fe, %	Cum. Fe, %
Rougher hydrocyclone underflow	11.33	11.33	57.52	57.52
Scavenging hydrocyclone underflow	1.26	12.59	54.45	57.21
Total	12.59		57.21	

Table 3.21
LONGI study of blended product

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Mag	8.22	8.22	62.15	62.15
Middling	1.00	9.22	57.44	61.64
Non-Mag	3.37	12.59	45.10	57.21
Total	12.59		57.21	

Table 3.22
LONGI scavenging study

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Mag	1.00	1.00	56.39	56.39
Middling	0.26	1.26	44.79	54.00
Non-Mag	2.11	3.37	39.79	45.10
Total	3.37		45.10	

The overflow of hydrocyclone was fed to HGMS (supplied by LONGI). The magnetic intensity of LONGI is 12000 gauss. The feed density was kept at 1.06 kg/m^3. The Fe content of the rougher magnetic fraction of LONGI could be achieved to 57.78 % Fe with overall yield of 1.81% whereas non-magnetic fraction contains 41.58% Fe with overall yield of 4.24 %. The rougher non-magnetic fraction was fed to the scavenging LONGI. The Fe content of the scavenging magnetic fraction of LONGI could be achieved to 43.21% Fe with overall yield of 0.82% and non-magnetic fraction contains 41.12% Fe with overall yield of 3.06%. The rougher and scavenging magnetic separation results are given in Table 3.23 and 3.24.

Table 3.23
LONGI study of hydrocyclone overflow

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Mag	1.81	1.81	57.78	57.78
Middling	0.46	2.27	49.28	56.06
Non-Mag	4.24	6.51	41.58	46.63
Total	6.51		46.63	

Table 3.24
LONGI scavenging study

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Mag	0.82	0.82	43.21	43.21
Middling	0.35	1.18	41.76	42.78
Non-Mag	3.06	4.24	41.12	41.58
Total	4.24		41.58	

Based on the above study and considering on the quality and quantity on the final product, following process were carried out. The beneficiation study was carried out by using screw scrubbing of the ROM sample followed by the Magnetic separation of the screw scrubber overflow and scavenging magnetic separation of rougher non-magnetic fraction. The results are given in the Table 3.25 to Table 3.27. The overall product is given in the Table 3.28 and the overall reject is given in the Table 3.29. The process flowsheet is shown in Figure 3.7. The chemical analysis of the product and reject are given in Table 3.30 and 3.31 respectively.

Table 3.25
Scrubbing study of bulk sample

Details	Wt., %	Cum Wt., %	Fe, %	Cum. Fe, %
Underflow	80.90	80.90	62.47	62.47
Overflow	19.10	100.00	53.61	60.78
Total	100.00		60.78	

Table 3.26
Rougher magnetic separation study of screw scrubber overflow

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Mag	10.03	10.03	61.36	61.36
Middling	1.46	11.49	54.87	60.54
Non-Mag	7.61	19.10	43.14	53.60
Total	19.10		53.61	

Table 3.26
Rougher magnetic separation study of screw scrubber overflow

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Mag	8.22	8.22	62.15	62.15
Middling	1.46	9.68	55.87	61.18
Non-Mag	9.42	19.10	45.80	53.61
Total	19.10		53.61	

Table 3.27
Scavenging magnetic separation study of rougher non-magnetic fraction

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Mag	2.81	2.81	58.66	58.66
Middling	0.61	3.42	45.66	56.34
Non-Mag	7.46	10.88	42.94	47.15
Total	10.88		47.15	

Table 3.28
Overall products

Details	Wt., %	Fe, %
Screw Scrubber underflow	80.90	62.47
Rougher MS Conc.	8.22	62.15
Scavenger MS Conc.	2.81	58.66
Total	91.93	62.32

Table 3.29
Overall rejects

Details	Wt., %	Fe, %
Scavenger Middling	0.61	45.66
Scavenger Tailings	7.46	42.94
Total	8.07	43.15

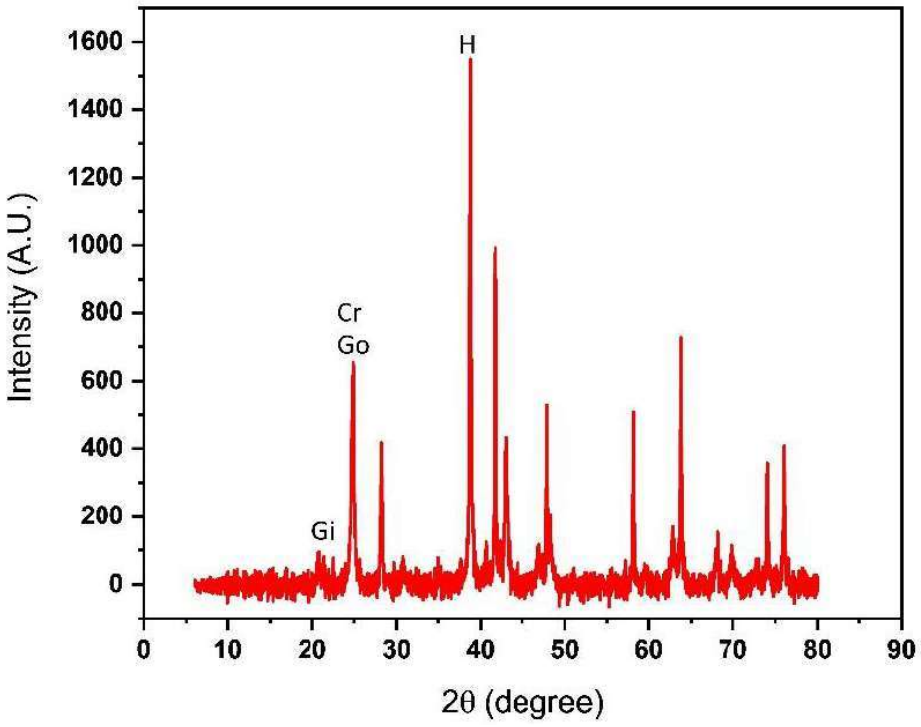
Table 3.30
Chemical analysis of the product

Details	Scrubber Underflow	Rougher Mag.	Scavenger Mag.	Overall Product
Fe (T)	62.47	62.15	58.66	62.32
Fe_2O_3	89.33	88.87	83.88	89.12
SiO_2	1.75	1.9	3.29	1.81
Al_2O_3	2.74	3.41	6.58	2.92
LOI	5.85	5.79	6.23	5.86

Table 3.31
Chemical analysis of the reject

Details	Percentage
Fe (T)	43.00
Fe_2O_3	61.49
SiO_2	13.72
Al_2O_3	17.70
LOI	7.01

XRD study was carried out on the product sample to determine the major minerals present in the samples. The XRD results is shown in Fig. 3.6. It indicates that the product sample have hematite as the major mineral phase and other minor minerals are quartz, goethite, cristobilite and quartz.



H: Hematite, Go: Goethite, Gi: Gibbsite, Cr: Cristobilite

Fig. 3.6 XRD study of product sample

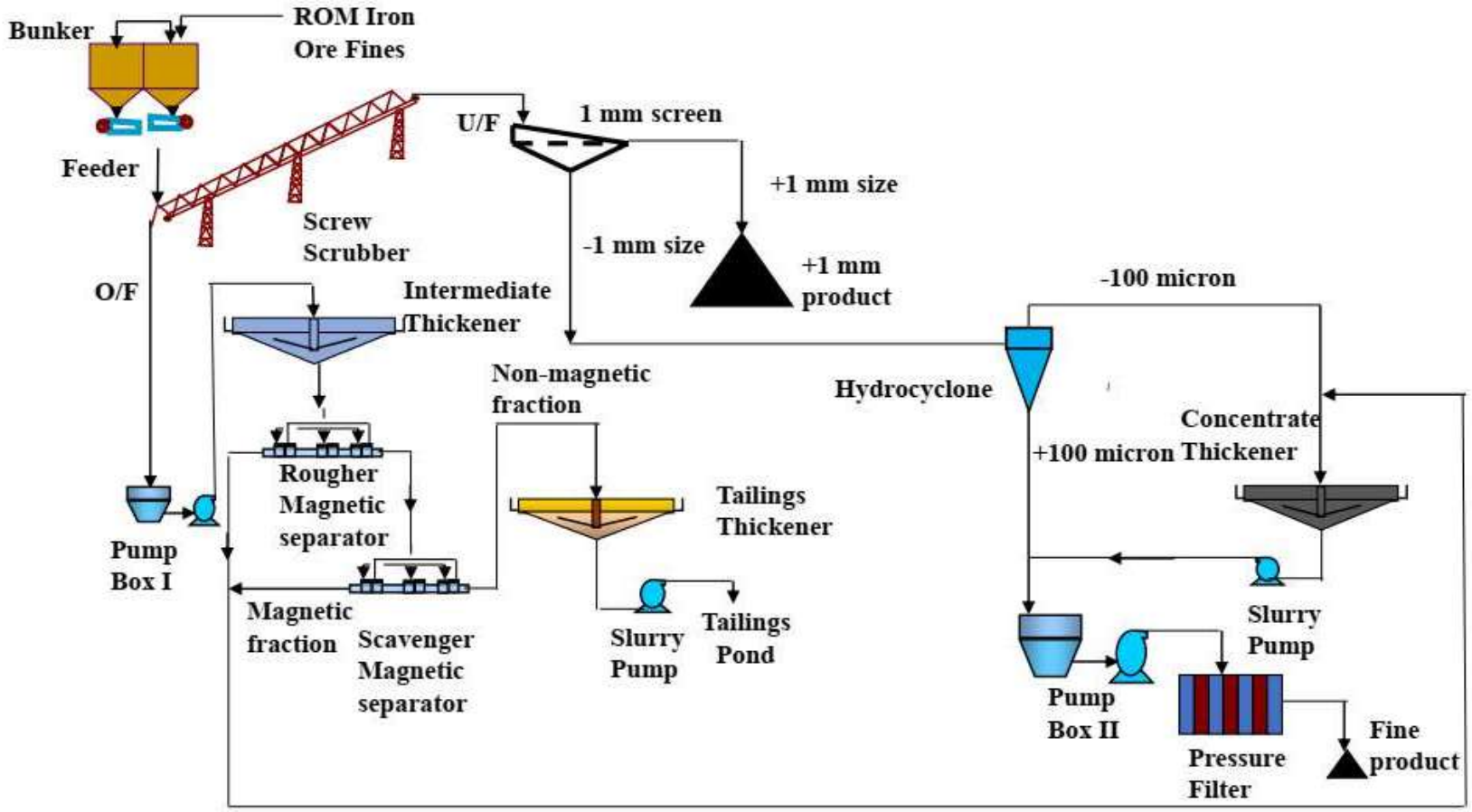


Fig. 3.7 Process flowsheet for washing of low-grade iron ore of Narayanposhi

3.8 Pressure Filtration Study

The pressure filtration study of magnetic separation concentrate and tailings were carried out by using Diemme Filter press and the results are given in Table 3.32 and 3.33. The pressure filter used for experiment is shown in Fig. 3.8.



Fig. 3.8 Pilot scale pressure filter set up

Table 3.32
Pressure filtration result of magnetic separation concentrate

Parameters	Exp. 1
Solid % in feed	60
Feeding time, min	15
Feeding pressure, bar	6
Air purging time, min	7.5
Air purging pressure, bar	8
Squeezing time, min	7.5
Squeezing pressure, bar	11
Total filtration time, min	30
Weight of cake (Wet), Kg	45.5
Cake Thickness, mm	20
Filtrate (water)	30
Cake moisture, %	17.2

Table 3.33
Pressure filtration result of magnetic separation tailings

Parameters	Exp. 1
Solid % in feed	32
Feeding time, min	15
Feeding pressure, bar	7
Air purging time, min	10
Air purging pressure, bar	8
Squeezing time, min	10
Squeezing pressure, bar	13
Total filtration time, min	35
Cake Thickness, mm	18.0
Cake moisture, %	21.8

3.9 Settling Studies

3.9.1 Materials Preparation

After processing of the iron ore, the tailing and concentrate samples were taken for the settling study to provide the basic data for design of thickeners for tailings and concentrate.

3.9.2 Experimental Method

The settling study was carried out in a graduated measuring cylinder of 1 liter capacity. Different solid concentration like 20% to 30% in increment of 5% of concentrate and 5% to 10% in the increment of 2.5% tailing samples are prepared. The pH of the concentrate sample was maintained at 6.5 and the pH of tailing is also 6.5. This is due to pH as the received in the process. The interface height was observed against the time intervals. The interface level with respect to time was recorded in each case.

3.9.3 Results and Discussion

The settling study was carried out on concentrate sample at different solids concentration of 20%, 25% and 30%. The pH of the sample was kept at 6.5 as the sample was received from the process at the same pH. The results of experiments were shown in Figures 3.9 to 3.12. It has been observed that the settling rate decreases with increasing of solid percentage. In case of 20% of solid concentration, the settling rate is 1.5 m/hr. Different dosses of flocculent was used to enhance the settling rate of solid. Very low doses of

flocculent is required at lower solid concentration to get satisfactory results to design the conventional thickener. At higher solid concentration, the flocculent dosage requirement is little high.

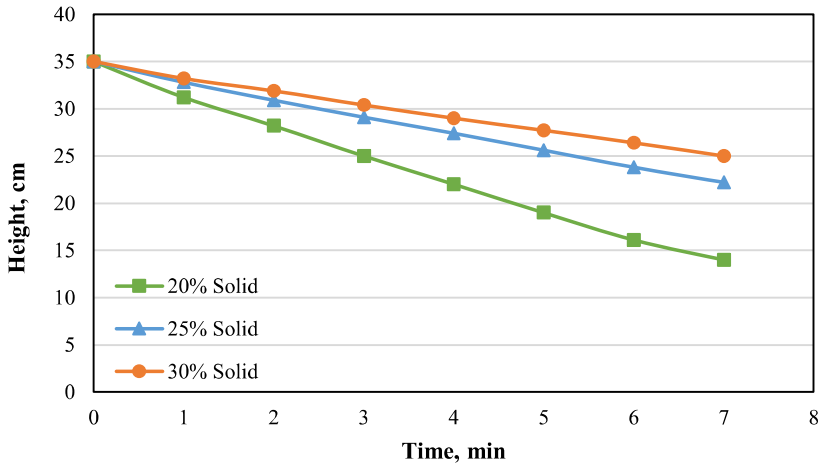


Fig. 3.9 Settling study of iron ore concentrate at different solid concentration

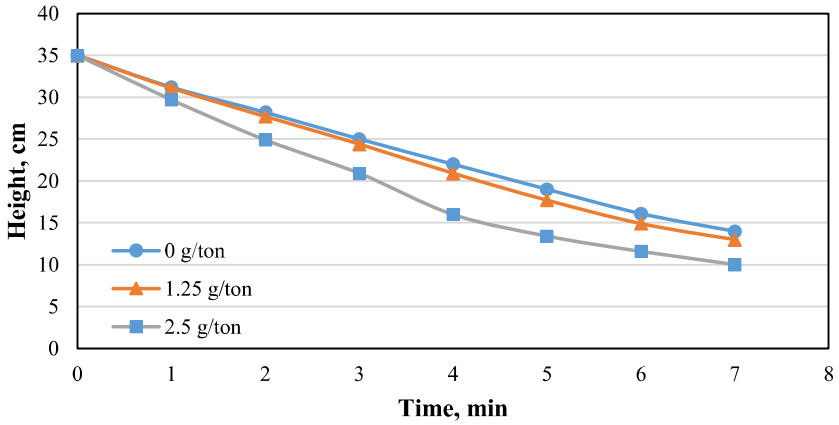


Fig. 3.10 Iron ore concentrate settling study at 20% solid concentration with different doses of flocculent

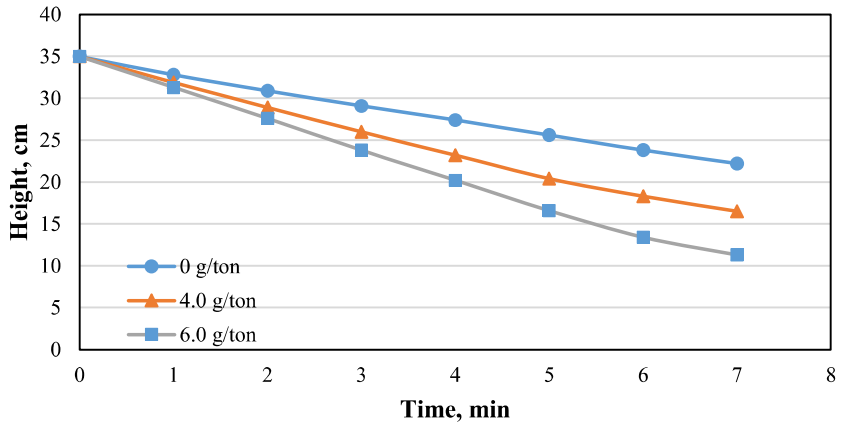


Fig. 3.11 Iron ore concentrate settling study of 25% solid concentration with different doses of flocculent.

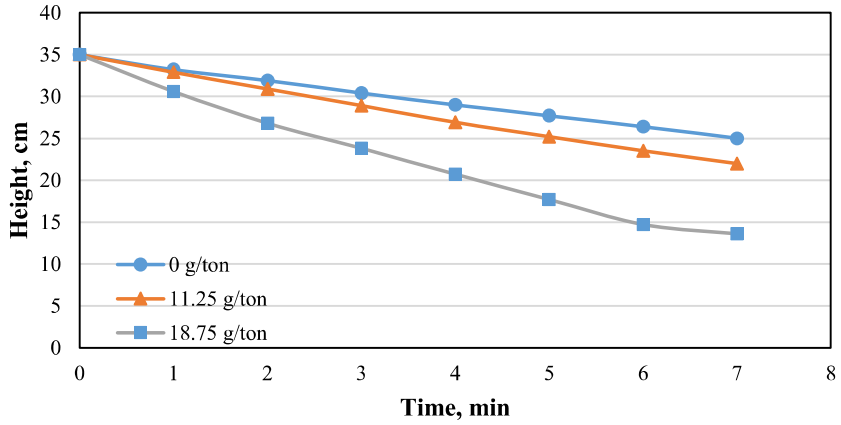


Fig. 3.12 Iron ore concentrate settling study of 30% solid concentration with different doses of flocculent.

Similarly settling studies of iron ore tailings were carried out at different concentration of 5%, 7.5% and 10%. The tests were carried out without and with addition of flocculent. The tests results are shown in Figure 3.13 to 3.16. It has been observed that the settling rate decreases with increasing of solid percentage. In case of 5% of solid concentration, the settling rate is 2 m/hr whereas in case 15 %, the settling rate is 0.8 m/hr. The flocculent rate was varied from 6.52 gm/tonne to 30 gm/tonne of solid. The settling rate with flocculent is very high at lower solid concentration. It indicates that after 5% solid concentration, the

flocculent may require at lower dosage to enhance the settling rate. At higher solid concentration, the flocculent dosage requirement is high. At 10% solid concentration, the settling rate is very poor even after adding the flocculent.

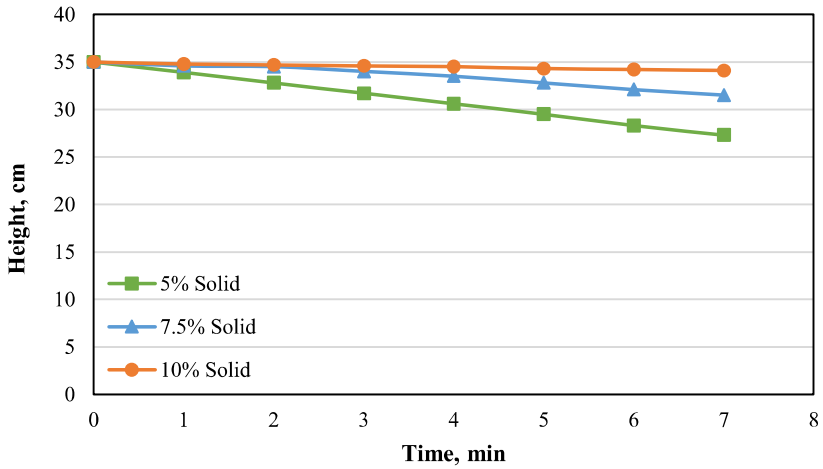


Fig. 3.13 Iron ore tailings settling study of different solid concentration

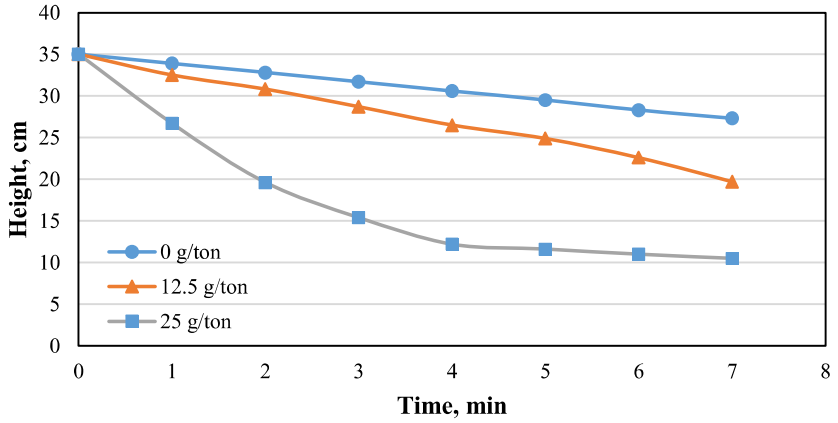


Fig. 3.14 Iron ore tailings settling study at 5% solid concentration with different doses of flocculent

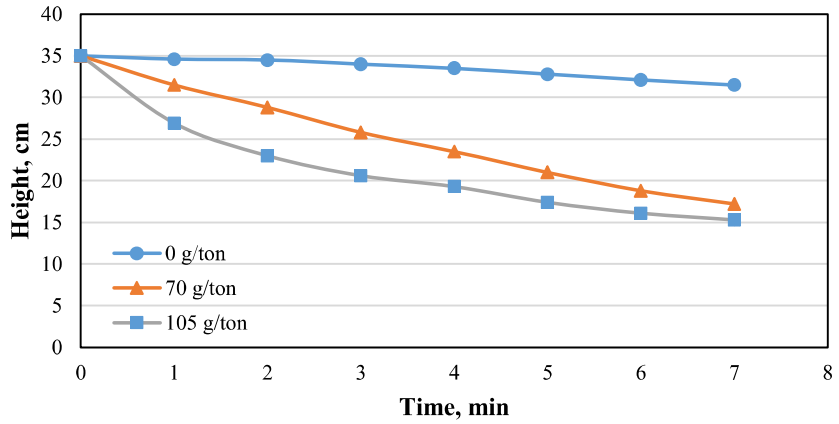


Fig. 3.15 Iron ore tailings settling study at 7.5% solid concentration with different doses of flocculent

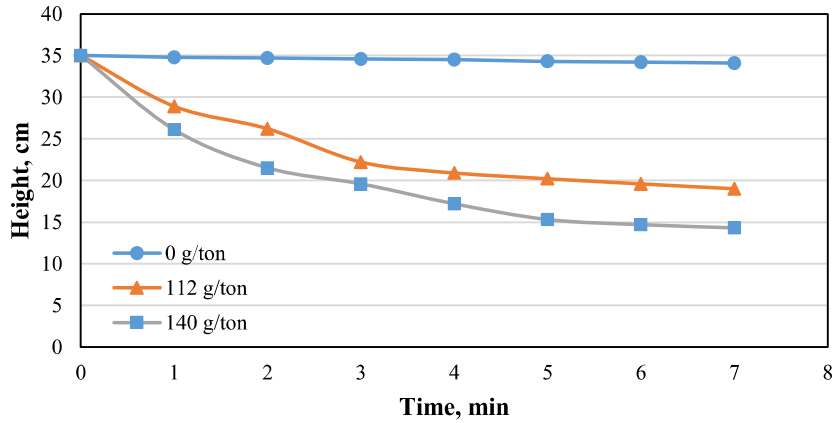


Fig. 3.16 Iron ore tailings settling study at 10% solid concentration with different doses of flocculent

3.10 Conclusions

The results of settling studies indicate the following observations;

1. The settling rate in case of tailings sample is very slow due to presence of ultra-fine clay minerals. Because of its surface charge, those try to remain in dispersion mode. The flocculent helps to neutralize the surface charge and make agglomerates the ultra-fine particles, as a result, the settling rate enhances.

2. The settling rate for conventional thickener design is required around 20 cm within 5-6 minutes. The above results are matching these phenomena.
3. For concentrate sample, small dose of flocculants was required to be added as there was less clay mineral compared to the tailings.

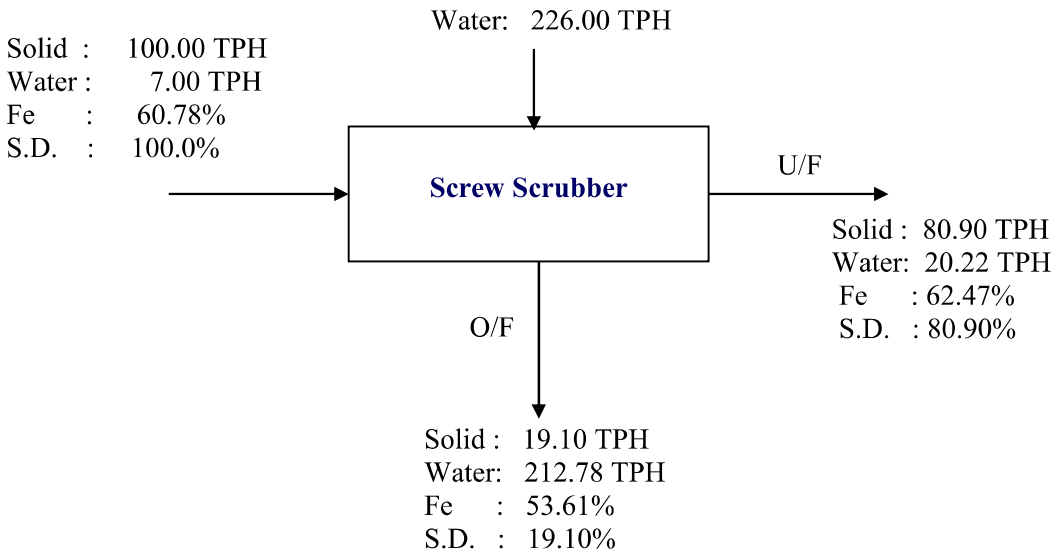
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Annexure II.A

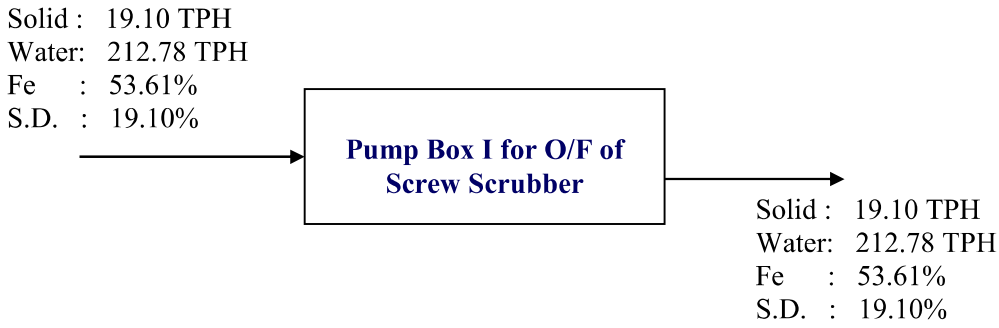
Material Balance of Process (Narayanposhi Iron ore)

Basis: 100 TPH

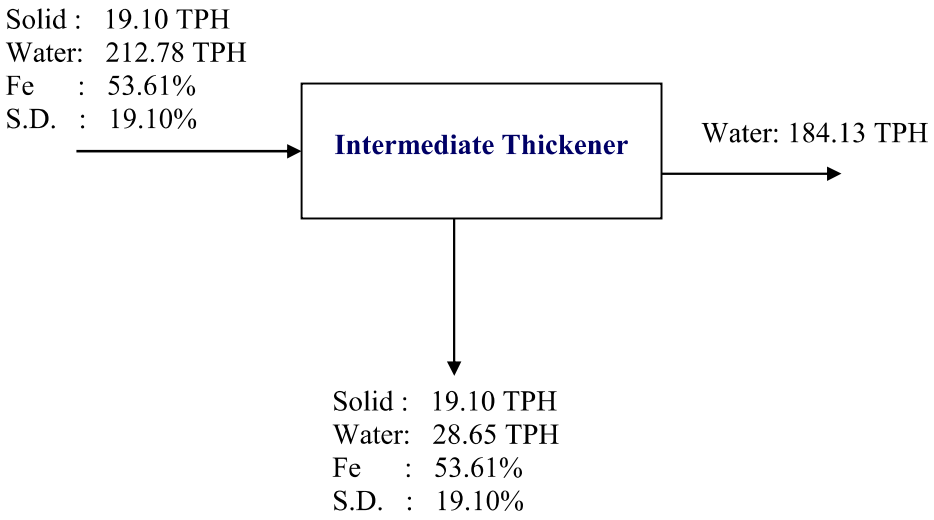
1. Screw Scrubber



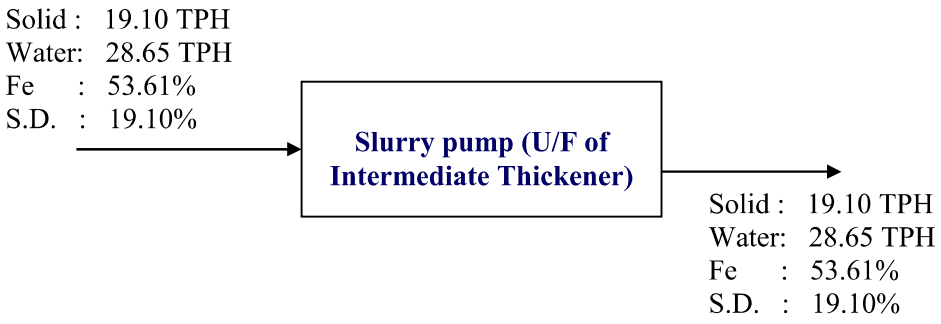
2. Pump Box I (O/F of Screw Scrubber)



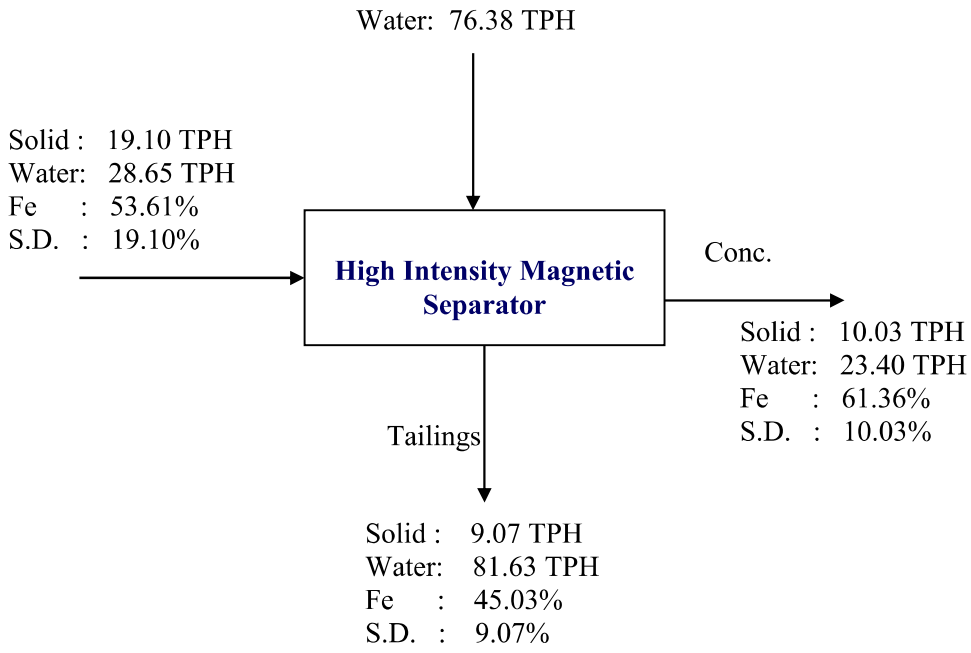
3. Intermediate Thickener



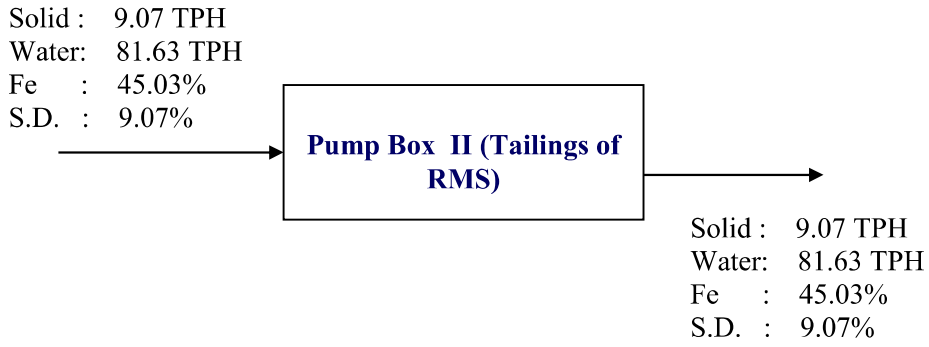
4. Slurry Pump I (U/F of intermediate thickener)



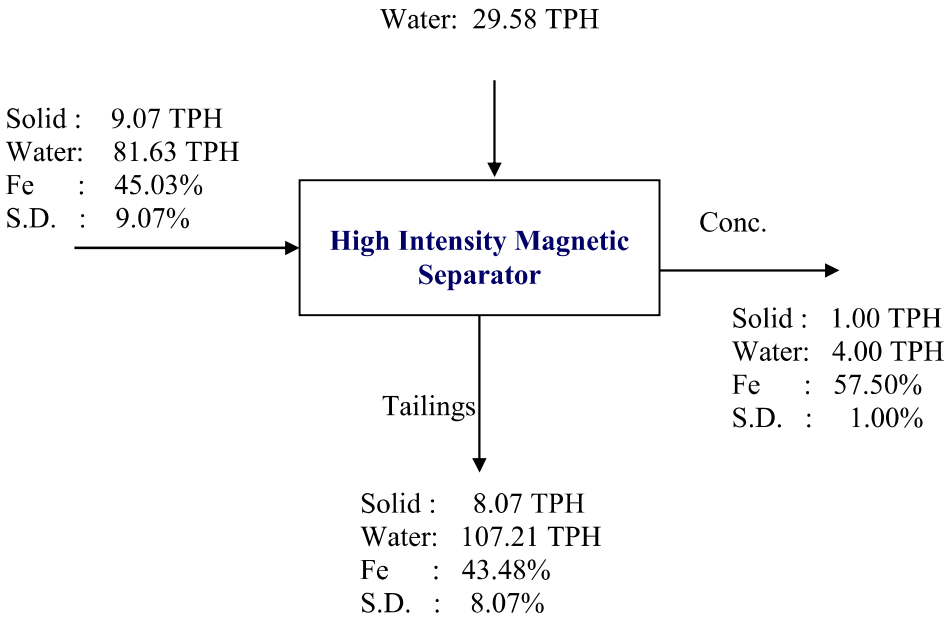
5. High Intensity Rougher Magnetic Separator



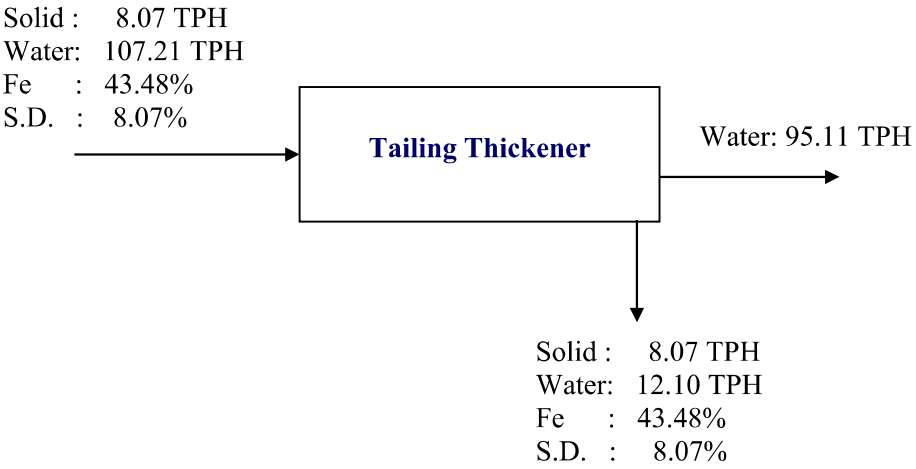
6. Pump Box II (Tailings of RMS)



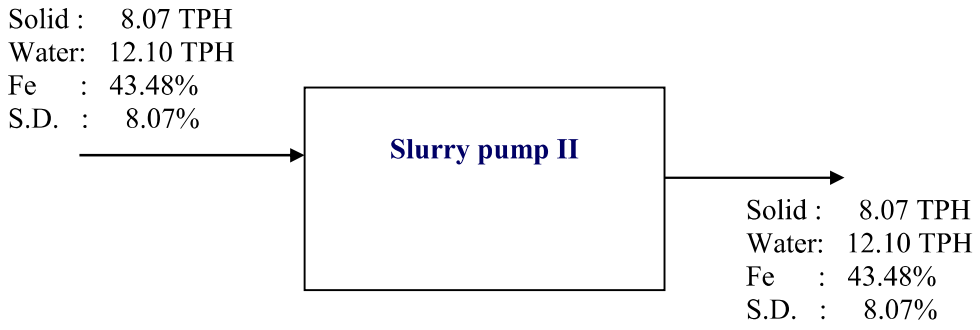
7. High Intensity Scavenging Magnetic Separator



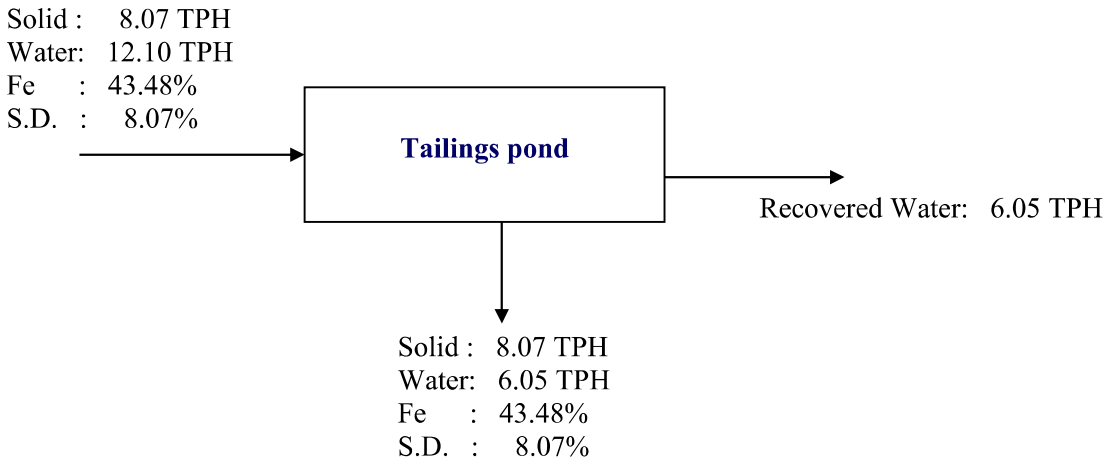
8. Tailing Thickener



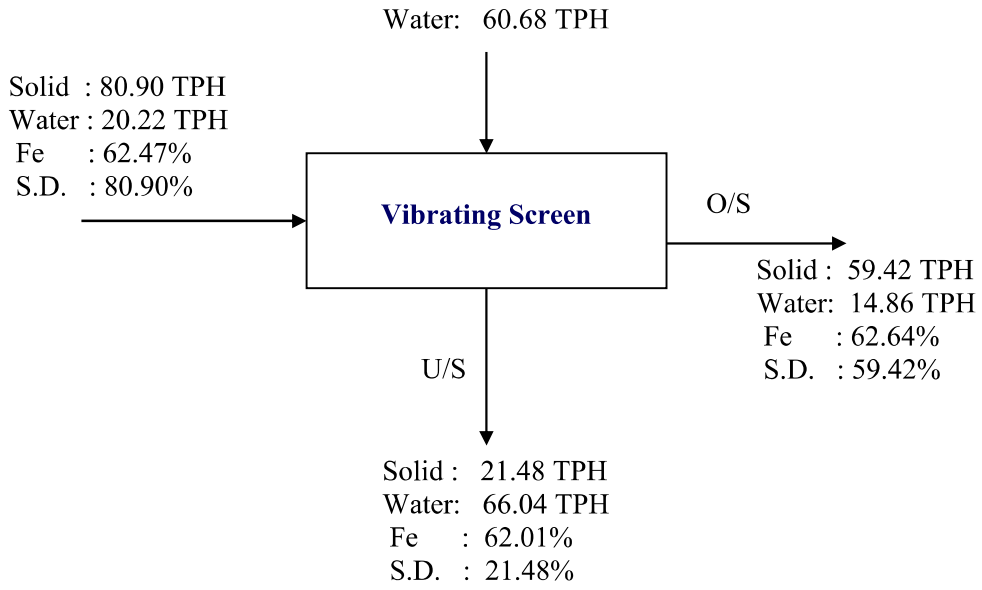
9. Slurry Pump II



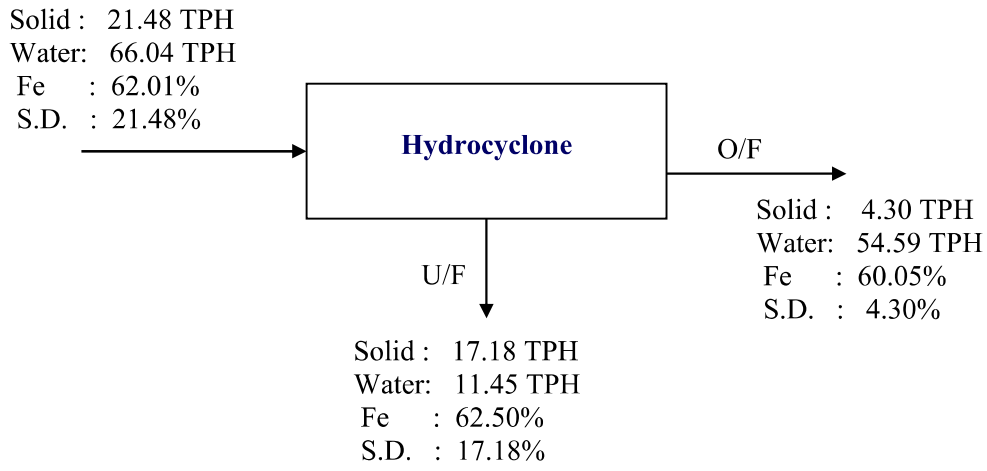
10. Tailings Pond



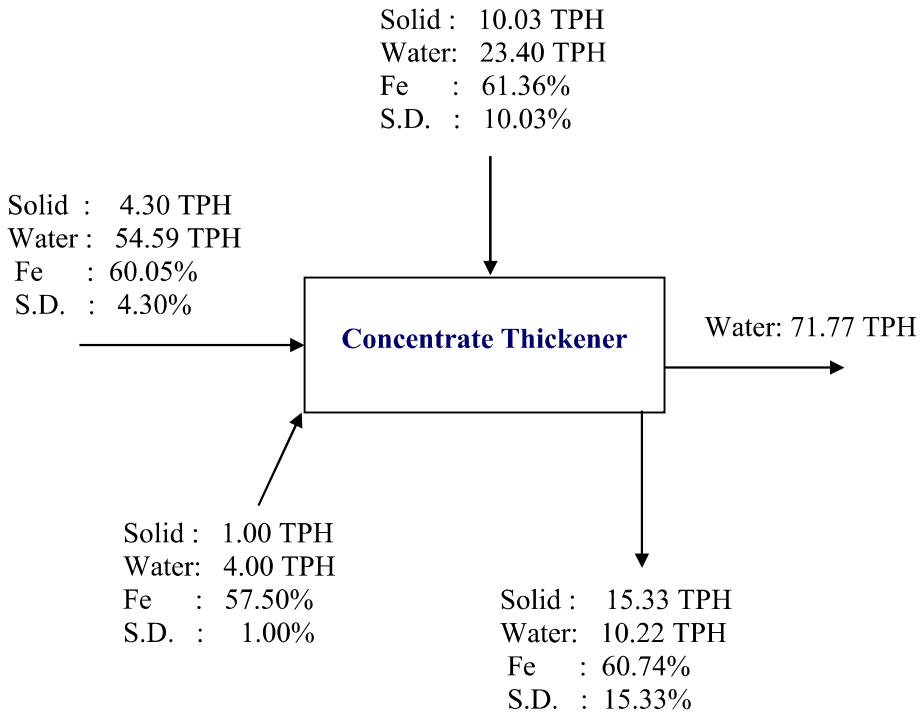
11. Vibrating Screen (1 mm size)



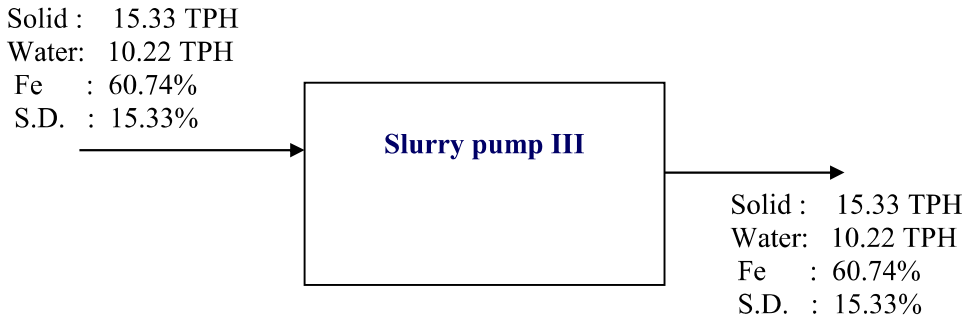
12. Hydrocyclone



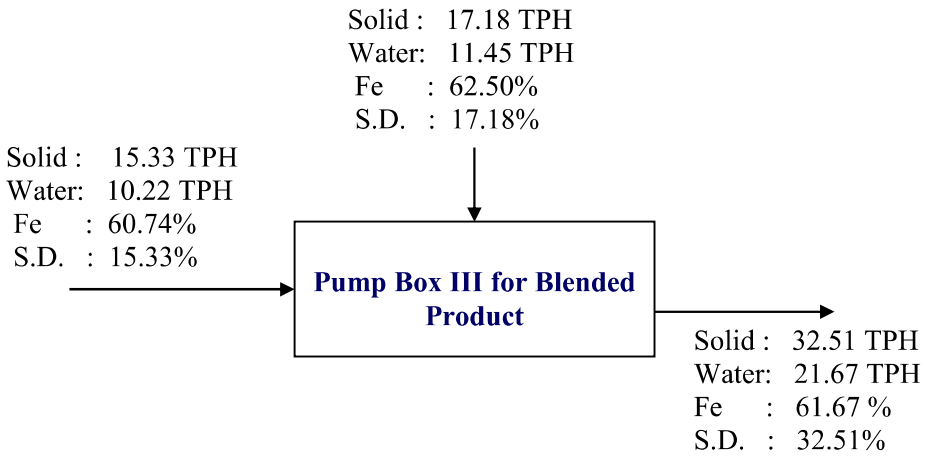
13. Concentrate Thickener



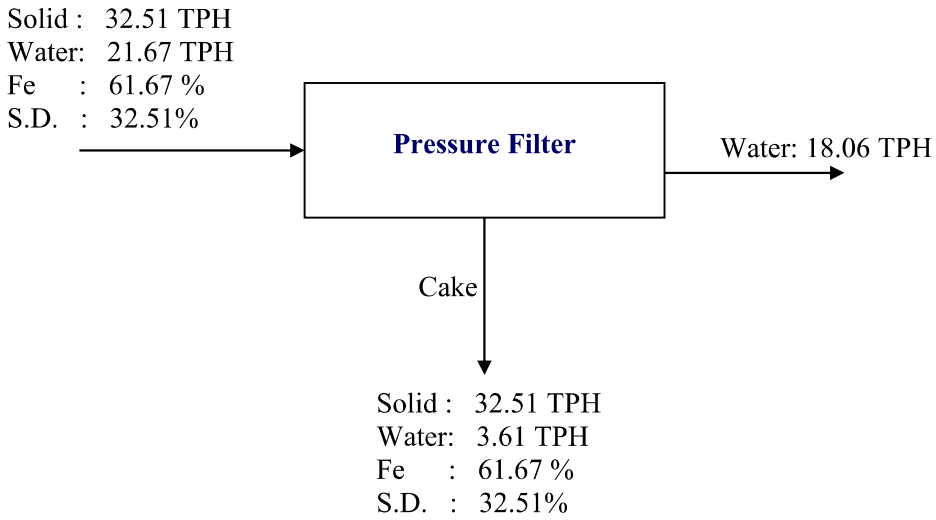
14. Slurry Pump III (Underflow of CT)



15. Pump Box III (Blended Product)



16. Pressure Filter



Water Balance

A. Water Handling

Sl. No.	List of Equipment	Water Addition, TPH
1	Bulk Sample	7.00
2	Screw Scrubber	226.00
3	Vibrating Screen	60.68
4	Rougher Magnetic Separator	76.38
5	Scavenger Magnetic Separator	29.58
Total		**399.64**

B. Water Recovered

Sl. No.	List of Equipment	Water recovered, TPH
1	Intermediate Thickener	184.13
2	Concentrate Thickener	71.77
3	Pressure Filter	18.06
4	Tailings Thickener	95.11
5	Tailing Pond	6.05
Total		**375.12**

C. Water Contains in Products

Sl. No.	Name of the Product	Water Contain, TPH
1	Pressure Filter	3.61
2	Vibrating screen	14.86
3	Tailing pond	6.05
Total		**24.52**

D. Make up water

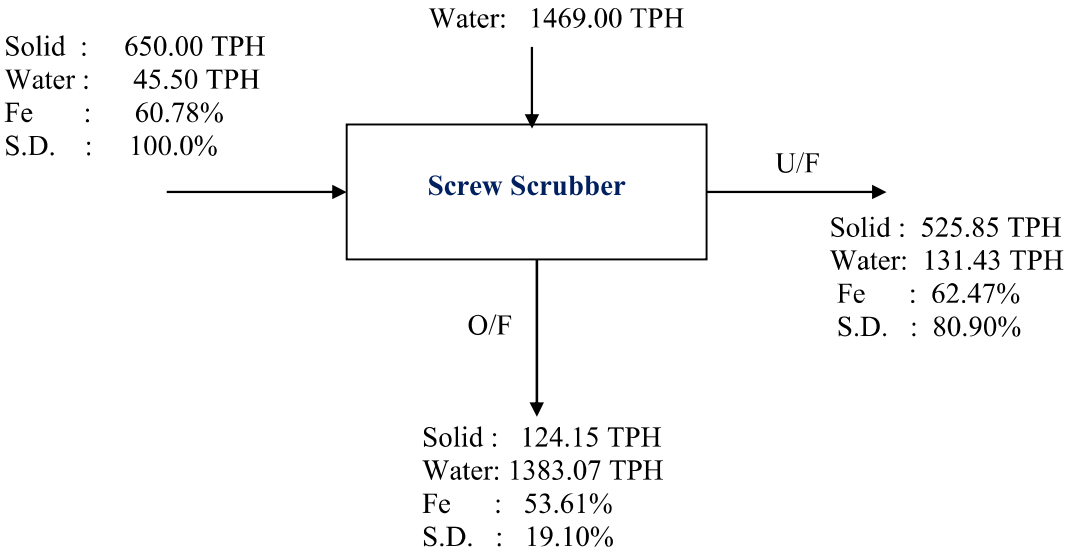
Sl. No.	Name of the Product	Water Contain, TPH
1	Water content in products	18.47
2	Water content in tailings	6.05
3	1% of handling loss	4.00
Total		**28.52**

Annexure II.B

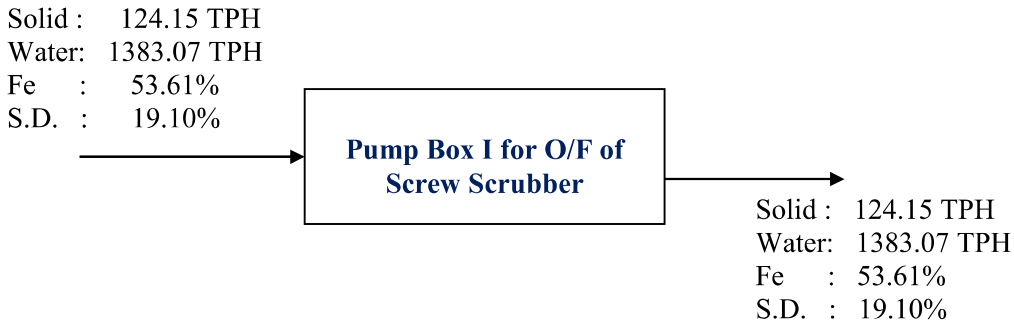
Material Balance of Process (Narayanposhi Iron ore)

Basis: 650 TPH

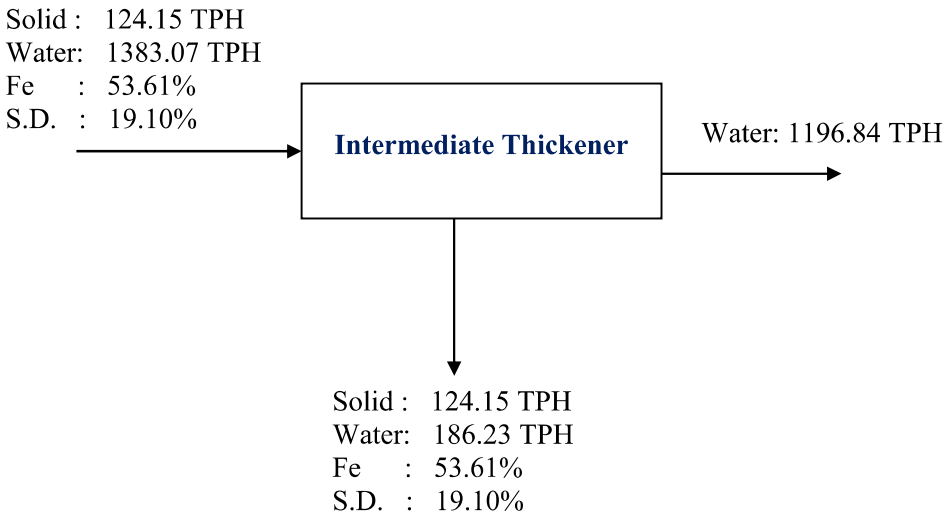
1. Screw Scrubber



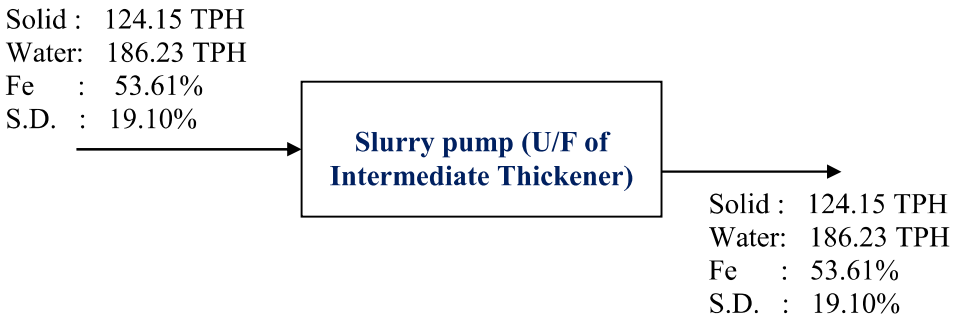
2. Pump Box I (O/F of Screw Scrubber)



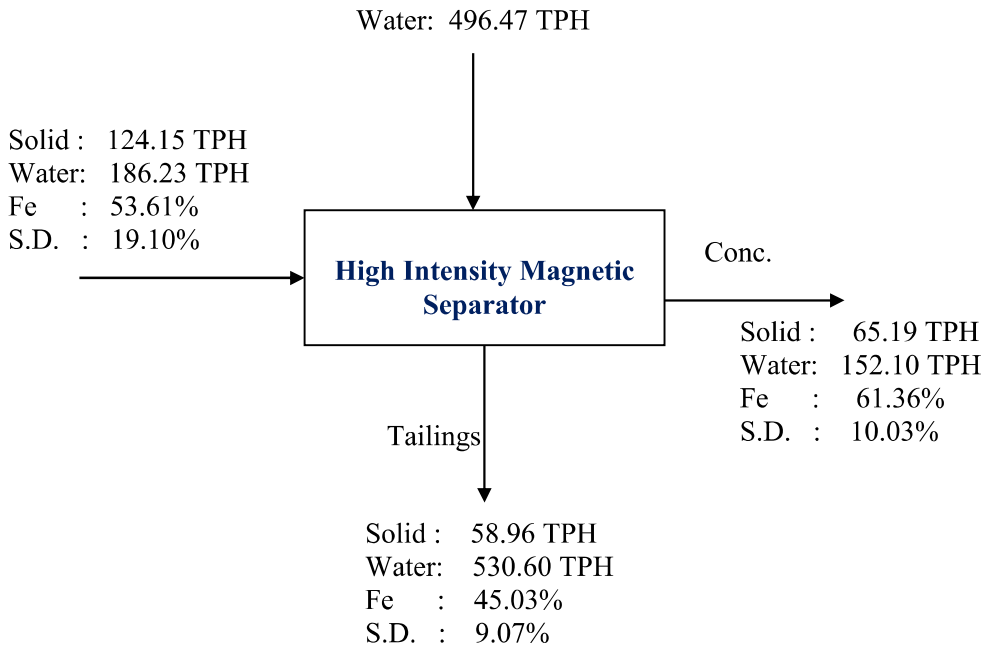
3. Intermediate Thickener



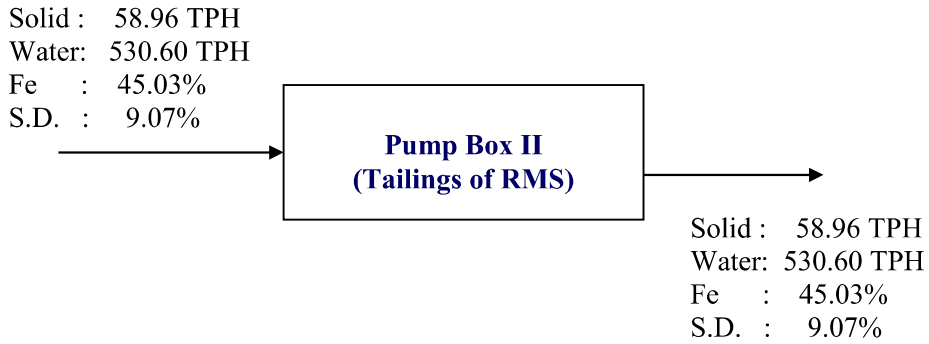
4. Slurry Pump I (U/F of intermediate thickener)



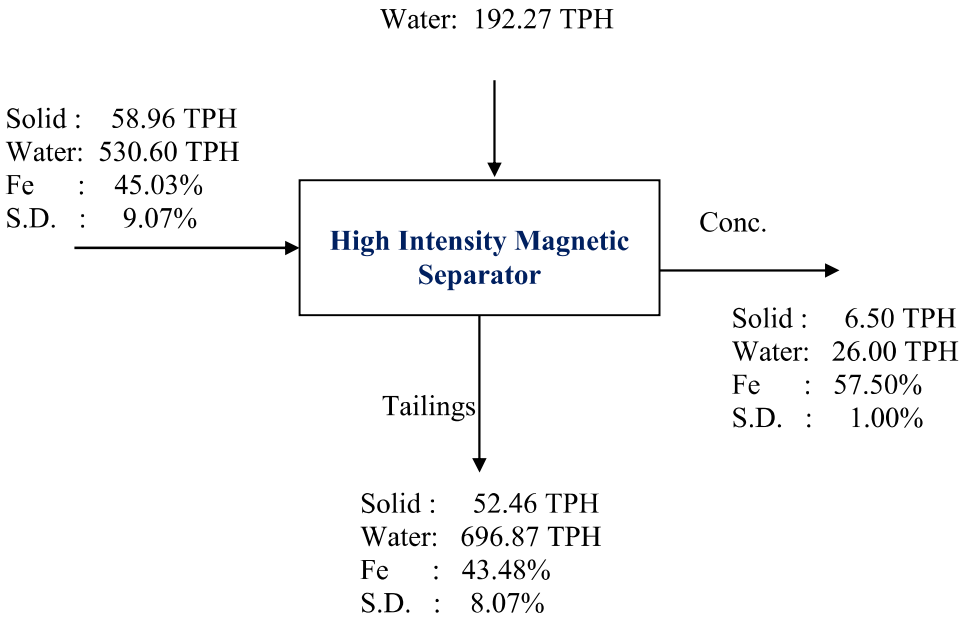
5. High Intensity Rougher Magnetic Separator



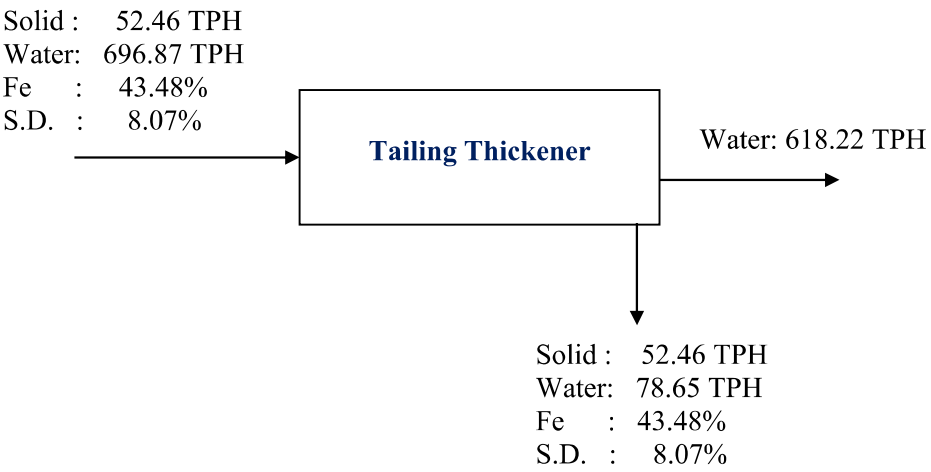
6. Pump Box II (Tailings of RMS)



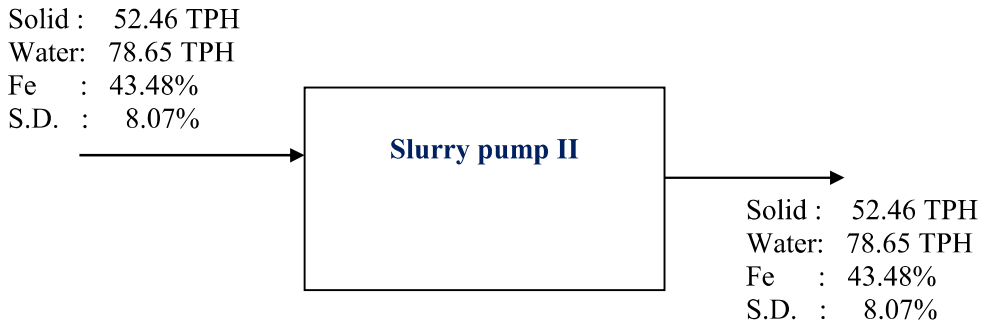
7. High Intensity Scavenging Magnetic Separator



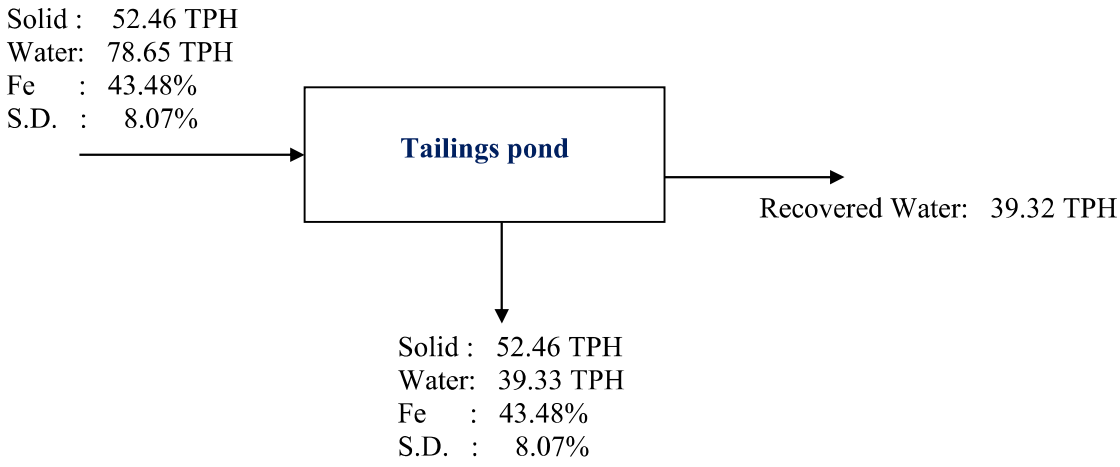
8. Tailing Thickener



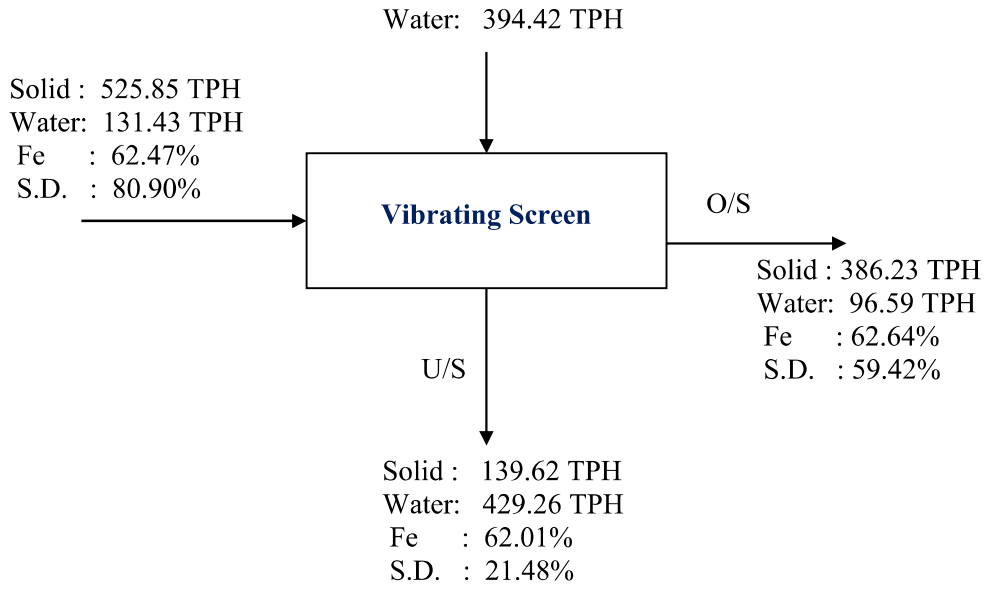
9. Slurry Pump II



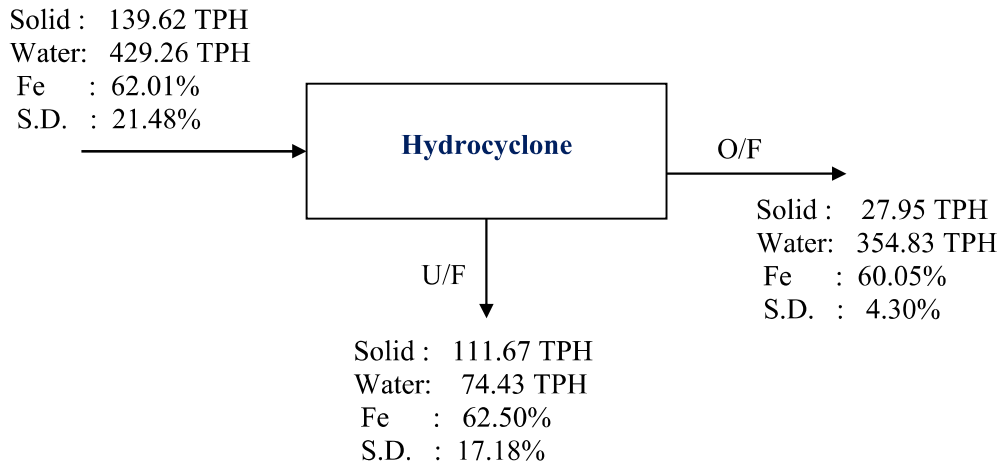
10. Tailings Pond



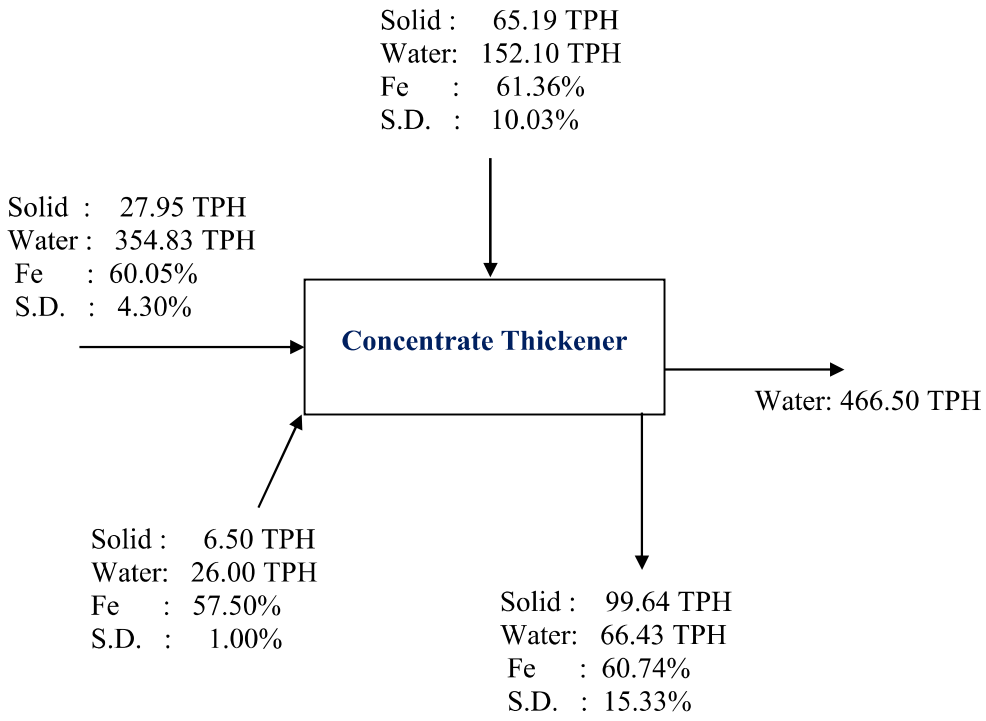
11. Vibrating Screen (1 mm size)



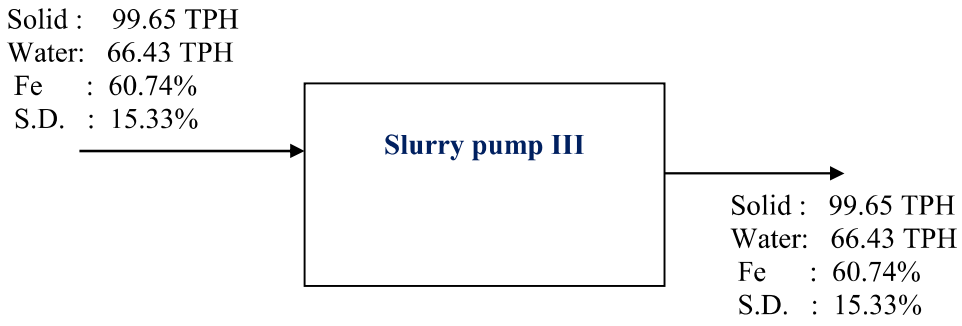
12. Hydrocyclone



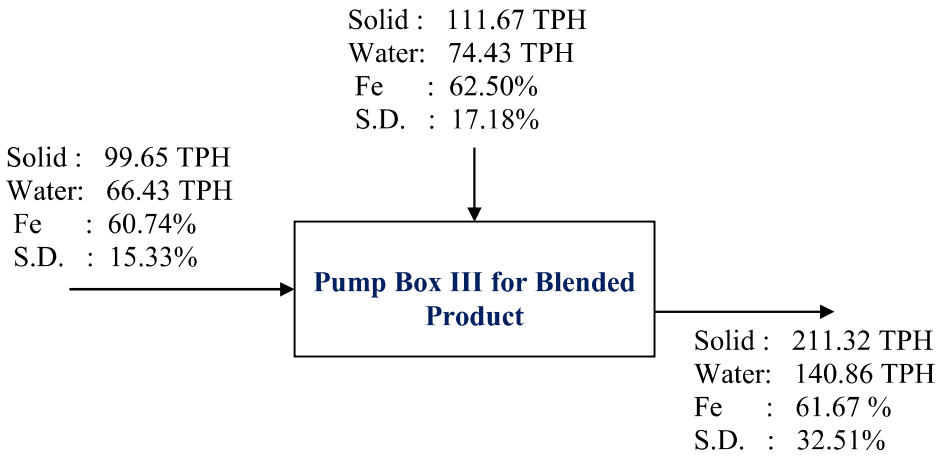
13. Concentrate Thickener



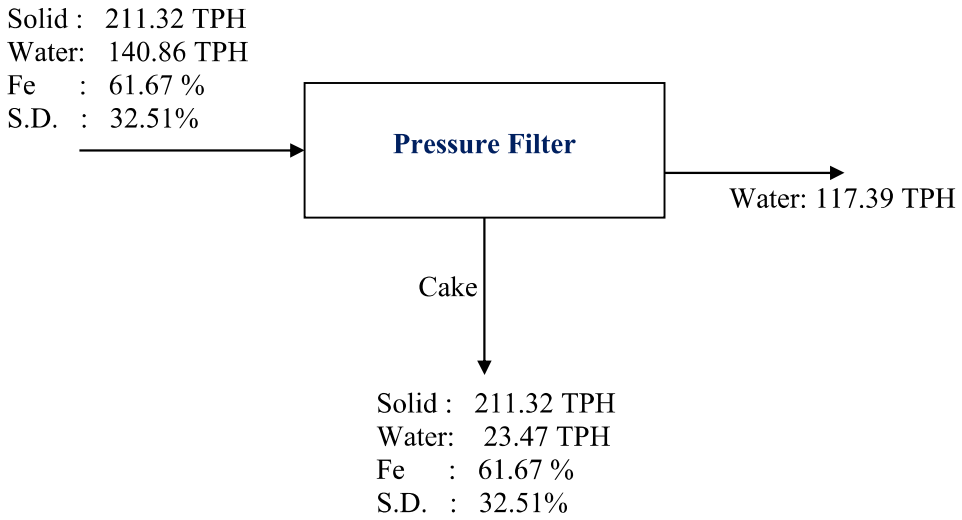
14. Slurry Pump III (Underflow of CT)



15. Pump Box III (Blended Product)



16. Pressure Filter



Water Balance

A. Water Handling

Sl. No.	List of Equipment	Water addition, TPH
1	Bulk Sample	45.50
2	Screw Scrubber	1469.00
3	Vibrating Screen	394.42
4	Rougher Magnetic Separator	496.47
5	Scavenger Magnetic Separator	192.27
Total		**2597.66**

B. Water Recovered

Sl. No.	List of Equipment	Water recovered, TPH
1	Intermediate Thickener	1196.84
2	Concentrate Thickener	466.50
3	Pressure Filter	117.39
4	Tailings Thickener	618.22
5	Tailing Pond	39.32
Total		**2438.27**

C. Water Contains in Products

Sl. No.	Name of the Product	Water contain, TPH
1	Pressure Filter	23.47
2	Vibrating screen	96.59
3	Tailing pond	39.33
Total		**159.39**

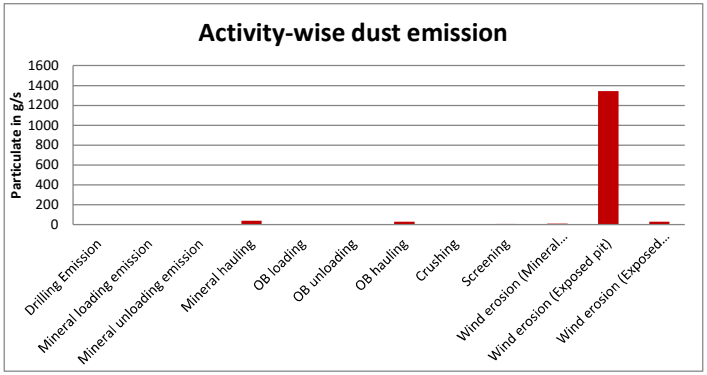
D. Make up water

Sl. No.	Name of the Product	Water contain, TPH
1	Water content in products	120.06
2	Water content in tailings	39.33
3	1% of handling loss	26.00
Total		**185.39**

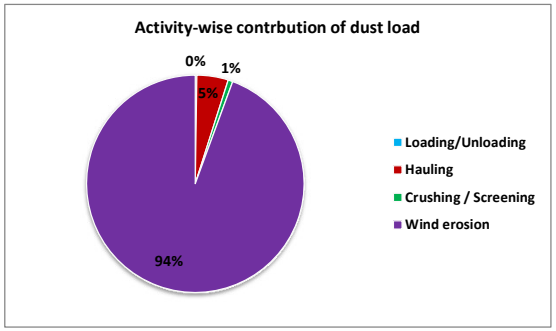
ANNEXURE X

RESULTS OF DUST LOAD CALCULATIONS

	Particulate matter in (g/s)	Particulate matter in (kg/d)	Particulate matter (kg per ton of ore)
Drilling Emission	0.06679882	5.771418206	0.000504539
Mineral loading emission	1.75785308	151.8785065	0.013277254
Mineral unloading emission	0.43629357	37.6957648	0.003295372
Mineral hauling	38.4323932	3320.558774	0.290284009
OB loading	0.70290758	60.73121467	0.005309137
OB unloading	0.46745375	40.38800417	0.003530729
OB hauling	29.6218769	2559.330164	0.223737229
Crushing	4.07407407	352	0.030771921
Screening	6.66666667	576	0.050354052
Wind erosion (Mineral stack)	10.8238828	935.1834701	0.081753953
Wind erosion (Exposed pit)	1344.93222	116202.1437	10.15841802
Wind erosion (Exposed OB dump)	27.8915593	2409.83072	0.210667954
Total	**1465.87**	**126651.51**	**11.0719**



Major Activity	Dust load (kg/day)
Loading/Unloading	290.69349
Hauling	5879.88894
Crushing / Screening	928
Wind erosion	119547.158



GO TO MAIN PAGE

GO TO DATA ENTRY PAGE

GASEOUS LOAD CALCULATIONS FOR NARAYANPOSHI IRON & MANGANESE ORE MINES

During the field study, it was observed that dust is the major source of emission from various surface mining activities, whereas emission of SO_2 and NOx were negligible in comparison to the NAAQS protocol. Therefore, SO_2 and NOx emissions were measured considering mine as a whole and not for each activity of the mine. And the CO emission measured is insignificant to calculate the load in the iron ore mines.

Formulae for SO_2 and NO_x emission rates of overall mine.

Activity	Parameter			Equation
	Symbol	Name	Unit	
Overall mine	u	Wind speed	m s^{-1}	For SO_2
	c	Iron ore production	Mt $year^{-1}$	$E = a^{0.1}\{u/(11 + 4.4u)\}[\{c/(9.9 + 1.6c)\} + \{b/(3.3 + 19.9b)\}]$
	b	Waste handling	Mm^3 $year^{-1}$	
	a	Leasehold area	km^2	For NO_x
	E	Emission rate	g s^{-1}	$E = 0.01au[\{c/(1.38 + 0.26c)\} + b^{1.1}]$

Source: S.K. Chaulya / Emission rate formulae for surface iron ore mining activities

Input data

1. u = wind-speed = 2.5 m/s
2. c = Iron ore production = 4.18 Mt/year
3. b = Waste handling = 0.43 Mm^3 /year
4. a = leasehold area = 3.47 km^2
5. E = Emission rate = g/s

Results of gaseous load

S. No.	Parameter	Value (g/s)	Kg/Day	Ton/Year
1	SO_2	0.037	3.2	1.17
2	NO_x	0.181	15.64	5.71

ANNEXURE XI

Online Monitoring Stations







Ambient Air Quality Monitoring Stations







Fugitive Dust Monitoring Stations









ANNEXURE XII

भारतीय गुणवत्ता परिषद्
QUALITY COUNCIL® OF INDIA
QCI Creating an Ecosystem for Quality

NABET

National Accreditation Board for Education and Training

Certificate of Accreditation

Visiontek Consultancy Services Pvt Ltd, Bhubaneswar

Plot No M-22&23, Chandaka Industrial Estate, Patia, Khorda, Bhubaneswar -751024

*The organization is accredited as **Category-A** under the QCI-NABET **Scheme for Accreditation of EIA Consultant Organization, Version 3**: for preparing EIA/EMP reports in the following Sectors*

S. No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1.	Mining of minerals including opencast / underground mining	1	1 (a) (i)	A
2.	River Valley projects	3	1 (c)	A
3.	Thermal power plants	4	1 (d)	A
4.	Coal washeries	6	2 (a)	A
5.	Mineral beneficiation	7	2 (b)	A
6.	Metallurgical industries (ferrous & non-ferrous)	8	3 (a)	A
7.	Cement plants	9	3 (b)	A
8.	Coke oven plants	11	4 (b)	A
9.	Synthetic organic chemicals industry	21	5 (f)	A
10.	Common hazardous waste treatment, storage and disposal facilities (TSDFs)	32	7 (d)	A
11.	Bio-medical waste treatment facilities	32A	7 (d a)	B
12.	Common Municipal Solid Waste Management Facility (CMSWMF)	37	7 (i)	B
13.	Building and construction projects	38	8 (a)	B
14.	Townships and Area development projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RAAC minutes dated April 04, 2025 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no QCI/NABET/ENV/ACO/25/3591 dated April 10, 2025. The accreditation needs to be renewed before the expiry date by Visiontek Consultancy Services Pvt Ltd, Bhubaneswar following due process of assessment.

Valid up to
December 17, 2027

Issue Date
April 10, 2025

Certificate No.
NABET/EIA/24-27/RA 0391

Varinder Kanwar

Prof (Dr) Varinder S Kanwar
(CEO – NABET)

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website.

ANNEXURE XIII

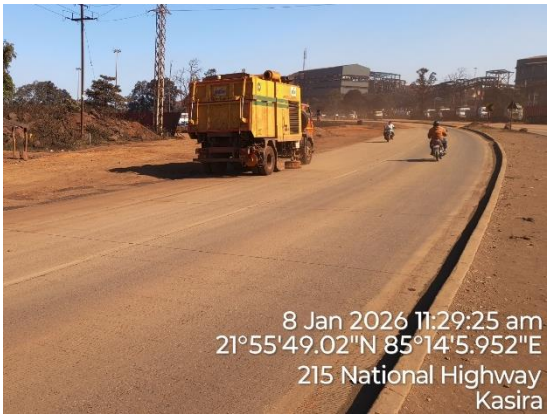
Tarpaulin covered Trucks





Road Sweeping Machine





Fixed Sprinkler System





50KL Mobile Sprinkler



16KL Mobile Sprinkler



Dry Fog Dust Suppression System



Wheel Washing System



Wet Drilling System



Dust Suppression Chemical



ANNEXURE XIV

Comprehensive Hydrogeological Report along with Groundwater Modelling Study

for

Narayanposhi Iron and Manganese Ore Mines

of

JSW STEEL LIMITED

Address

Narayanposhi Iron and Manganese Ore Mines

Village: Kasira, Block/Taluka: Koida, District: Sundargarh,

Odisha - 770048

Prepared By

Geo Climate Risk Solutions Pvt Ltd
Accredited by CGWA and ISO 9001:2015 Certified Company
CGWB Accreditation number & Validity: CGWB/RGI/005 & 14.02.2026
APIS, Sunrise Incubation Tower, Hill No.3, Madhurawada,
Visakhapatnam, 530048
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May 2026

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1 SALIENT FEATURES OF THE PROPOSAL

Sl. No.	Particulars	Information
1	Application No.	21-4/859/OR/MIN/2016
2	Submission Date	17.04.2026
3	Fresh or Renewal	Renewal
4	Existing or New/Proposed	Existing
5	If Renewal, date of validity of existing /last NOC	Valid up to: 18.01.2026 (Extended Validity)
6	CTO issue Date	21.12.2016
7	Name of the Project with Address	**Narayanposhi Iron and Manganese Ore Mines**, JSW Steel Limited, Village: Kasira, Block/Taluka: Koida, District: Sundargarh, Odisha - 770048
8	State	Odisha
9	District	Sundargarh
10	Block/Taluka	Koida
11	Category of Block/Taluka (as per Prevailing GWRE	Koida block comes under "Safe" category
12	Quantum of GW Applied (KLD)	**2,884** (seepage:1095, rainwater: 1169 and borewell:620)
13	Quantum of GW Applied ($m^{3/}$year)	**10,52,660** m^3/year (seepage: 3,99,675, rainwater: 4,26,685 and borewell: 2,26,300)
14	Alluvium/ Non-alluvium	Non-Alluvium
15	Ground water Modelling Required (Yes/No)	Yes
16	Name of Authorized Signatory of the Project and Designation	Mr. Suresh Kumar Mohapatra (Associate Vice President)
17	Consultant Details with Name of Authorized Signatory (If Institution)	Geo Climate Risk Solutions Pvt. Ltd. Mr. G Prasad Babu (Founder & CEO)
18	In case the report is prepared jointly by accredited Institute and Individual consultant, name details of chapters prepared by the Individual consultant	NA
19	Accreditation Certificate No. and Date/ Validity (In case jointly as per Point No. 18, No. and validity of both institution and individual are to be given)	CGWB Accreditation number & Validity: CGWB/RGI/005 & 14.02.2026

Mr. G Prasad Babu (Founder & CEO)
Signature with Name

2 ABOUT THE PROJECT

JSW Steel Limited is a leading integrated steel producer in India and the flagship company of the diversified JSW Group. Founded in 1982, it has become the country's largest private sector steel producer through a series of mergers and acquisitions. Narayanposhi Iron and Manganese Ore Mines of M/s JSW Steel Ltd spread over an area of 347.008 Ha (As per DGPS) /349.254 Ha (As per ROR) & located in Village: Koida, Tahsil: Koida, District: Sundargarh of Odisha State. The mine operation capacity of 10 MTPA of Iron ore and 0.036 MTPA (ROM) of Manganese ore along with screening, crushing.

The mine lease area falls under Survey of India Toposheet No. 73 G/1 and 73 G/5 and bounded by the indicative coordinates of latitudes: 21° 54' 46.0836"- 21° 56' 23.0928" and longitudes: 85° 13' 41.2176"- 85° 14' 54.9996".

The Narayanposhi Iron and Manganese Ore Mines hold all the statutary clearances like Environment Clearance, State Pollution Control Board approval, Forest Clearance and respective approved mining plan for the mine.

The mine is well connected with NH-520 as it is passing within the mine lease area. The nearest railway station is Barbil located at 37 km from the mine and the nearest airport is Biju Patnaik International Airport, Bhubaneswar is at 311km.

The existing NOC for Narayanposhi Iron and Manganese Ore Mines has been obtained from CGWA vide no. CGWA/NOC/MIN/REN/2/2024/10057 for NOC quantum of 2082 m^3/day or 4,38,000 m^3/year with an extended validity from 19.01.2022 to 18.01.2026. Presently, the application is for seeking permission of NOC quantum of **2,884 m3/day** (seepage:1095 m3/day, rainwater:1169 m3/day and borewell:620 m3/day)

OBJECTIVE

The study's overall objective is to carry out hydrogeological study as per the new SOP notified on May 2023 (Version 9.1) by the CGWA for the preparation of comprehensive hydrogeological report on the groundwater conditions in the core and buffer zones within the radius of 2 km and 10 km respectively from the project boundary to obtain NOC approval from the Central Ground Water Authority for dewatering of **2,884** m^3/day.

APPROACH AND METHODOLOGY

In order to achieve the objectives hand in hand with the scope of work outlined above, a multidisciplinary approach has been adopted, dovetailing the domain skills of hydrogeological and groundwater modelling, giving equal opportunities to arrive at an optimal strategy addressing the issues holistically. The methodology encompasses detailed hydrogeological investigation in and around the mine lease area, establishing an aquifer extent and an optimal

groundwater monitoring network to monitor water quantity and quality changes. Estimating mine seepage in time and space has been attempted, evaluating the influence on groundwater in terms of space and quantifying contribution from groundwater. Further, an attempt has been made to arrive at technically viable engineering interventions for water harvesting and groundwater recharge following standard norms and guidelines within the statutory framework of various regulatory authorities.

For the hydrogeological study and assessment of groundwater resources, a core zone of 2 km and a buffer zone of 10 km from the mine lease boundary have been considered as per the norms of the Central Ground Water Authority (CGWA). The Toposheet map and Google Earth Imagery of the study area are given in Figure 2.2 and Figure 2.3, respectively.

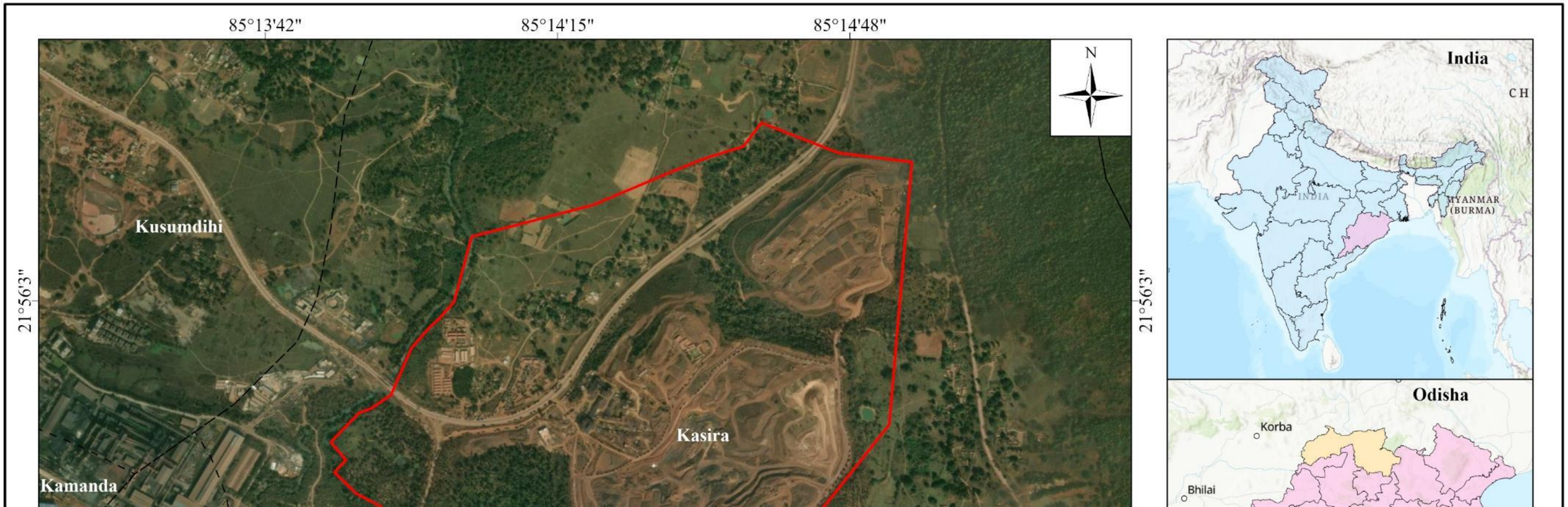
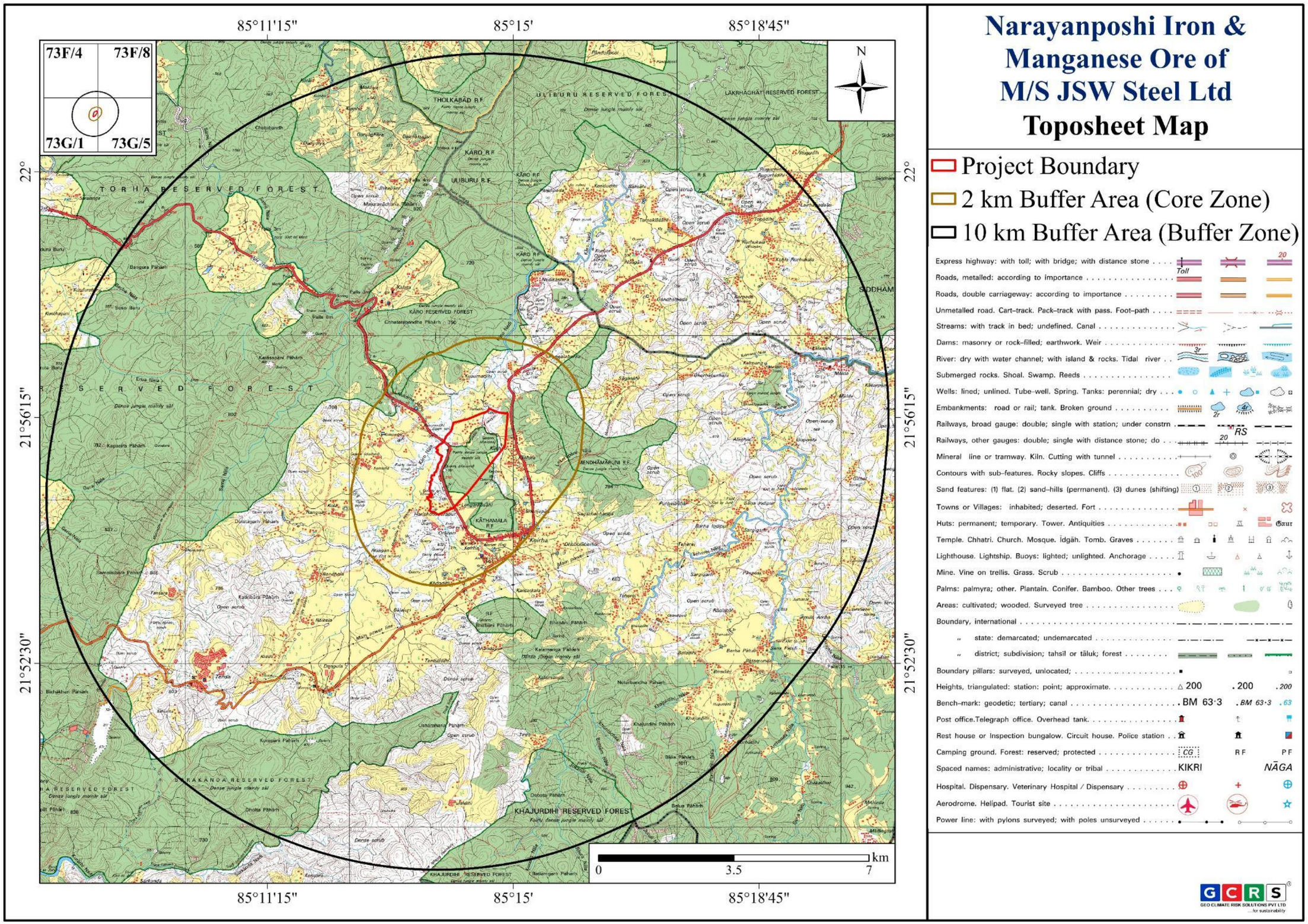


Figure 2.1: Location map of the project area.



Narayanposhi Iron & Manganese Ore of M/S JSW Steel Ltd

Toposheet Map

- Project Boundary
- 2 km Buffer Area (Core Zone)
- 10 km Buffer Area (Buffer Zone)

Express highway: with toll; with bridge; with distance stone
Roads, metalled: according to importance
Roads, double carriageway: according to importance
Unmetalled road. Cart–track. Pack–track with pass. Foot–path
Streams: with track in bed; undefined. Canal
Dams: masonry or rock–filled; earthwork. Weir
River: dry with water channel; with island & rocks. Tidal river
Submerged rocks. Shoal. Swamp. Reeds
Wells: lined; unlined. Tube–well. Spring. Tanks: perennial; dry
Embankments: road or rail; tank. Broken ground
Railways, broad gauge: double; single with station; under constrn
Railways, other gauges: double; single with distance stone; do
Mineral line or tramway. Kiln. Cutting with tunnel
Contours with sub–features. Rocky slopes. Cliffs
Sand features: (1) flat. (2) sand–hills (permanent). (3) dunes (shifting)
Towns or Villages: inhabited; deserted. Fort
Huts: permanent; temporary. Tower. Antiquities
Temple. Chhatri. Church. Mosque. Idgāh. Tomb. Graves
Lighthouse. Lightship. Buoys: lighted; unlighted. Anchorage
Mine. Vine on trellis. Grass. Scrub
Palms: palmyra; other. Plantain. Conifer. Bamboo. Other trees
Areas: cultivated; wooded. Surveyed tree
Boundary, international
„ state: demarcated; undemarcated
„ district; subdivision; tahsīl or tāluk; forest
Boundary pillars: surveyed, unlocated;
Heights, triangulated: station: point; approximate. △ 200 . 200 .200
Bench–mark: geodetic; tertiary; canal . BM 63·3 .BM 63·3 .63
Post office.Telegraph office. Overhead tank.
Rest house or Inspection bungalow. Circuit house. Police station
Camping ground. Forest: reserved; protected CG RF PF
Spaced names: administrative; locality or tribal KIKRI NĀGA
Hospital. Dispensary. Veterinary Hospital / Dispensary
Aerodrome. Helipad. Tourist site
Power line: with pylons surveyed; with poles unsurveyed

GCRS GEO CLIMATE RISK SOLUTIONS PVT LTD ...for sustainability

Figure 2.2: Toposheet of the study and project area (Source: Survey of India).

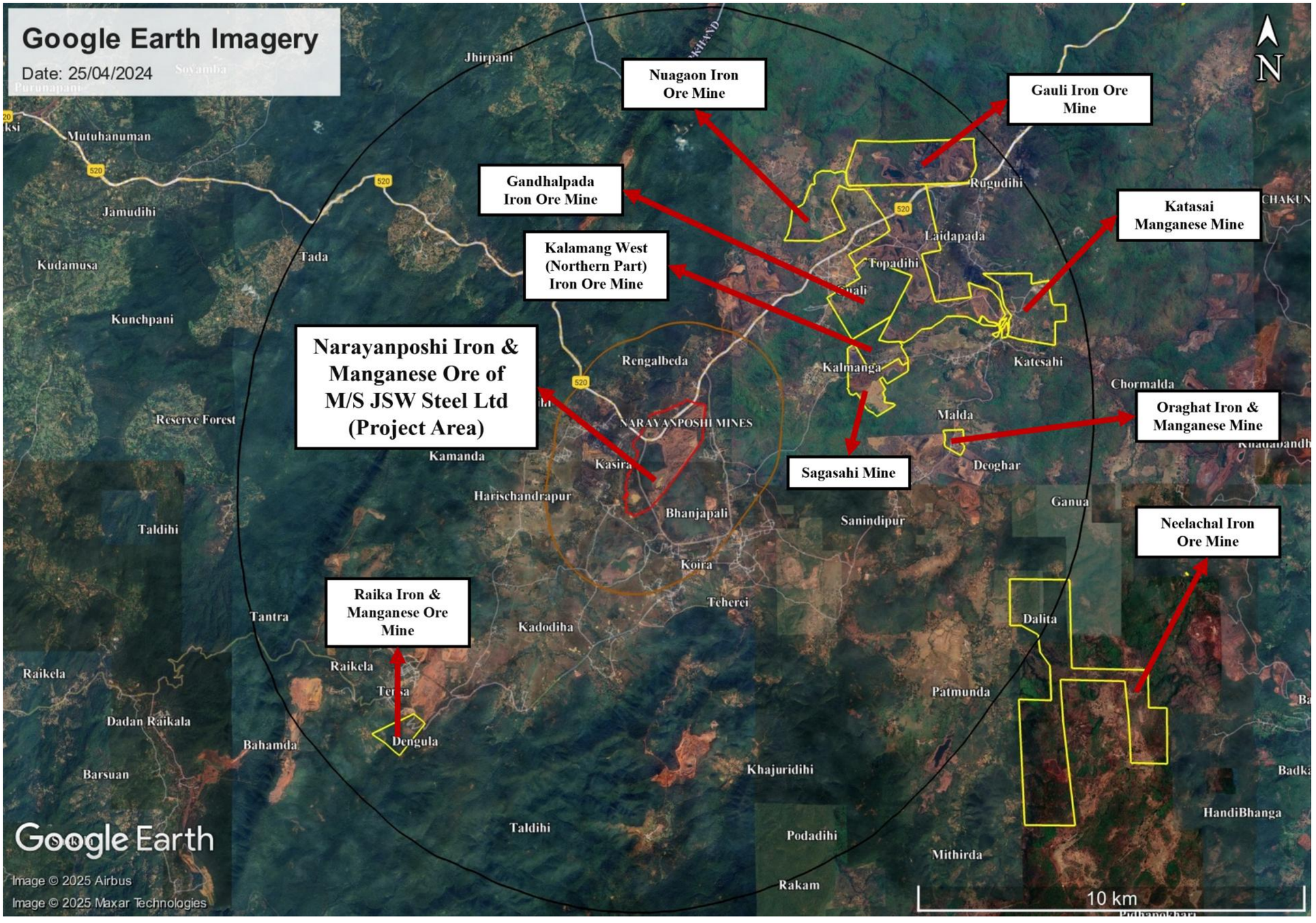


Figure 2.3: Google Earth imagery of the study area.
The red colour boundary shows the project area; the brown colour boundary shows the core area (2 km) and black colour boundary indicates the buffer area (10 km).

2.1 LANDUSE / LAND COVER OF LEASE AREA AND SURROUNDING AREA

The land use and land cover (LULC) maps are the fundamental data source for land management and planning. The accurate mapping of LULC classes is a valuable tool for understanding the relationship between humans and the environment (Pratico et al., 2021; Schulz et al., 2021; Viana et al., 2019; Qian and Zhang, 2022). The LULC maps for the present study were prepared using Sentinel-2 data on Google Earth Engine (GEE) platform. The GEE platform is widely used to shorten the processing time, which helps the user to store decades of data and removes the need, to download satellite imagery. The spatial resolution of LULC classes in the present study area is mainly related to the topographic factors/conditions. In the present study, a map has been prepared with 9 LULC classes for the month of April, 2026 (Figure 2.4). The predominant land use in the study is forest (74.77%), followed by crop land (13.80%), mining (4.26%), current fallow (2.99%), built-up (2.27%), scrub land (1.56%), river (0.16%), water bodies (0.16%) and barren land (0.04%). The different land-use classes present in the study area is given in Table 2.1.

Table 2.1: Land Use Pattern of the study area.

Sl. No.	LULC Classes	Area (%)
1	Forest	74.77
2	Crop land	13.80
3	Mining	4.26
4	Current Fallow	2.99
5	Built-up	2.27
6	Scrub land	1.56
7	River	0.16
8	Water Bodies	0.16
9	Barren land	0.04
Total		**100**

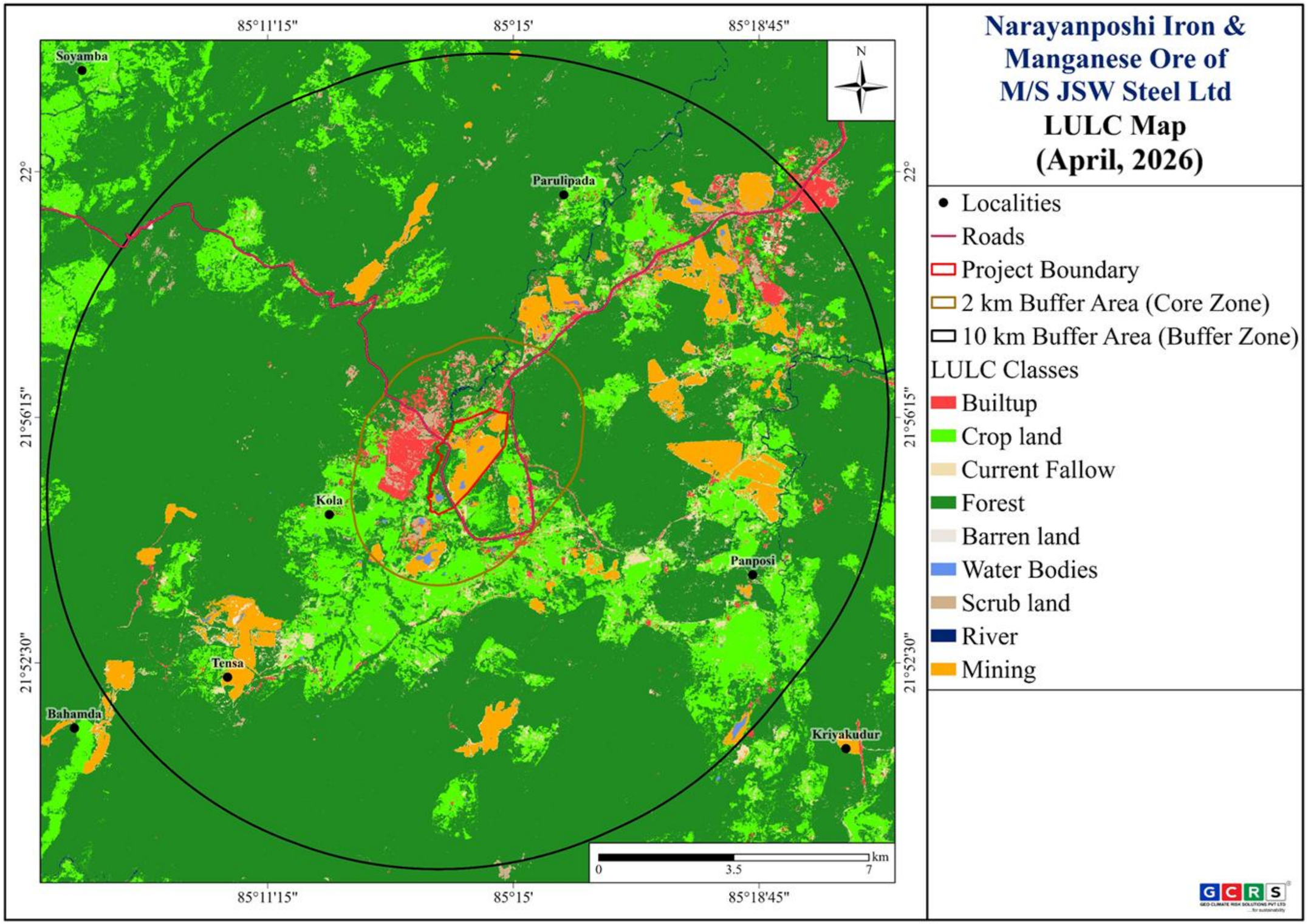


Figure 2.4: Land use map of the study area for the month of April, 2026.

2.2 DEM / TOPOGRAPHY

Digital Elevation Model (DEM) is the digital representation of the land surface elevation with respect to any reference datum. It reflects the physical surface of the earth and helps us to understand the nature of terrain using interpreting the landscape using modern techniques and high-resolution images. It is profitable to comprehend the nature of the topography, address the practical problems and fix them by applying new insights, upcoming high resolutions, satellite images, and techniques. In contrast, the topography is land surface's physical and natural features. A topographic map shows natural and manmade features (Balasubramanian, 2017).

The surface topography/DEM map is prepared using ArcGIS Pro software from SRTM-DEM of 30 m spatial resolution data. Topographically, the study area exhibits highly undulating terrain forming uneven elevation with presence of hills, valleys and mounds. Ridges can also be observed that extended laterally in south-west to north-east direction and creates a water divide in this region. These rolling uneven surface character of the study area also guides the surface water flow. The southern & south-eastern part of the study area exhibits higher altitude as compared to others. The elevation in the overall study area ranges from 346 to 1070 mamsl, whereas it ranges from 547 to 648 mamsl in the project area. The topography map of the study area is shown in Figure 2.5.

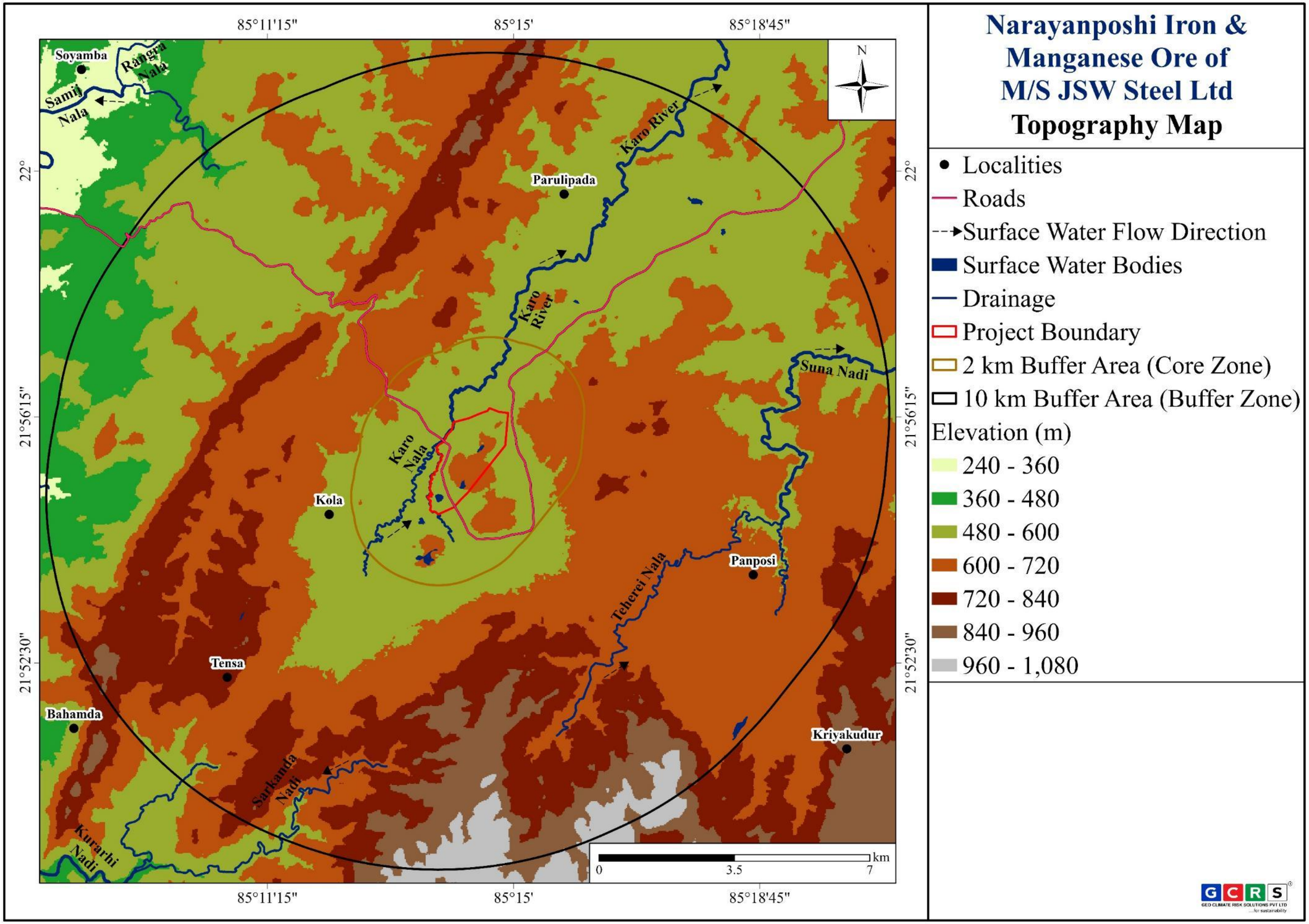


Figure 2.5: DEM/Topography of the study area (Source: SRTM-DEM).

2.3 GEOMORPHOLOGY AND DRAINAGE

The significant geomorphological features of the study area are moderately dissected hills and valleys of structural origin & subsequently followed by pediment of denudational origin, ridge of structural origin, active quarry of anthropogenic origin, residual hill of denudational origin, intermontane valley of denudational origin and others (Figure 2.6).

The drainage network of the study area is extracted from SRTM-DEM of 30 m spatial resolution (USGS website) using the Hydrology tool of ArcGIS Pro software. The drainage pattern of the study area is predominantly dendritic (Figure 2.7). The drainage system of this region is mainly regulated by the Karo River, which originates from the central part of the study area & flows due north-east direction, close to the western boundary outside the lease area. In addition to that, Suna Nadi also influences the drainage system at the eastern part of the study area. Major tributaries like Teherei Nala, Sarkanda Nadi, Samij Nala & Suna Nala play a significant role in the drainage system. Rather than these, numerous small streams/nalas like Kukarha Jora, Lekerapani Nala, Topadihi Nala, Kalmang Nala, Gahirajala Nala, Kundra Nala, Geria Nala, Bacha Nala, Korei Nala & others enhances the drainage intensity of the study area and contribute their water to form major streams/nalas. One seasonal nala i.e. Kashira Nala is flowing inside the project area. Some seasonal nalas may emerge in the study area during peak rainfall period.

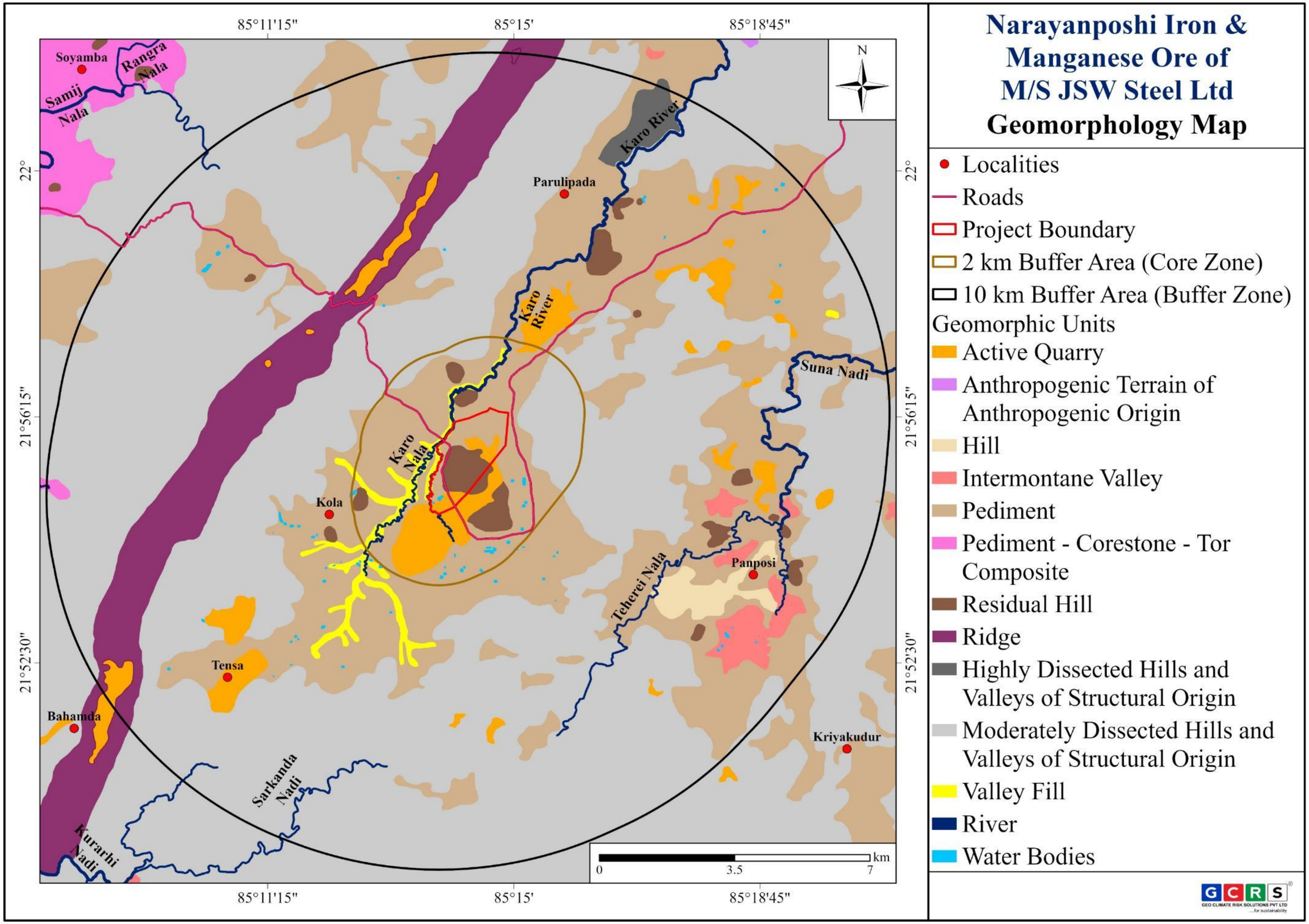


Figure 2.6: Geomorphology map of the study area (Source: Bhukosh, GSI, https://bhukos.gsi.gov.in/Bhukosh/MapViewer.aspx).

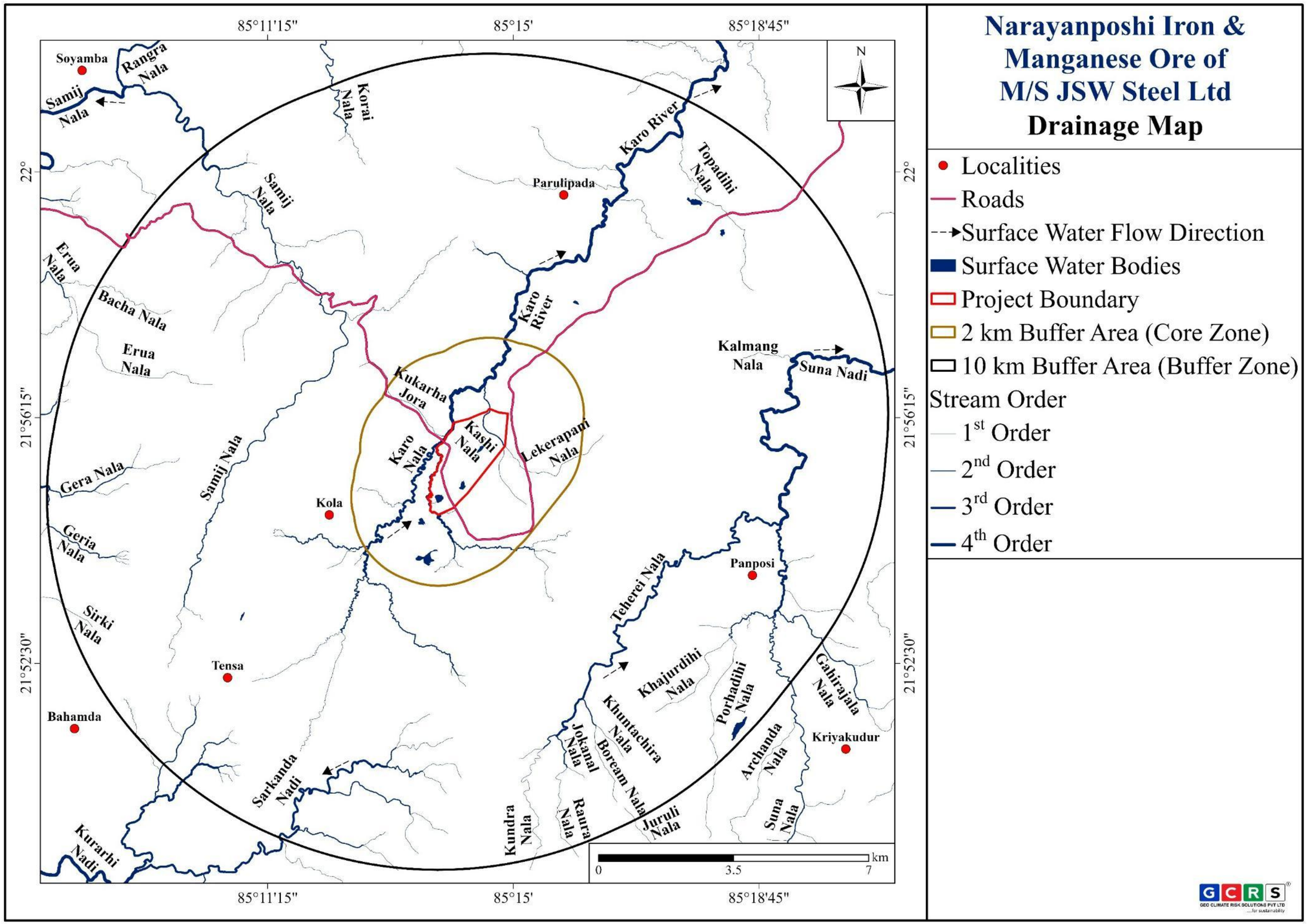
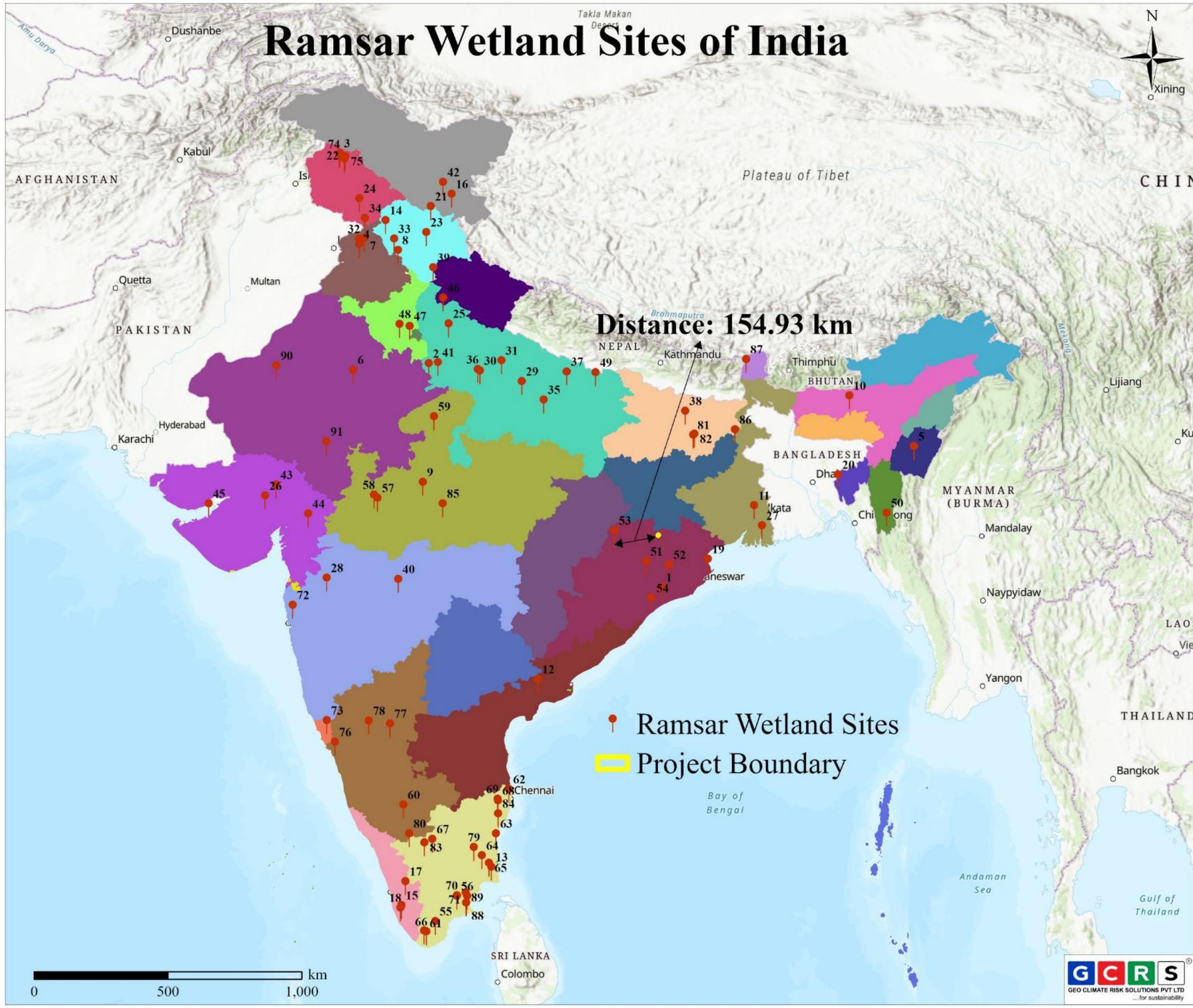


Figure 2.7: Drainage map of the study area (Source: SRTM-DEM).

2.4 DETAILS OF WETLANDS / MAJOR WATER BODIES

A wetland is a distinct ecosystem flooded by water, either permanently or seasonally, where oxygen-free processes prevail. The primary factor that distinguishes wetlands from other landforms or water bodies is the characteristic vegetation of aquatic plants, adapted to the unique hydric soil. Any wetland site listed under the Ramsar Convention that aims to conserve it and promote sustainable use of its natural resources is called a Ramsar Site. There are total of 91 Ramsar wetland sites present in India as per the recent publication (https://www.ramsar.org/) (Figure 2.8).

The nearest Ramsar Wetland site from the project area is Hirakud Reservoir, situated at an aerial distance of 154.93 km in the State of Odisha. Hence, no Ramsar wetland sites are present in the vicinity of 500 m radius from the mine lease or within the study area. Therefore, a certificate regarding the same is not applicable for this project.



Sno	Site name	Designation date	Area (ha)
1	Chilika Lake	01-10-1981	116500
2	Keoladeo National Park	01-10-1981	2873
3	Wular Lake	23-03-1990	18900
4	Harike Lake	23-03-1990	4100
5	Loktak Lake	23-03-1990	26600
6	Sambhar Lake	23-03-1990	24000
7	Kanjli	22-01-2002	183
8	Ropar	22-01-2002	1365
9	Bhoj Wetland	19-08-2002	3201
10	Deepor Beel	19-08-2002	4000
11	East Calcutta Wetlands	19-08-2002	12500
12	Kolleru Lake	19-08-2002	90100
13	Point Calimere Wildlife and Bird Sanctuary	19-08-2002	38500
14	Pong Dam Lake	19-08-2002	15662
15	Sasthamkotta Lake	19-08-2002	373
16	Tsomoriri	19-08-2002	12000
17	Vembanad-Kol Wetland	19-08-2002	151250
18	Ashtamudi Wetland	19-08-2002	6140
19	Bhitarkanika Mangroves	19-08-2002	65000
20	Rudrasagar Lake	08-11-2005	240
21	Chandertal Wetland	08-11-2005	49
22	Hokera Wetland	08-11-2005	1375
23	Renuka Wetland	08-11-2005	20
24	Surinsar-Mansar Lakes	08-11-2005	350
25	Upper Ganga River	08-11-2005	26590
26	Nalsarovar	24-09-2012	12000
27	Sundarban Wetland	30-01-2019	423000
28	Nandur Madhameshwar	21-06-2019	1437
29	Nawabganj Bird Sanctuary	19-09-2019	224.6
30	Sarsai Nawar Jheel	19-09-2019	161.27
31	Sandi Bird Sanctuary	26-09-2019	308.54
32	Beas Conservation Reserve	26-09-2019	6428.92
33	Nangal Wildlife Sanctuary	26-09-2019	116
34	Keshopur-Miani Community Reserve	26-09-2019	343.9
35	Samaspur Bird Sanctuary	03-10-2019	799.371
36	Saman Bird Sanctuary	02-12-2019	526.3
37	Parvati Arga Bird Sanctuary	02-12-2019	722
38	Kabartal Wetland	21-07-2020	2620
39	Asan Conservation Reserve	21-07-2020	444.4
40	Lonar Lake	22-07-2020	427
41	Sur Sarovar	21-08-2020	431
42	Tso Kar Wetland Complex	17-11-2020	9577
43	Thol Lake Wildlife Sanctuary	05-04-2021	699
44	Wadhvana Wetland	05-04-2021	630
45	Khijadia Wildlife Sanctuary	13-04-2021	511.745
46	Haiderpur Wetland	13-04-2021	6908
47	Sultanpur National Park	25-05-2021	142.52
48	Bhindawas Wildlife Sanctuary	25-05-2021	412
49	Bakhira Wildlife Sanctuary	29-06-2021	2894
50	Pala Wetland	31-08-2021	1850
51	Satkosia Gorge	12-10-2021	98196.72
52	Ansupa Lake	12-10-2021	231
53	Hirakud Reservoir	12-10-2021	65400
54	Tampara Lake	12-10-2021	300
55	Koonthankulam Bird Sanctuary	08-11-2021	72.04
56	Chitrangudi Bird Sanctuary	08-11-2021	260.47
57	Sirpur Wetland	07-01-2022	161
58	Yashwant Sagar	07-01-2022	822.9
59	Sakhya Sagar	07-01-2022	248
60	Ranganathittu Bird Sanctuary	15-02-2022	517.7
61	Vembannur Wetland Complex	08-04-2022	19.746
62	Pallikaranai Marsh Reserve Forest	08-04-2022	1247.537
63	Pichavaram Mangrove	08-04-2022	1478.642
64	Vaduvur Bird Sanctuary	08-04-2022	112.638
65	Udhayamarthandapuram Bird Sanctuary	08-04-2022	43.767
66	Suchindram Theroor Wetland Complex	08-04-2022	94.229
67	Vellode Bird Sanctuary	08-04-2022	77.185
68	Vedanthangal Bird Sanctuary	08-04-2022	40.348
69	Karikili Bird Sanctuary	08-04-2022	58.442
70	Kanjirankulam Bird Sanctuary	08-04-2022	96.891
71	Gulf of Mannar Marine Biosphere Reserve	08-04-2022	52671.876
72	Thane Creek	13-04-2022	6521.08
73	Nanda Lake	08-06-2022	42.01
74	Hygam Wetland Conservation Reserve	08-06-2022	801.82
75	Shallbugh Wetland Conservation Reserve	08-06-2022	1675
76	Aghanashini Estuary	14-02-2023	4801
77	Ankasamudra Bird Conservation Reserve	10-03-2023	99
78	Magadi Kere Conservation Reserve	14-02-2023	54
79	Karaivetti Bird Sanctuary	24-05-2023	454
80	Longwood Shola Reserve Forest	24-05-2023	116
81	Nagi Bird Sanctuary	10-11-2023	205.817
82	Nakti Bird Sanctuary	10-11-2023	332.608
83	Nanjarayan Bird Sanctuary	16-01-2024	125.865
84	Kazhuveli Bird Sanctuary	16-01-2024	5151.6
85	Tawa Reservoir	08-01-2024	20050
86	Udiwa Lake Bird Sanctuary	08-01-2024	936
87	Khachoedpalri Wetland	15-07-2024	172
88	Sakkarakottai Bird Sanctuary	15-07-2024	230.5
89	Therthangal Bird Sanctuary	15-07-2024	29
90	Khichan Wetland	19-02-2025	54.2
91	Menar Wetland Complex	19-02-2025	463.4

Figure 2.8: Ramsar Wetland sites of India (modified after http://wiienvis.nic.in/Database/ramsar_wetland_sites_8224.aspx).

3 HYDROGEOLOGY

3.1 GEOLOGICAL SET UP

Regional Geology

The Narayanposi Iron and Manganese Ore Mines belongs to Bonai-Keonjhar belt of Sundargarh district. The feebly metamorphosed Precambrian volcano-sedimentary rocks exposed in this belt between the Singhbhum granite on the east and Bonai granite on the west and are classified as 'Iron ore Group' (Sarkar & Saha, 1962) or 'Koira Group' (Murty and Acharya, 1975). These rocks are disposed in form of a low northerly plunging 'Horse-shoe' shaped synclinorium (Jones, 1934).

The belt was first reported by Jones in 1934 and has been studied in detail by several eminent geo-scientists, since then. The major litho types are metamorphosed sandstone, lithic wacke mostly in the east, BIF, and iron ore fragments. Shale, lavas, volcanic, pyroclastic tuffs, phyllite and Banded Iron Formation (BIF) including Banded Hematite Quartzite (BHQ) and the Kolhan Group of rocks are exposed.

The Precambrian rocks of this region comprising of basic lava, tuffs, banded iron formation (BIF), shales, conglomerates and sandstones etc. were mapped for the first time by Jones (1934). The stratigraphic succession established by Jones has largely been modified later by Dunn (1940) based on detailed mapping in the northern parts of the belt. Dunn recognized a new group lying unconformably over the Iron Ore Group which he named as the “Kolhan Group”. The rock types of the area belonging to the Kolhan group lies to the north of the Noamundi in Bihar.

The most acceptable litho-stratigraphic succession for the belt was proposed by Murthy and Acharaya (1975). They identified different depositional facies and proposed a more detailed stratigraphic succession. They also proposed a new name the “Kolhan Group” to the rocks of Bonai-Keonjhar belt. The stratigraphic succession suggested by Murthy and Acharya (1975) is given in Table 3.1.

Table 3.1: The stratigraphic succession suggested by Murthy and Acharya (1975)

KOLHAN GROUP	Sandstone, Conglomerate, Breccias
----------Unconformity----------	
Mixed Facies Formation	• Basic Lava, tuffs and tuffites of volcanic facies. • Iron, Manganese, Lenses of Iron formation, Chert, small dolomite patches of chemical facies. • Minor lenses of sandy and silty shale of clastic facies.
Banded Shale Formation	• Banded shale member • Black shale member • Black shale – chert member
Banded Iron formation	• Finally banded Jaspilite Member • Coarsely banded jaspilite member
Volcanic Formation	• Tuffaceous shale • Basic Lava
Basal Sandstone	Gritty Sandstone, Quartzite, Conglomeratic at places with interbedded Lava at top
----------Unconformity----------	
Singhbhum Granite with enclaves of older meta-basic and meta-sedimentary rocks.	

(Source: Lithostratigraphy of the Precambrian rocks around Koira, Sundargarh district, Orissa, Murty, V. N., & Acharya, S, 1975).

Local Geology:

The available field studies conducted indicates that the local structural elements are compatible with the general regional trend of the western limb of the synclinorium. The main rock types found in this mine are BHQ, Iron ore (Massive, Laminated), Lateritic Iron Ore and ferruginous laterite and Manganiferous shale. In the ML area, Iron ore found as mainly hard massive and laminated and powdery variety. The lithological succession established as observed within the lease hold area are compatible with other locations on the western limb of the synclinorium.

In the mine lease area, iron ore found as mainly hard massive and laminated variety. The strike of the ore body is NE-SW. The ore body is dipping due NW and the dip amount varies from 20º to 70º at different locations. This trend normally conform to the regional trend of the rock in Bonai Synclinorium.

(Source: Approved Mining plan)

The geology of study area is mainly characterised by Slate, Phyllite, Mica Schist, which covers major part of the study area, followed by Banded Hematite Quartzite; Amphibolite, Hornblende Schist, Chlorite Schist; Quartzite; Basic Meta – Volcanics; Newer Dolerite and lastly, Granite. All these geological deposits are of Archean – Paleoproterozoic Era (Figure 3.1).

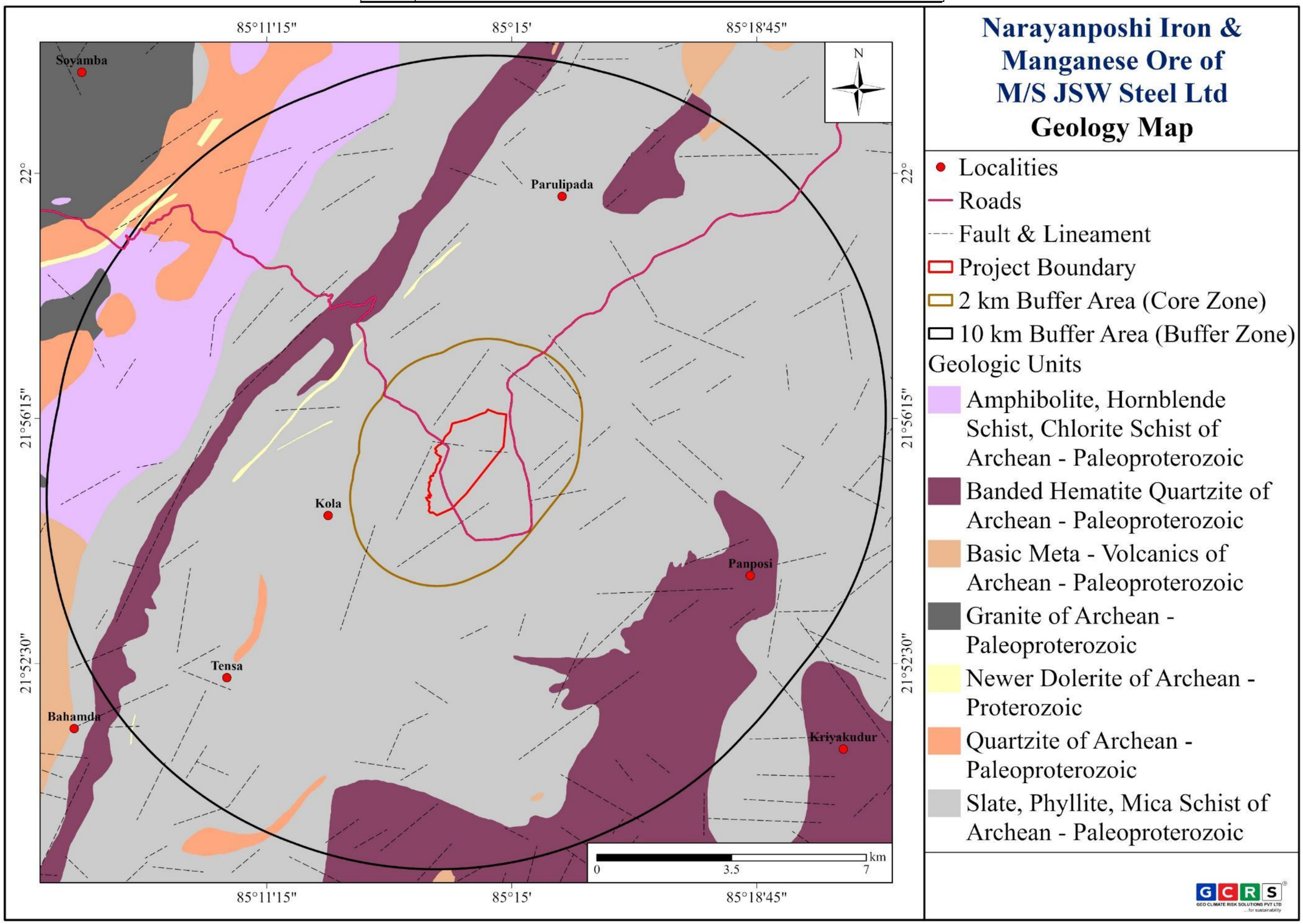


Figure 3.1: Geology map of the study area (Source: https://bhukosh.gsi.gov.in/Bhukosh/MapViewer.aspx).

3.2 GEOPHYSICAL STUDIES

In order to reconstruct the sub-surface geometry of the study area, a detailed geophysical investigation has been carried out using Vertical Electrical Sounding (VES) survey. In the present study, the VES data were interpreted using the physical parameters, such as the thickness of the formation and resistivity upon comparing the VES section graph with the available lithology in the vicinity of each VES transect to interpret the sub-surface stratigraphy. The present study used depth-wise resistivity variation in VES data to interpret the sub-surface stratigraphy (Telford et al., 1990; Reynolds, 2011). The apparent resistivity of the formation is calculated by measuring the change in the potential in the proximity of the applied external electric current to the electrodes, excluding the self-potential of the formation (Chandra, 2015).

METHODOLOGY

The resistivity soundings were carried out in the study area by applying the Schlumberger configuration with possible current electrode separation to get the maximum depth of investigation. Apparent resistivity (ρa) can be measured at different depths in the form of the pseudo-depth section by using four electrodes (2 current and 2 potential) system by placing electrodes in different spacing. In this technique, the current electrode/ potential electrode separation is increased in a sequence. The investigation depth depends on the total spread length and the array configuration used for data collection. The configuration of the VES technique is shown in Figure 3.2.

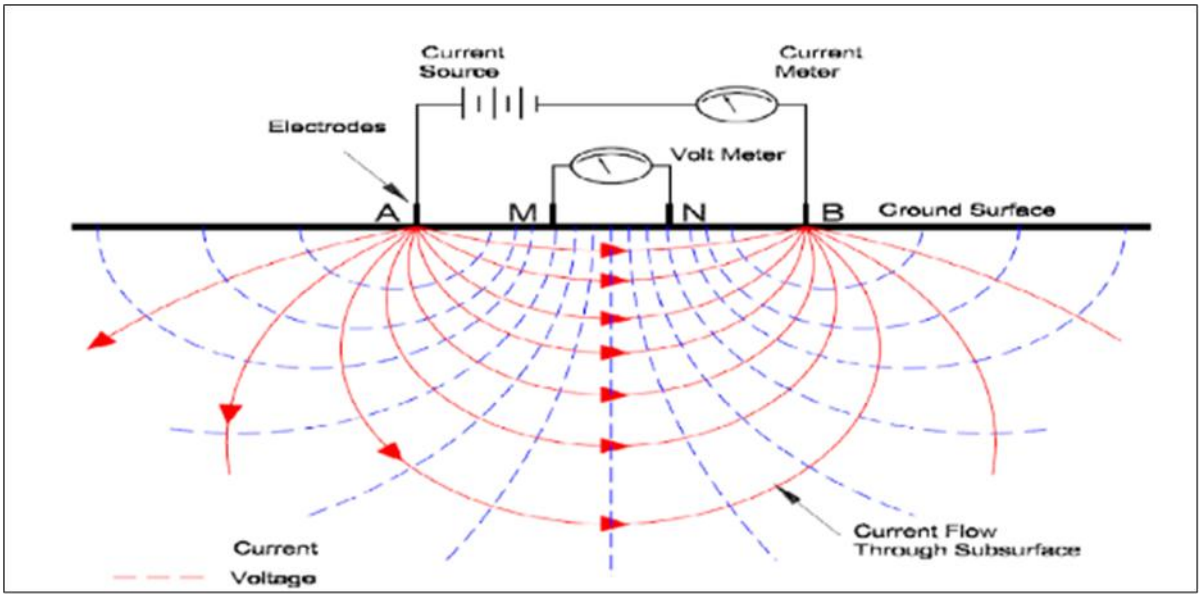


Figure 3.2: Configuration of Vertical electrical sounding technique.

Schlumberger Array Configuration

In this array, four electrodes are placed in a line around a common midpoint. The two outer electrodes, A and B, are current electrodes, and the two inner electrodes, M and N, are potential electrodes, as shown in Figure 3.3. With the Schlumberger array, for each measurement, the current electrodes A and B are moved outward to a greater separation throughout the survey, while the potential electrodes M and N stay in the same position until the observed voltage becomes too small to measure (Bhattacharya, 2012). At this point, the potential electrodes M and N are moved outward to a new spacing. As a thumb rule, the reasonable distance between M and N should be equal to or less than one-fifth of the distance between A and B at the beginning. This ratio goes about up to one-tenth or one-fifteenth, depending on the signal strength. The formula for the derivation of the apparent resistivity with the Schlumberger array is given below.

$$\rho_a = \frac{\pi}{4}\frac{V}{I}\frac{(L^2 - a^2)}{a}$$

Where, ρa is apparent resistivity; I is current intensity; V is the potential difference between M and N Point, L is the distance between outer electrodes A and B, and "a" is the distance between inner electrodes M & N.

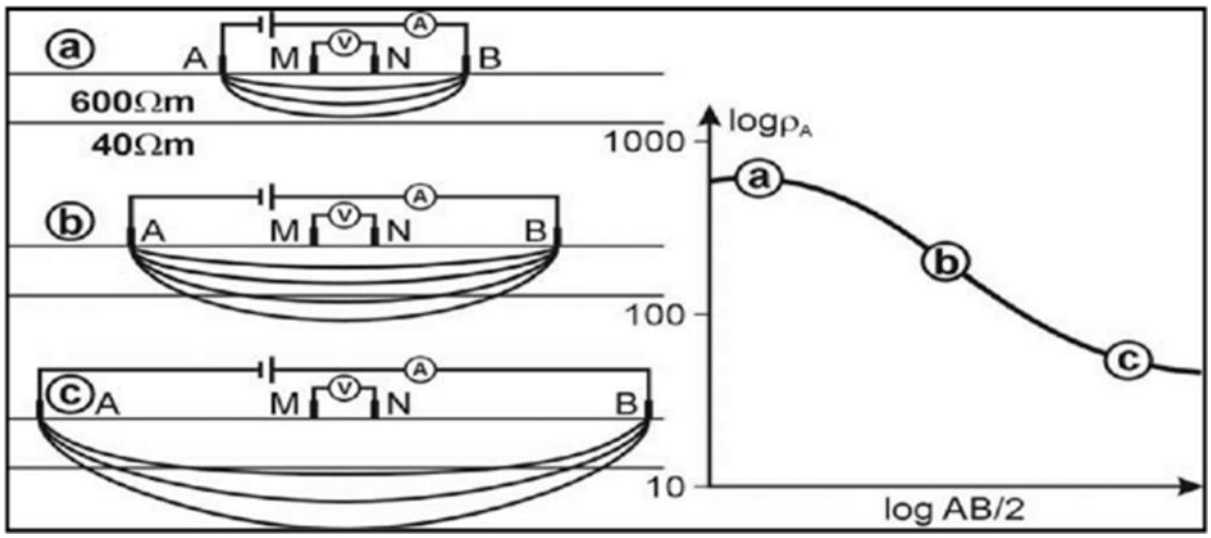


Figure 3.3: Schlumberger Array Configuration. From (a) to (c), A and B (current electrodes) are moved outward to a greater separation from the centre.

Data Processing and Interpretation:

The present study's interpretation of vertical electrical-sounding data was carried out in two stages. In the first stage, the VES data were interpreted based on theoretical knowledge to establish the basic geoelectrical model, based on the VES data. In the second stage, the

interpreted results found in stage 1 were correlated with the available borehole lithological data and further validated accordingly to determine the resistivity range for different lithological units.

The log resistivity graph, resistivity-depth table, and pseudo section were also received after processing the software. The log resistivity graph of VES 1 & VES 2 illustrates the double log plot of AB/2 on the x-axis and resistivity on the y-axis (Figure 3.4 & Figure 3.5) respectively. The resistivity-depth table gives information about the different layers' resistivity and thickness, along with the depth from the surface (Table 3.2 & Table 3.3).

Results and Discussion

Description of VES transect:

A total of 2 VES has been carried out at different points inside the lease area. A 5-layer model for the first VES site was developed based on the resistivity sounding (Figure 3.4). It shows resistivity variation from 42.4– 503 Ohm.m (Table 3.2). Layer- 1, the resistivity is 165 Ohm.m and extends to a depth of around 1m from the surface. Layer-2, the resistivity is 389 Ohm.m, extending up to 10.1m and having a thickness of 9.11 m. Layer-3 has a resistivity of 42.4 Ohm.m and extends up to a depth of 32.1 m and having a thickness of 22 m, layer 4 has a resistivity of 251 Ohm.m, and extends up to a depth of 102 m and having a thickness of 69.9 m and layer 5 has a resistivity of 503 Ohm.m and extends to the maximum depth of investigation. As the first layer has lower resistivity than the second layer, the second layer has higher resistivity than the third layer, the third layer has lower resistivity than the fourth layer, and the fourth layer has lower resistivity than the last layer.

Upon comparing the VES 1 section graph with the available lithology in the vicinity of this transect, it is evident that the top layer is mostly composed of soil, the second layer is composed of weathered rock, the third layer is composed of highly fractured rock, the fourth layer is composed of fractured rock and lastly the fifth layer is composed of hard rock.

A 4-layer model for the second VES site was developed based on the resistivity sounding (Figure 3.5). It shows resistivity variation from 110– 566 Ohm.m (Table 3.3). Layer- 1, the resistivity is 241 Ohm.m and extends to a depth of around 1.96 m from the surface. Layer-2, the resistivity is 566 Ohm.m, extending up to 4.32 m and having a thickness of 2.35 m. Layer-3 has a resistivity of 110 Ohm.m and extends up to a depth of 66.7 m and having a thickness of 62.4 m, layer 4 has a resistivity of 242 Ohm.m, and extends up to the maximum depth of investigation. As the first layer has lower resistivity than the second layer, the second layer has higher resistivity than the third layer, the third layer has lower resistivity than the last layer.

Upon comparing the VES 2 section graph with the available lithology in the vicinity of this transect, it is evident that the top layer is mostly composed of soil, the second layer is composed of weathered rock, the third layer is composed of fractured rock, the fourth layer is composed of hard rock.

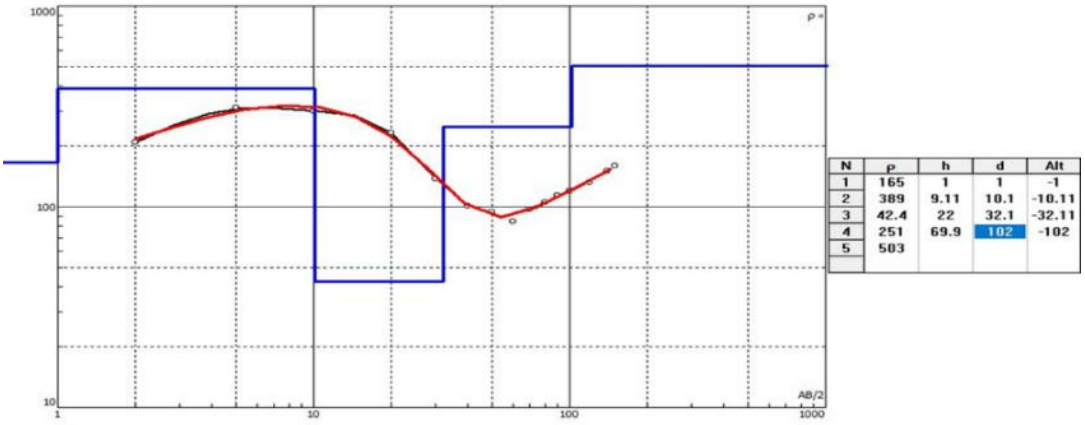


Figure 3.4: Apparent resistivity vs AB/2 plot of VES 1

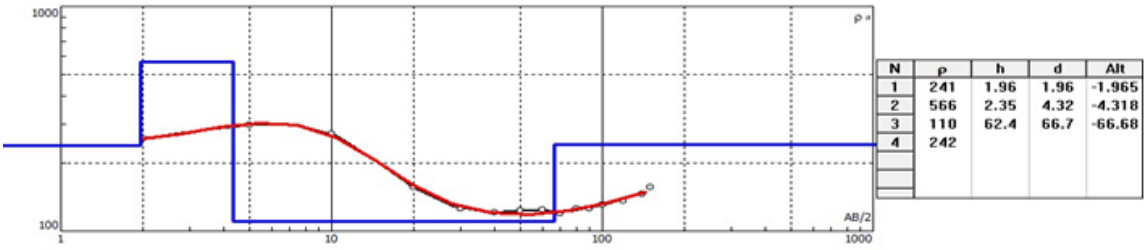


Figure 3.5: Apparent resistivity vs AB/2 plot of VES 2

Table 3.2: Description of VES 1

Layer No	Resistivity (Ohm-m)	Thickness (m)	Depth (m)	Lithology
1	165	1	1	Topsoil
2	389	9.11	10.1	Weathered Zone
3	42.4	22	32.1	Highly Fractured Rock
4	251	69.9	102	Fractured Rock
5	503		Infinity	Hard Rock

Table 3.3: Description of VES 2

Layer No	Resistivity (Ohm-m)	Thickness (m)	Depth (m)	Lithology
1	241	1.96	1.96	Topsoil
2	566	2.35	4.32	Weathered Zone
3	110	62.4	66.7	Fractured Rock
4	242		Infinity	Hard Rock

3.3 HYDROGEOLOGICAL SET UP

The hydrogeological structure of the study area is mainly controlled by geological settings, intensity and distribution pattern of rainfall, and the degree of primary and secondary porosities in the prevailing geological formations for storage and movement of groundwater.

The occurrence and movement of groundwater in hard rock terrains is primarily governed by secondary porosity features such as joints, fractures, and zones of weathering. The Sundargarh district is underlain by hard crystalline rock of Precambrian age, such as Granite, Granite gneiss, Mica schist, Phyllite, Meta basics, limestone and dolomite. The maximum yield of the ground water found in Metabasics and granite gneiss up to 7.5 lps. The major contribution of ground water for shallow aquifer stored in weathered zone up to depth of 30.0 mbgl. For deep aquifer study, drilling has been conducted up to depth of 200m and find out that fracture zone depth, varies from 30 to 120 m having discharge from 0.2 lps to 11 lps.

(Source: Aquifer mapping and management of ground water resources, Sundargarh district, Odisha)

Monitoring Stations

Groundwater level monitoring has been carried out in the core zone, buffer zone and some locations beyond the buffer zone to acknowledge hydrogeological scenario of the study area. This monitoring will decipher the orientation of the groundwater level in the study area.

The said water level monitoring has been carried out during the month of April 2026 (pre-monsoon) and October 2025 (post-monsoon) (Table 3.4). The same has been used to derive the water table elevation contours above mean sea level. At the same time, the wells considered beyond the study area will be used for the interpolation of the water levels and its derivatives within the buffer area and their subsequent presentation in the concerned maps. The location map of the groundwater monitoring wells is presented as Figure 3.6. In this regard, a hydrogeological map of the study area has been prepared as presented as Figure 3.7.

The predominant aquifer of the study area is Slate, Phyllite, Mica Schist with yield capacity 1 to 5 lps & subsequently followed by Banded Hematite Quartzite (yield: 3 to 10 lps), Amphibolite, Hornblende Schist, Chlorite Schist (yield: 1 to 5 lps) , Quartzite (yield: 3 to 10 lps), Basic Meta – Volcanics (yield:10 to 15 lps), Newer Dolerite (yield:0.5 to 1.5 lps) and lastly, Granite (yield: 3 to 10 lps).

Table 3.4: Details of water level monitoring locations in the study area & its periphery.

Sl. No.	Well ID	Village Name	Longitude	Latitude	Elevation (m)	Water Level (mbgl)		Water Table Contour (mamsl)		Fluctuation (m)
						April 2026	October 2025	April 2026	October 2025	
1	NPWL1	Inside Mine	85.234999	21.916385	574	13.34	8.93	560.66	565.07	4.41
2	NPWL2	Koida	85.253871	21.908418	587	10.35	7.87	576.65	579.13	2.48
3	NPWL3	Kamanda	85.210812	21.926728	589	14.34	9.12	574.66	579.88	5.22
4	NPWL4	Tentulidihi	85.226259	21.87597	619	7.98	4.01	611.02	614.99	3.97
5	NPWL5	Segasahi	85.274691	21.942444	632	9.65	6.28	622.35	625.72	3.37
6	NPWL6	Teherei	85.286515	21.899102	625	13.12	8.73	611.88	616.27	4.39
7	NPWL7	Patmunda	85.308836	21.874423	629	8.76	4.03	620.24	624.97	4.73
8	NPWL8	Deoghar	85.353868	21.929401	577	9.25	5.51	567.75	571.49	3.74
9	NPWL9	Katesahi	85.325435	21.955939	583	18.98	15.16	564.02	567.84	3.82
10	NPWL10	Rugudi	85.320621	22.000132	539	20.98	17.27	518.02	521.73	3.71
11	NPWL11	Kendudihi	85.271352	21.993664	528	10.12	6.95	517.88	521.05	3.17
12	NPWL12	Kalta	85.216379	21.967644	603	14.39	11.26	588.61	591.74	3.13
13	NPWL13	Tada Bhuyan Basti	85.180558	21.981534	519	9.65	7.25	509.35	511.75	2.4
14	NPWL14	Kunduruburu	85.141266	21.974534	376	8.98	6.67	367.02	369.33	2.31
15	NPWL15	Tensa Nature Camp Gate	85.163138	21.869059	773	41.29	29.9	731.71	743.1	11.39
16	NPWL16	Jaldihi	85.234268	21.840467	937	42.12	31.44	894.88	905.56	10.68

(mbgl- meters below ground level, mamsl-meters above mean sea level)

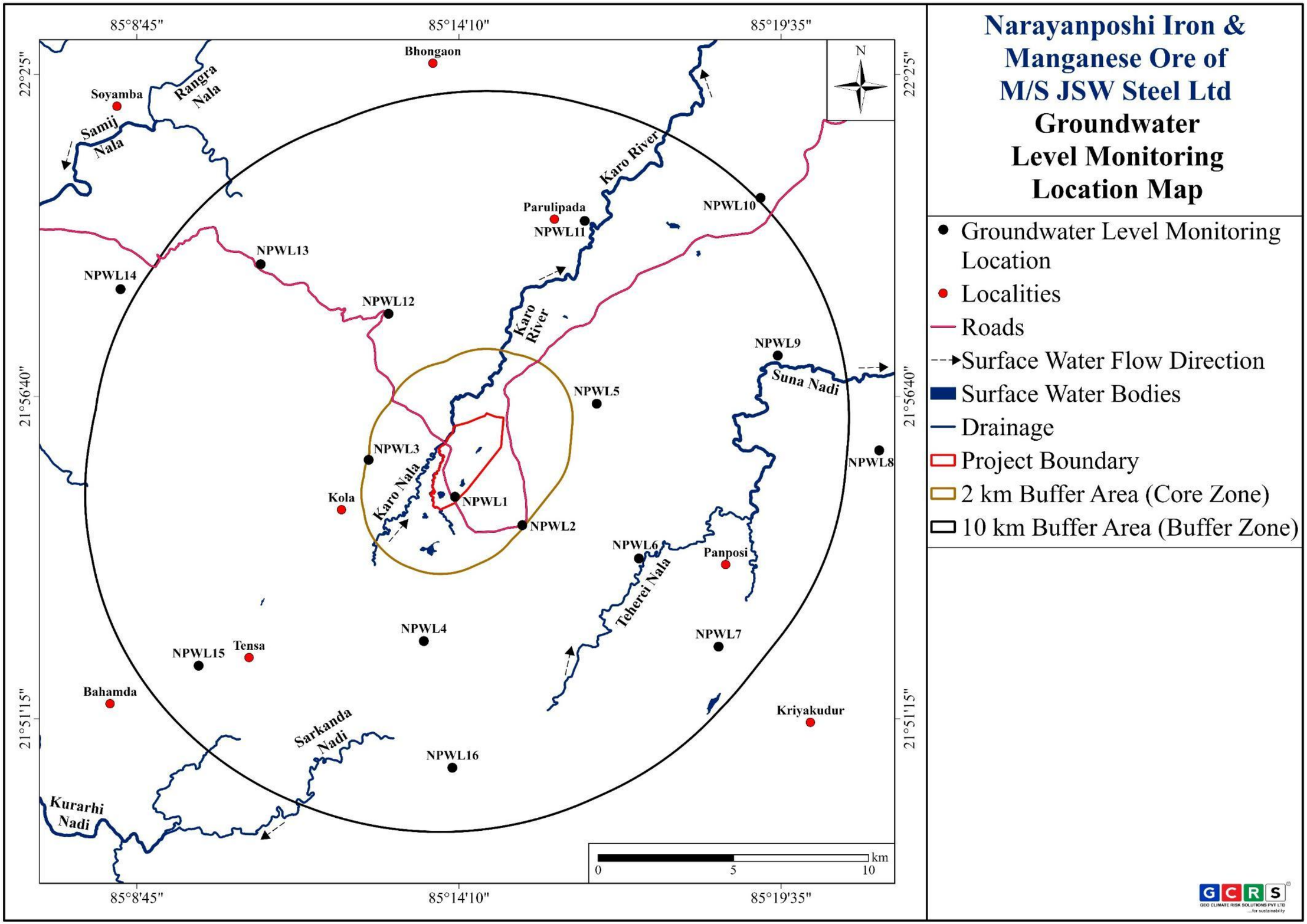


Figure 3.6: Location map of groundwater monitoring stations in and around the study area.

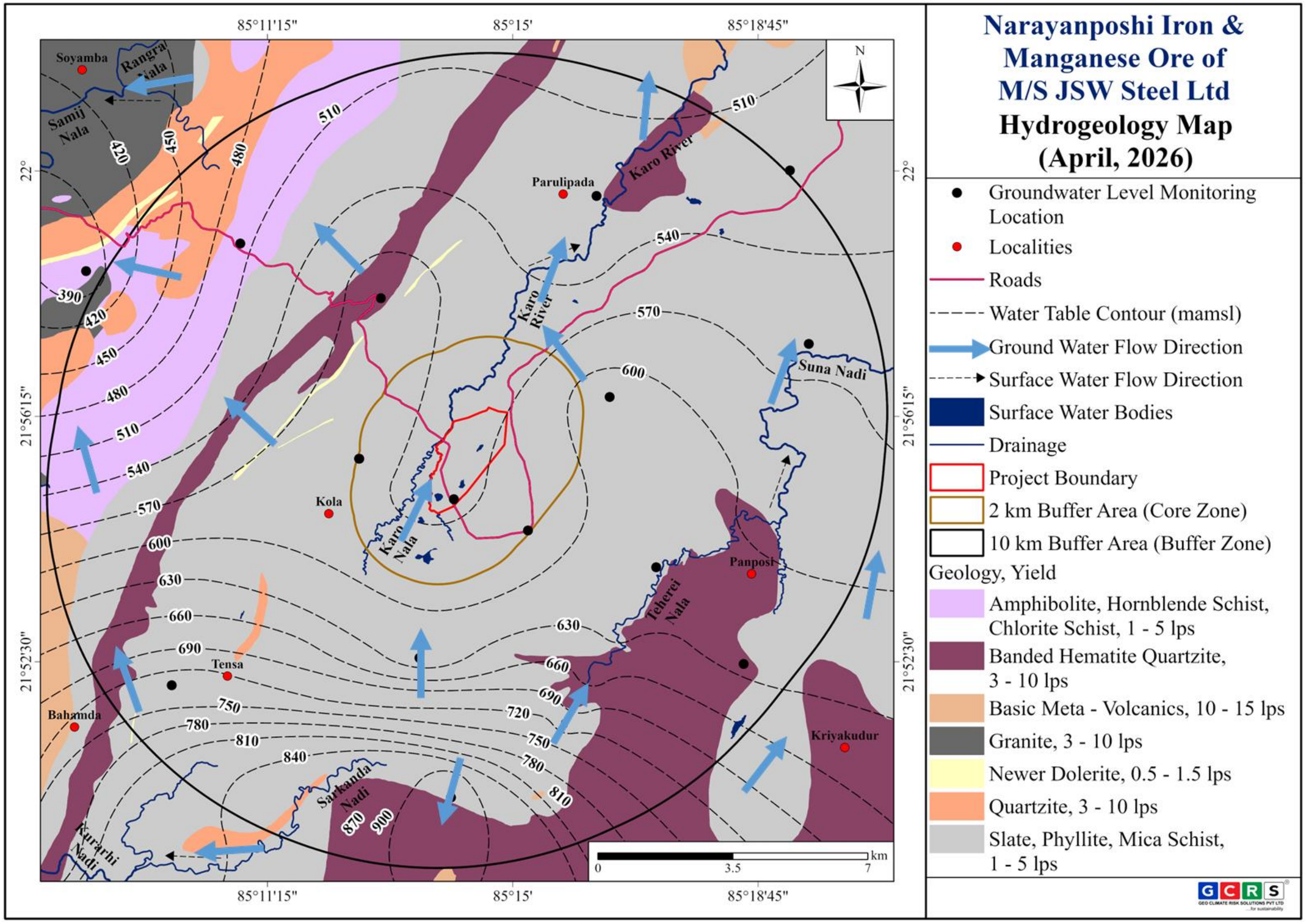


Figure 3.7: Hydrogeology map of the study area (Source: CGWB data & Field data).

3.3.1 Aquifer Characteristics

A pumping test is a method used to determine the hydraulic properties of an aquifer, such as the Transmissivity, Storativity, and Permeability of the subsurface material. These properties are important for understanding how water moves through an aquifer and how much water can be pumped from a well without depleting the aquifer. To verify the aquifer parameters of the study area, a short-duration pumping test was conducted in this area. The test involves pumping water from a well at a constant rate for a specified period and measuring the resulting water level changes. The data collected during the test is then used to calculate the aquifer's properties using mathematical models. This method is widely used in groundwater exploration, management, and remediation (Figure 3.8).

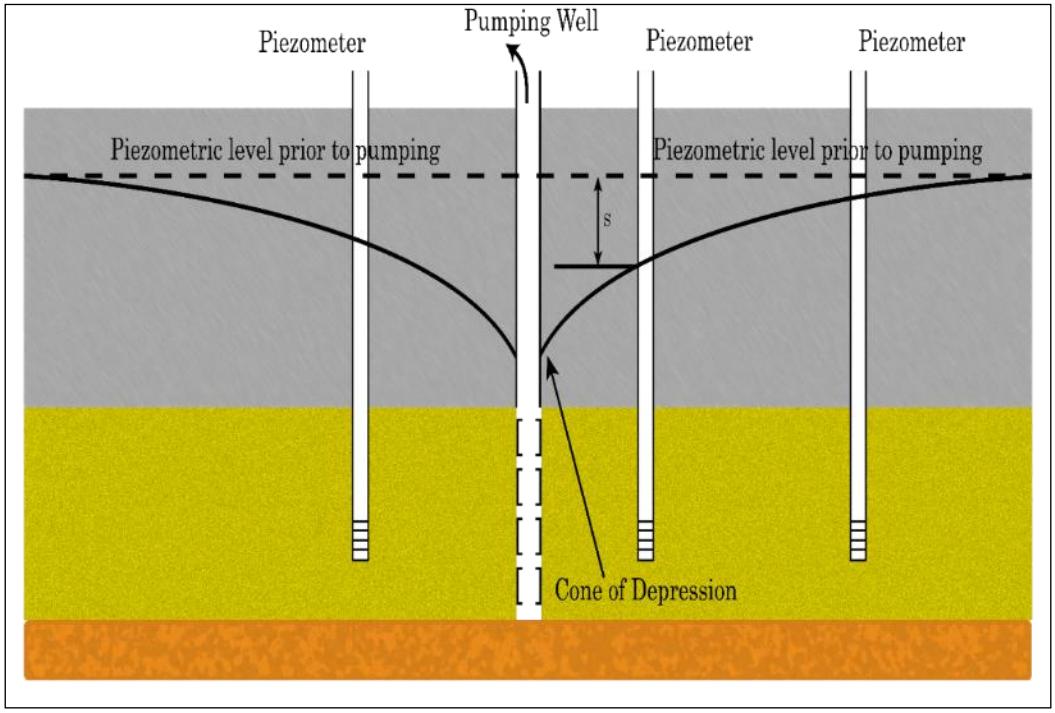


Figure 3.8: Drawdown in a pumped well.

Methodology:

To verify the aquifer parameters of the study area, short-duration pumping tests were conducted on a bore well near the project site. The test sites were so selected assuming that they represent the larger part of the area and the hydrogeological condition does not change over a short distance. In this current study, we have re-analysed and reinterpreted the pumping test data (Table 3.5).

Analysis of Pumping test data:

In the present study, the method used for the pumping test analysis is the Cooper-Jacob method. There are more methods that can be used to analyse pumping test data, depending on the aquifer and the goals of the test (Fetter, 1988). Jacob's method (Cooper and Jacob, 1946) uses the data

to calculate the transmissivity (T) and storage coefficient (S) of the aquifer using the following equations:

$T = 2.303Q / (4\pi\Delta s)$

Where Q is the pumping rate, and Δs is the slope of the fitted line (change in drawdown per log cycle time) (Cooper and Jacob, 1946).

Table 3.5: Details of pumping test conducted.

Location		Height of measuring point (agl)					0.05 m
Latitude	21.98901	Initial Depth to WL (bmp)					23.8 m
Longitude	85.3987	Elevation (amsl)					583 m
Diameter of the well			0.1524 m				
Average Discharge rate			192 m^3/day				
Pumping data			**Recovery data**				
Time (min)	Water level (m)	Drawdown (m)	Time since pumping started in min (t)	Time since pumping stopped in min (t')	t/t'	Water Level (m)	Residual drawdown (m)
0	23.8	0	241	1	241	30.62	6.82
1	26.9	3.1	242	2	121	29.95	6.15
2	28.01	4.21	243	3	81	29.415	5.615
3	28.7	4.9	244	4	61	28.98	5.18
4	29.28	5.48	245	5	49	28.65	4.85
5	29.72	5.92	246	6	41	28.35	4.55
6	30.34	6.54	247	7	35.29	28.1	4.3
7	31.35	7.55	248	8	31	27.88	4.08
8	31.72	7.92	249	9	27.67	27.68	3.88
9	32	8.2	250	10	25	27.49	3.69
10	32.15	8.35	251	11	22.82	27.32	3.52
11	32.22	8.42	252	12	21	27.16	3.36
12	32.31	8.51	253	13	19.46	27	3.2
13	32.375	8.575	254	14	18.14	26.85	3.05
14	32.42	8.62	255	15	17	26.7	2.9
15	32.45	8.65	256	16	16	26.55	2.75
20	32.65	8.85	257	17	15.12	26.4	2.6
25	32.7	8.9	258	18	14.33	26.27	2.47
30	32.8	9	259	19	13.63	26.14	2.34
35	32.9	9.1	260	20	13	26.02	2.22
40	33	9.2	261	21	12.43	25.91	2.11
45	33.1	9.3	262	22	11.91	25.8	2

50	33.2	9.4	263	23	11.43	25.7	1.9
55	33.3	9.5	264	24	11	25.59	1.79
60	33.35	9.55	265	25	10.6	25.48	1.68
80	33.45	9.65	266	26	10.23	25.38	1.58
100	33.55	9.75	267	27	9.89	25.28	1.48
120	33.6	9.8	268	28	9.57	25.19	1.39
150	33.72	9.92	269	29	9.28	25.12	1.32
180	33.78	9.98	270	30	9	25.05	1.25
210	33.81	10.01	275	35	7.86	24.9	1.1
240	33.82	10.02	280	40	7	24.75	0.95
			285	45	6.33	24.6	0.8
			290	50	5.8	24.47	0.67
			295	55	5.36	24.32	0.52
			300	60	5	24.2	0.4
			320	80	4	24.1	0.3
			330	90	3.67	24.02	0.22
			340	100	3.4	23.95	0.15
			350	110	3.18	23.9	0.1
			360	120	3	23.87	0.07
			390	150	2.6	23.86	0.06
			420	180	2.33	23.85	0.05
			450	210	2.14	23.85	0.05

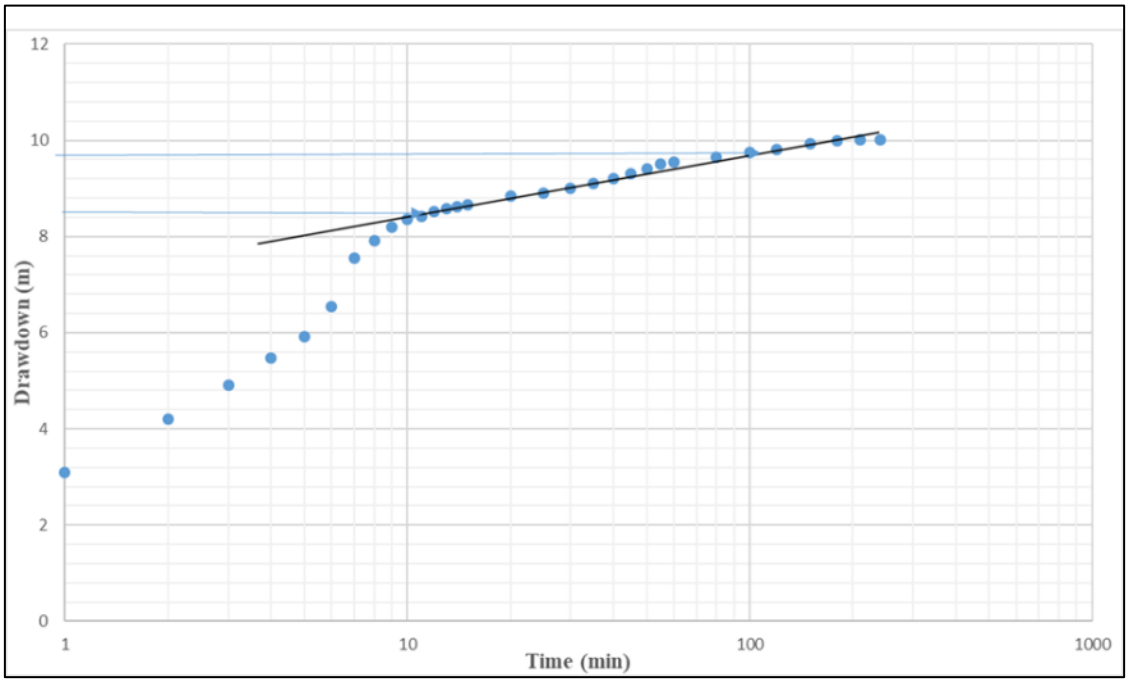


Figure 3.9: Drawdown data of the Pumping well.

After the analysis of pumping test data of the Well by Jacob's straight- line method, Δs was found to be 1.2 for the pumping test data. Hence, the average Transmissivity was estimated to be 29.33 m^2 /day. Summarised results of the pumping test conducted are given in Table 3.6.

Table 3.6: Summarized results of pumping test conducted in this area.

Type of test	ΔS (m)	Transmissivity (m^2/day)	Thickness of the aquifer (m)	Permeability (m/day)	Q (m^3/day)
Pumping	1.2	29.33	30	0.98	192

3.3.2 Groundwater flow and aquifer interaction with surface water bodies

The groundwater flow and aquifer interaction with surface water bodies provides valuable insights into the groundwater movement and interaction with surface water features in the study area. By analysing various factors such as water table contours and water table elevations, a comprehensive understanding of the groundwater flow has been obtained and represented in the Hydrogeological map (Figure 3.7).

The water table in & around the study area varies from 2025369.33 to 905.56 mamsl during October, 2025, whereas it varies from 367.02 to 894.88 mamsl during April, 2026 (Table 3.4). The ground water flow direction based on these contours have been drawn and presented as water table contour maps both for October, 2025 and April, 2026 (Figure 3.10 and Figure 3.11). The groundwater flow direction in the project area is in north-east direction, whereas, in the overall study area is towards north-east as well as north-west direction. The summarised details of water table contours are given in Table 3.7.

Table 3.7: Summarised details of water table contours

	Water Table Contours (mamsl)					
	October, 2025			April, 2026		
	Minimum	Maximum	Standard Deviation	Minimum	Maximum	Standard Deviation
Core Zone	565.07	579.88	6.81	560.66	576.65	7.12
Buffer zone (Study area)	511.75	905.56	99.27	509.35	894.88	96.87
Beyond buffer zone	369.33	571.49	86.00	367.02	567.75	85.35

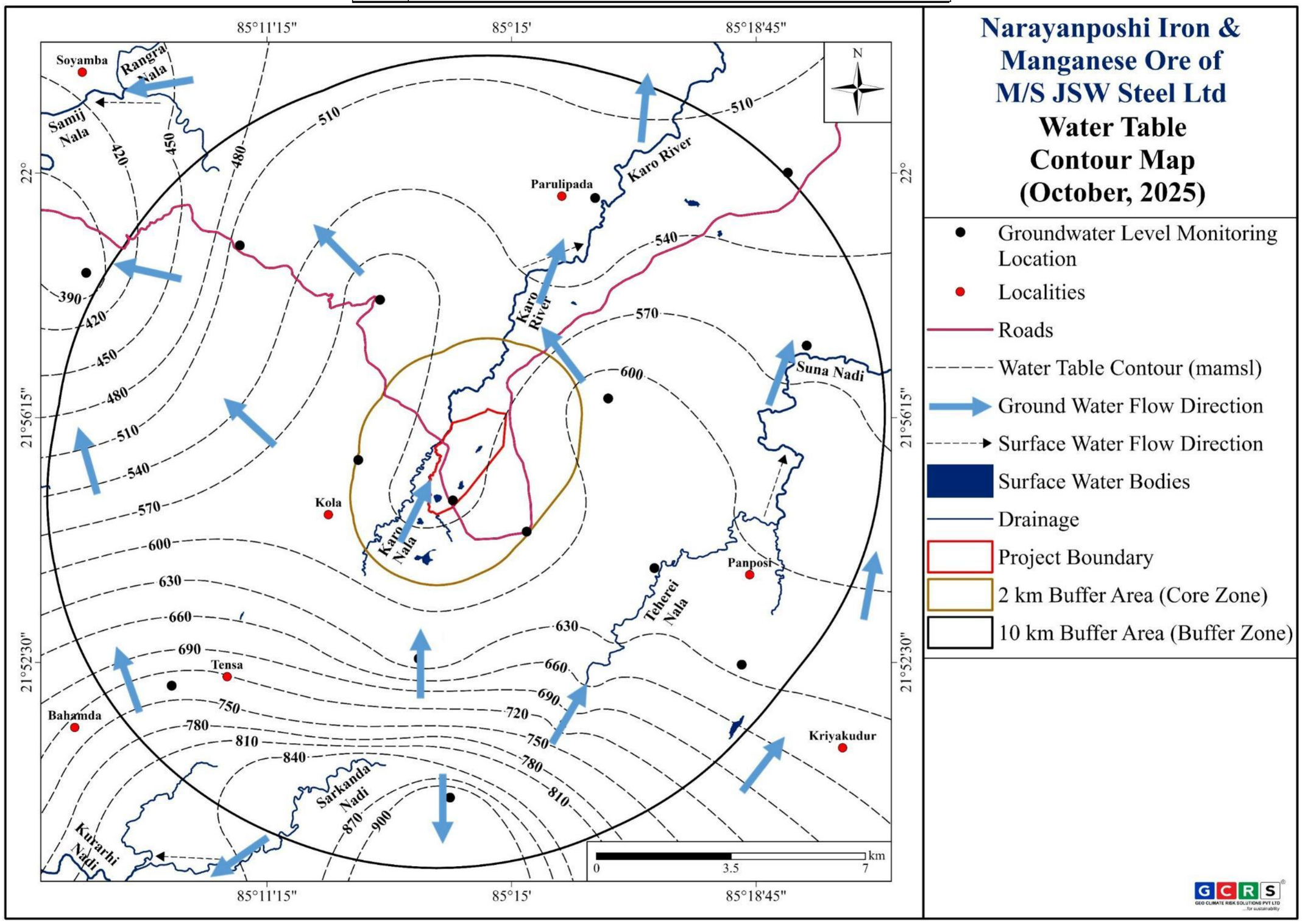


Figure 3.10: Water table contour map for October, 2025.

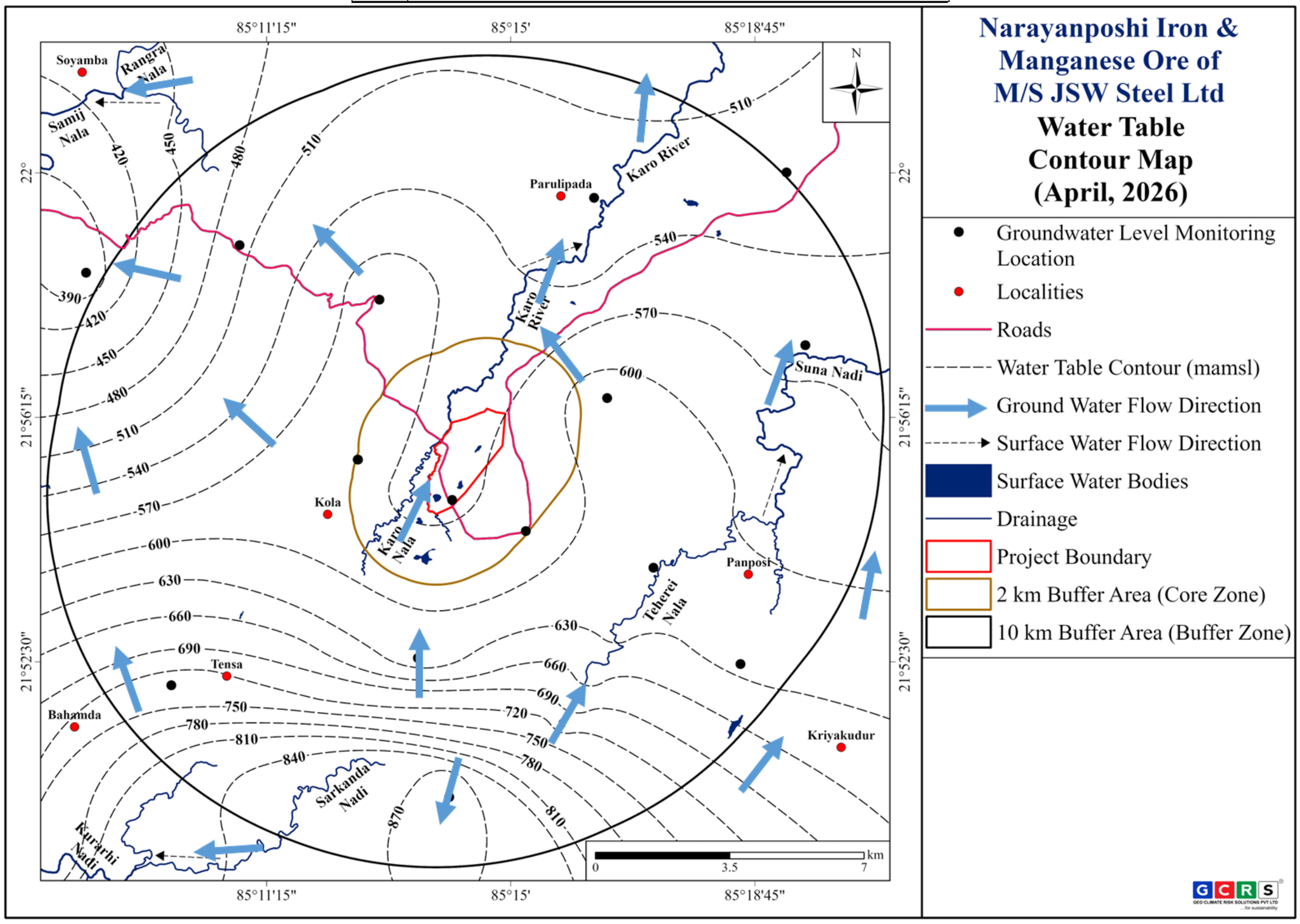


Figure 3.11: Water table contour map for April, 2026.

3.3.3 Depth to Water Level

Groundwater always remains under the influence of time-dependent recharging and discharging factors. Due to this continuous influence, water levels of the aquifer system fluctuate, and the range depends on the period of influence. The recharge to the groundwater system is controlled by several factors such as rainfall, seepage from reservoirs, lakes, ponds, rivers, and irrigation. The output from the groundwater system includes groundwater withdrawal, natural seepage to rivers and sea, evaporation from the shallow water table and transpiration through vegetation also influences the water levels prevailing in each area.

The depth to water level in and around the study area varies from 4.01 to 31.44 mbgl during October, 2025 and it varies from 7.98 to 42.12 mbgl during April, 2026 (Table 3.4). Similarly, in the core zone (2km) it varies from 7.87 to 9.12 mbgl during October 2025 & it varies from 10.35 to 14.34 mbgl during April, 2026. In the buffer zone (10 km study area) it varies from 4.01 to 31.44 mbgl during October, 2025 & it varies from 7.98 to 42.12 mbgl during April, 2026. Beyond the buffer zone (outside study area), it varies from 5.51 to 17.27 mbgl during October, 2025 & varies from 8.98 to 20.98 mbgl during April, 2026. The depth to water level maps of the study area is presented in Figure 3.12 & Figure 3.13. The water level fluctuation

varies from 2.31 to 11.39m in the overall study area & its periphery (Figure 3.14). The depth to water level data with standard deviation of the aforesaid monitoring wells summarised in Table 3.8.

Table 3.8 Summarised results of water level data.

	Water level (mbgl)					
	October, 2025			**April, 2026**		
	Minimum	Maximum	Standard Deviation	Minimum	Maximum	Standard Deviation
Core Zone	7.87	9.12	0.55	10.35	14.34	1.70
Buffer zone (Study area)	4.01	31.44	8.60	7.98	42.12	11.14
Beyond buffer zone	5.51	17.27	5.29	8.98	20.98	5.59

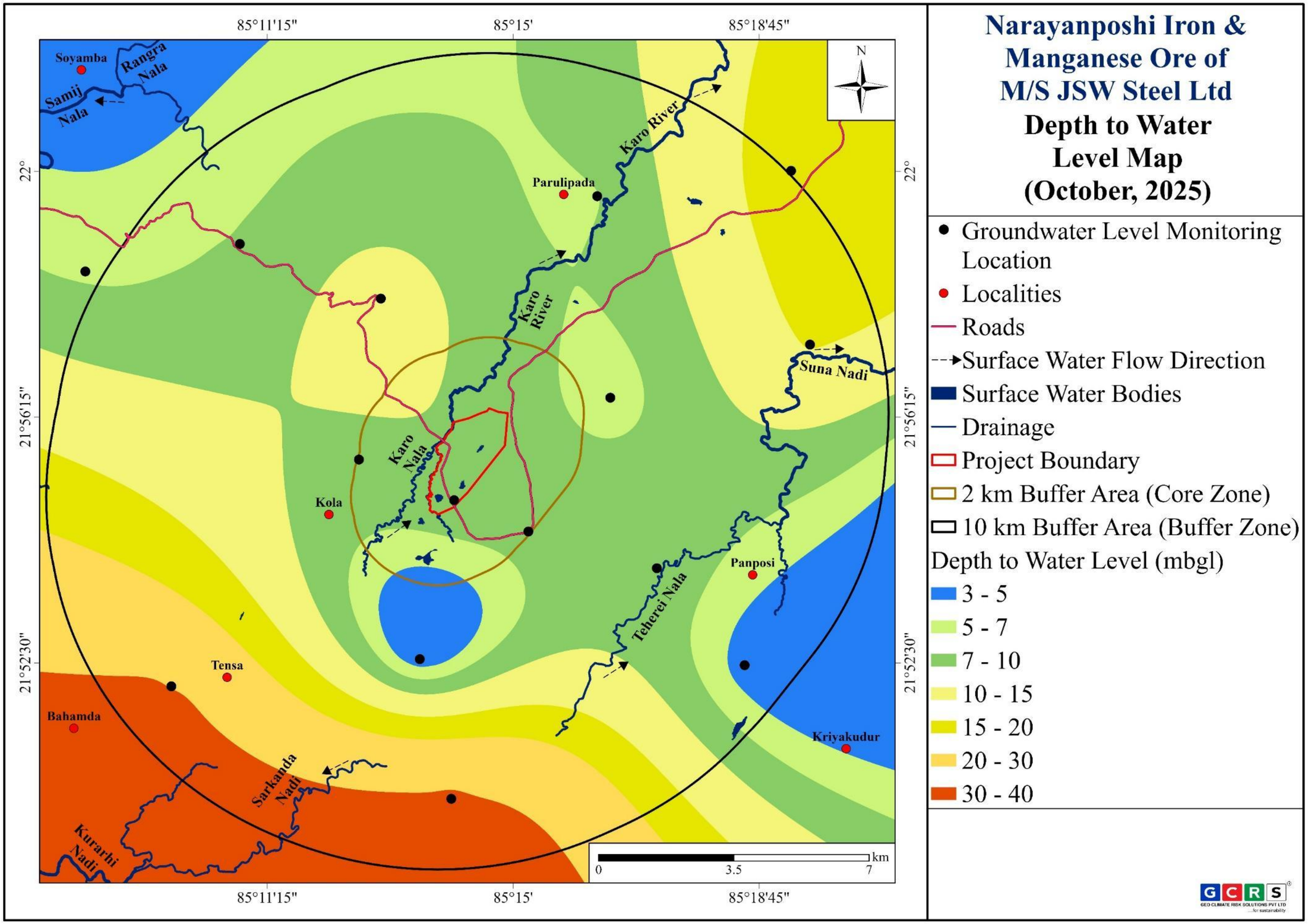


Figure 3.12: Depth to water level map for October, 2025 (Source: Field data).

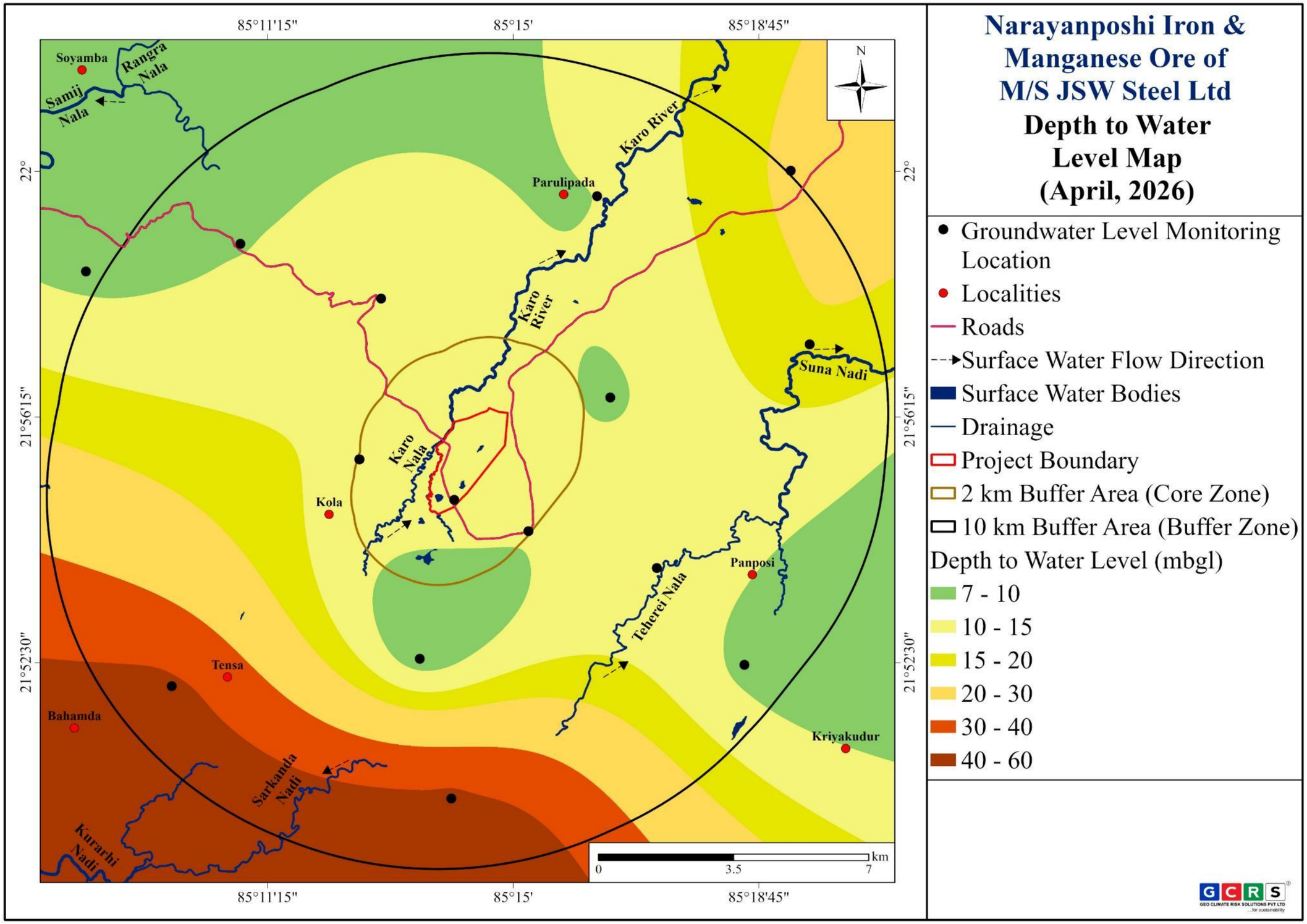


Figure 3.13: Depth to water level map for April, 2026 (Source: Field data).

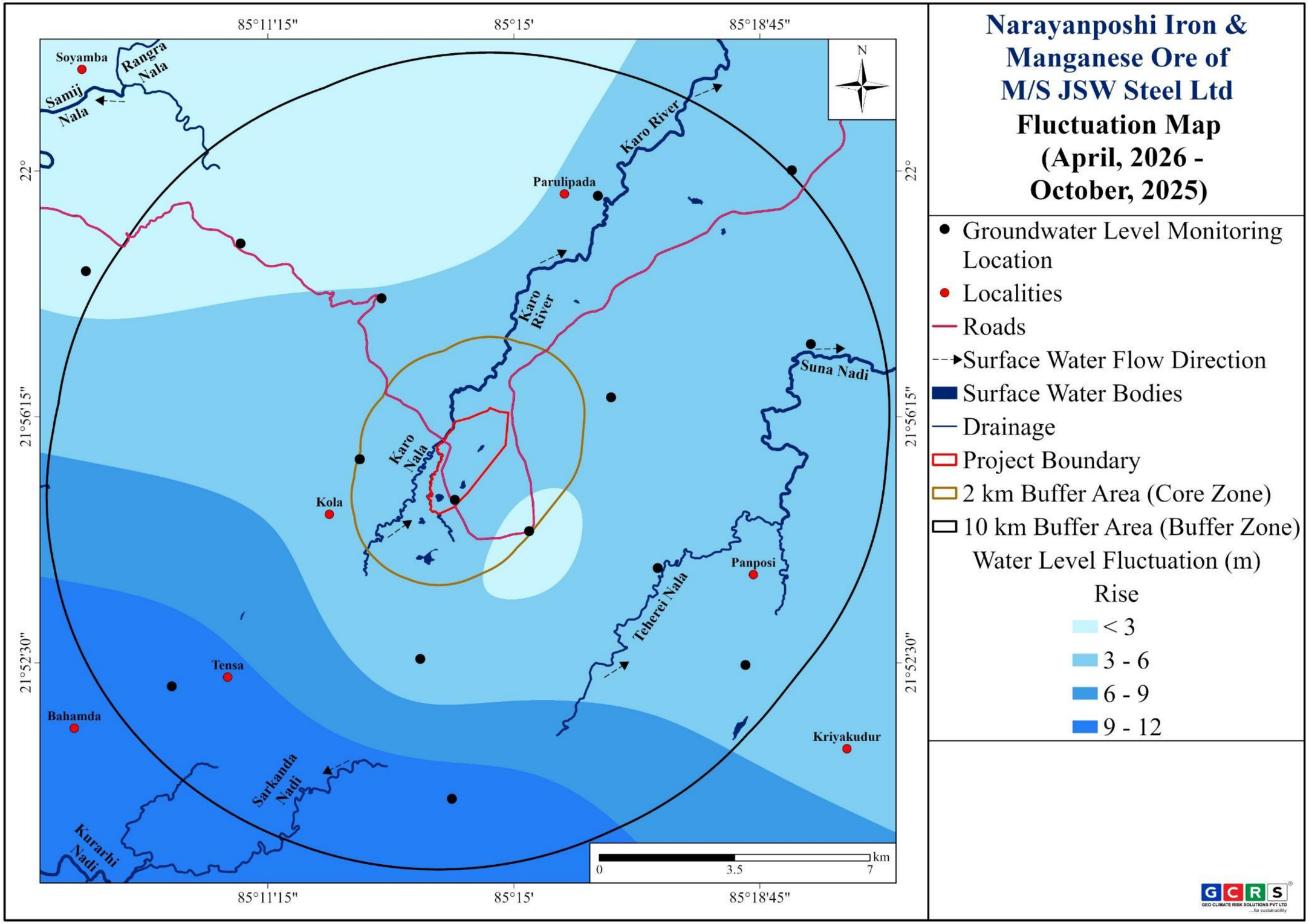
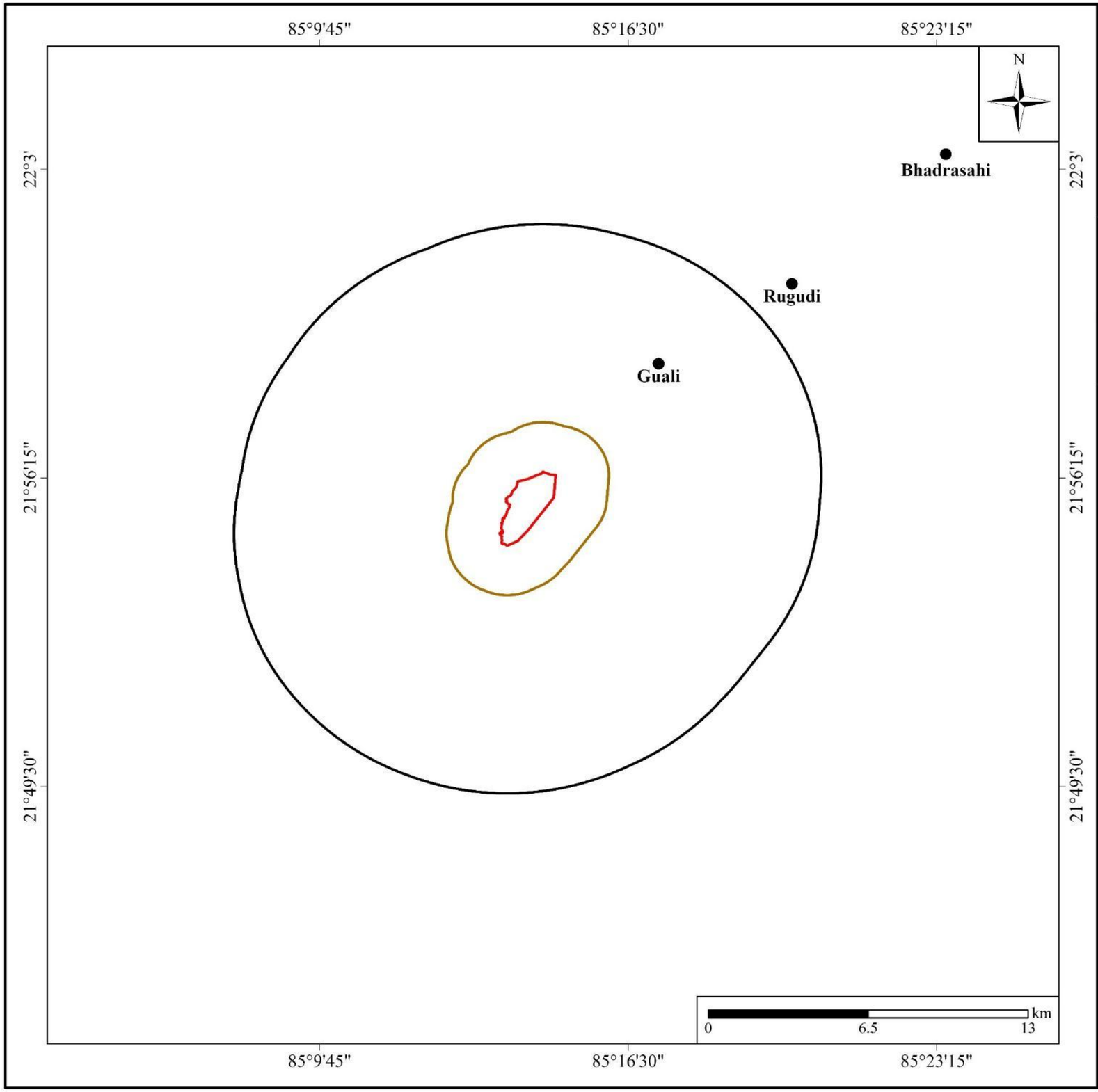


Figure 3.14: Fluctuation map of the study area (October 2025 vs April 2026).

3.3.4 Long-term water level data analysis

To study the long-term changes in groundwater level with respect to time, time series analysis through analysis of hydrographs has been attempted. The variation in groundwater level recorded systematically for a longer period is plotted in the form of a hydrograph. The long-term water level data of the study area has been analysed based on the CGWB water level data of 03 (three) monitoring stations in & around the study area and the data has been considered from year 2014 to 2024 (Annexure -I) (Figure 3.15).

The variation in the aforesaid groundwater level data plotted as hydrographs and presented in Figure 3.16. The non-significant variations observed during these years from the average ground water level may be attributed due to variation in rainfall vis-a-vis recharge or variation in groundwater draft for irrigation, domestic or other purposes. The seasonal fluctuation of water level has been observed in past years of regional water level trends.



Narayanposhi Iron & Manganese Ore of M/S JSW Steel Ltd

Map of Monitoring Locations for Hydrograph

- Monitoring Location
- Project Boundary
- 2 km Buffer Area (Core Zone)
- 10 km Buffer Area (Buffer Zone)

Monitoring Location Name	Distance & Direction from Project Boundary
Guali	5.97 km (NE)
Rugudi	11.78 km (NE)
Bhadrasahi	19.59 km (NE)

Figure 3.15: Map showing the monitoring locations of hydrograph.

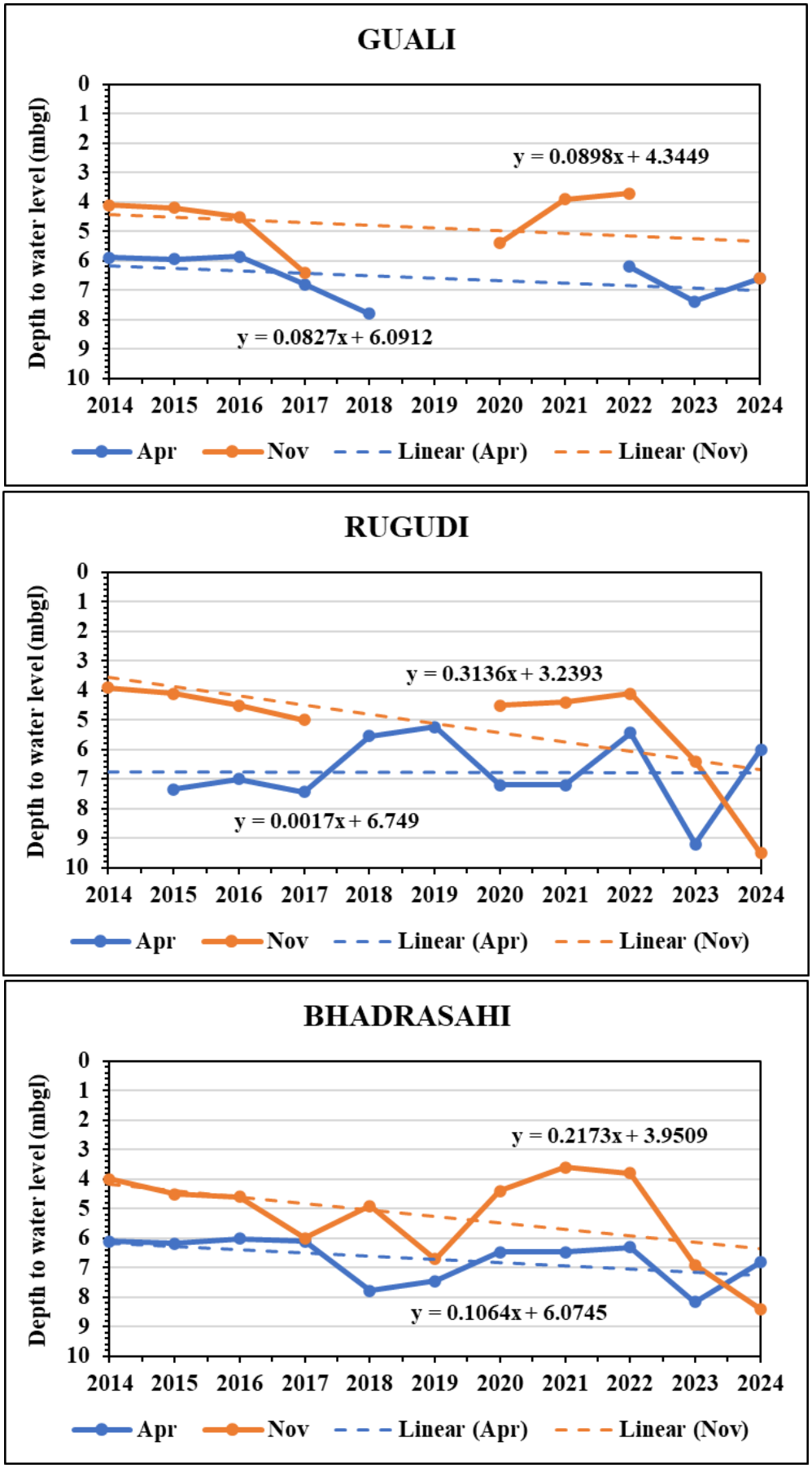


Figure 3.16: Hydrographs of CGWB monitoring locations.

3.3.5 Groundwater quality

The suitability of groundwater for drinking/irrigation/industrial purposes is determined keeping in view the effects of various physio-chemical constituents present in water for the growth of human beings, animals & various plants, and the industrial requirement. There are various standard norms suggested by statutory bodies to assess the water quality parameters. The concentration of any ion exceeding the permissible limit in water can cause serious health issues and may unfit for various industrial purpose. However, many ions are very essential for the growth of plants and human body but when present in excess, have an adverse effect on health and growth.

To analyse the ground water quality of ground water, samples were collected from various locations in and around the study area (Figure 3.17). Further, these samples were sent to NABL accredited laboratory for qualitative analysis (Annexure-II). The values pertaining to the analysis report (Table 3.9) indicates that all the quality parameters lie within the permissible limits stipulated by IS: 10500:2012.

The values for the Electrical Conductivity and the Chloride content have been used to prepare EC and Chloride contours (Figure 3.18 and Figure 3.19). Further, the values for the Fluoride and Nitrate are plotted as point data in terms of their magnitude of concentration proportional to the size of the point and their distribution is shown in the form of Nitrate and Fluoride distribution map of the study area and presented in Figure 3.20 and Figure 3.21 respectively. The electrical conductivity (EC) contour ranges from 115 to 335 µS/cm in the study area and its outer periphery. Similarly, the value of chloride is ranges from 2.46 mg/L to 17.99 mg/L in the overall study area & beyond it. Nitrate concentration ranges from 1.19 to 7.71 mg/L. The fluoride concentration ranges from 0.04 to 0.13 mg/L in the overall study area & its periphery, which is notably very low as per the standards.

Table 3.9: Summarised water quality analysis report.

Sl No.	Sample ID	Location	Longitude	Latitude	pH	EC	TDS	TH	Ca	Mg	Cl	TA	SO_4	NO_3	Na	K	F	Fe	Mn
1	NPWQ1	Inside Mine	85.234999	21.916385	6.87	115	71	35.9	12.1	1.37	4.16	122.3	4.271	2.03	1.51	0.99	0.09	BDL	BDL
2	NPWQ2	Koida	85.253871	21.908418	6.92	136	82	42.4	11.2	3.4	6.58	42.7	6.89	1.22	2.83	0.61	0.08	BDL	BDL
3	NPWQ4	Tentulidihi	85.226259	21.87597	6.86	150	89.4	44.8	12.9	3.09	4.09	18.8	3.37	2.56	7.6	1.27	0.08	BDL	BDL
4	NPWQ5	Segasahi	85.274691	21.942444	6.88	139	81.3	33.9	11.8	1.09	2.46	25.6	5.27	1.19	1.13	8.57	0.10	BDL	BDL
5	NPWQ6	Teherei	85.286515	21.899102	7.01	123.7	78	32.6	10.8	1.46	6.11	24.8	5.98	7.71	3.73	4.28	0.07	BDL	BDL
6	NPWQ7	Patmunda	85.308836	21.874423	6.93	154	97	41.9	12.9	2.43	7.93	31.1	2.99	6.44	5.14	1	0.07	BDL	BDL
7	NPWQ8	Deoghar	85.353868	21.929401	7.04	136	80	45.8	14.8	2.18	3.95	26.5	5.45	3.56	1.52	1.91	0.07	BDL	BDL
8	NPWQ9	Katesahi	85.325435	21.955939	6.78	145	87	42.4	14.3	1.52	5.22	30.1	4.65	2.3	4.66	0.82	0.05	BDL	BDL
9	NPWQ10	Rugudi	85.320621	22.000132	6.79	149	88	51.5	15.9	2.98	3.06	42.7	6.04	1.24	1.41	0.94	0.05	BDL	BDL
10	NPWQ11	Kendudihi	85.271352	21.993664	7.2	144	94	48.2	13.4	3.52	3.9	31.6	5.82	1.35	1.26	1.09	0.05	BDL	BDL
11	NPWQ12	Kalta	85.216379	21.967644	6.98	128	82	40.8	11.2	3.16	5.99	27.8	3.21	4.26	3.3	1.61	0.04	BDL	BDL
12	NPWQ13	Tada Bhuyan Basti	85.180558	21.981534	7.65	123	79	37.2	10.9	2.41	5.79	35.6	6.75	2.09	2.17	1.11	0.05	BDL	BDL
13	NPWQ14	Kunduruburu	85.141266	21.974534	7.18	335	211	58	16.4	4.13	17.99	61.6	12.3	2.53	21.29	0.63	0.13	BDL	BDL
14	NPWQ15	Tensa Nature Camp Gate	85.163138	21.869059	6.92	150	90	47.6	14.4	2.82	3.81	33.7	9.02	1.62	1.64	8.36	0.08	BDL	BDL
15	NPWQ16	Jaldihi	85.234268	21.840467	6.8	134.9	86	35.8	10.2	2.52	7.99	36.2	7.64	3.02	5.43	1.33	0.04	BDL	BDL

Note: All the units are in mg/L except for pH (no unit) and EC in µS/cm. EC (Electrical Conductivity), TDS (Total Dissolved Solids), TH (Total Hardness), Ca (Calcium), Mg (Magnesium), Cl (Chloride), TA (Total Alkalinity), SO_4 (Sulphate), NO_3 (Nitrate), Na (Sodium), K (Potassium), F (Fluoride), Fe (Iron), Mn (Manganese).

BDL: Below detection limit.

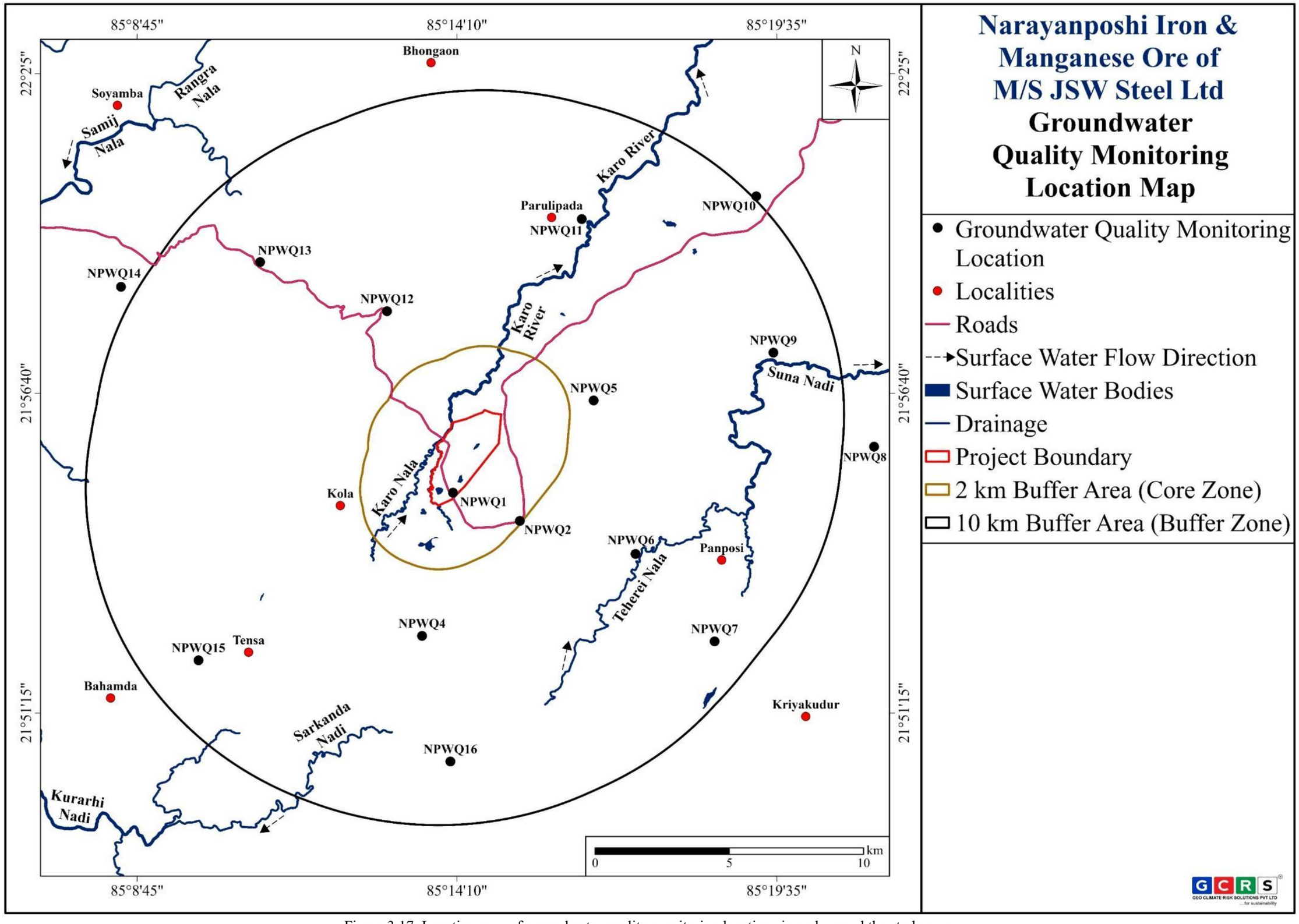


Figure 3.17: Location map of groundwater quality monitoring locations in and around the study area.

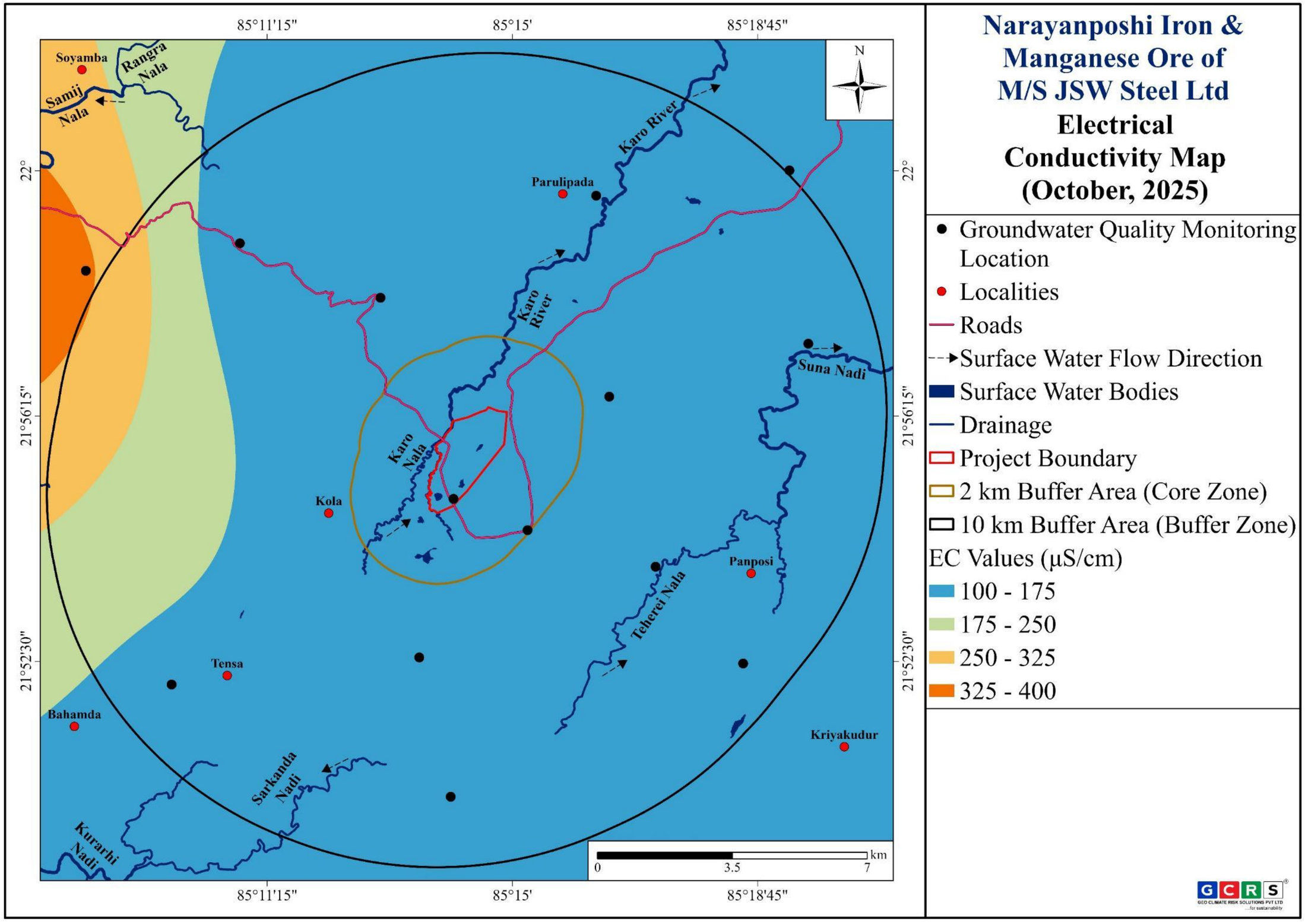
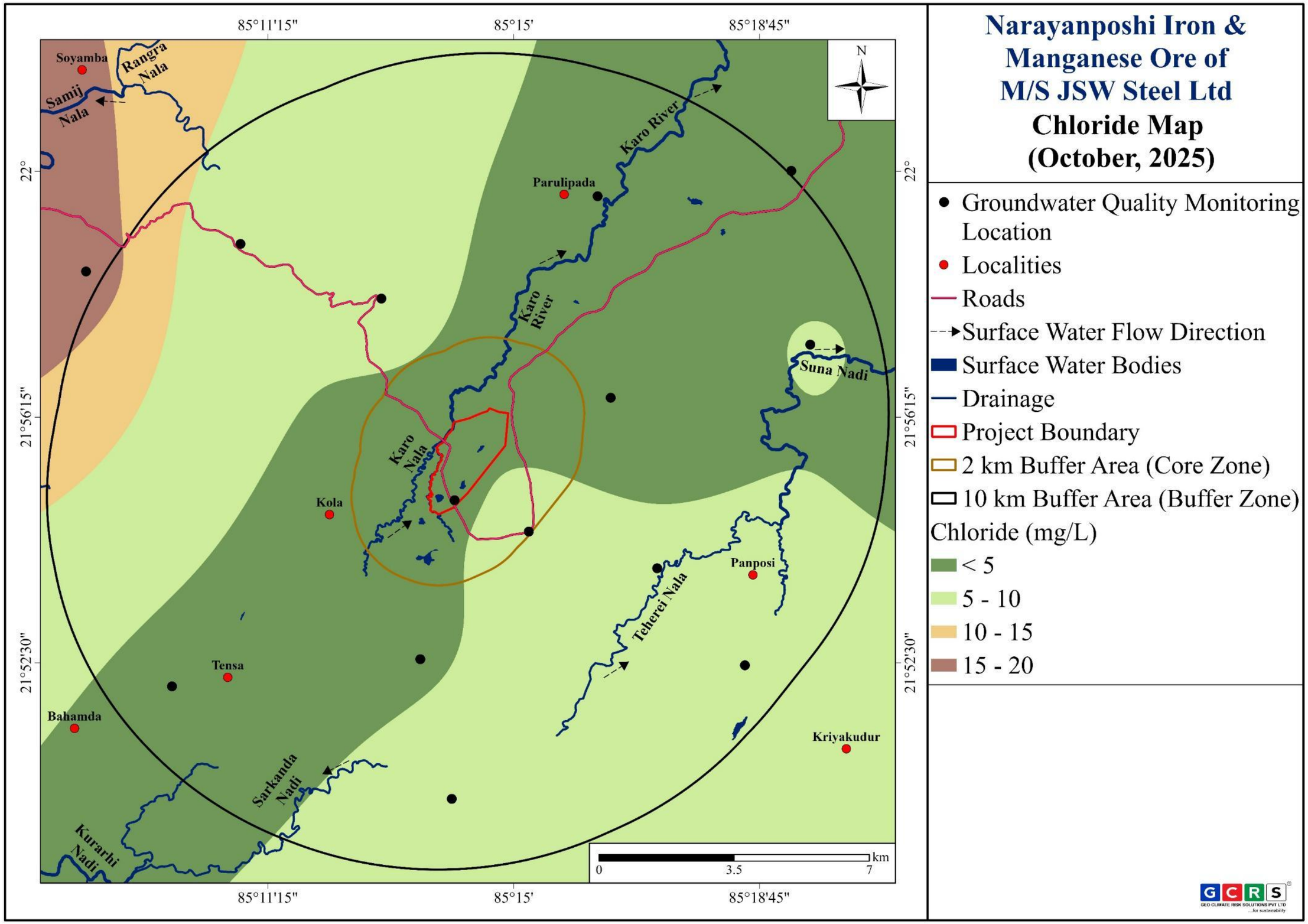


Figure 3.18: EC contour map in and around the study area (Source: Field data).



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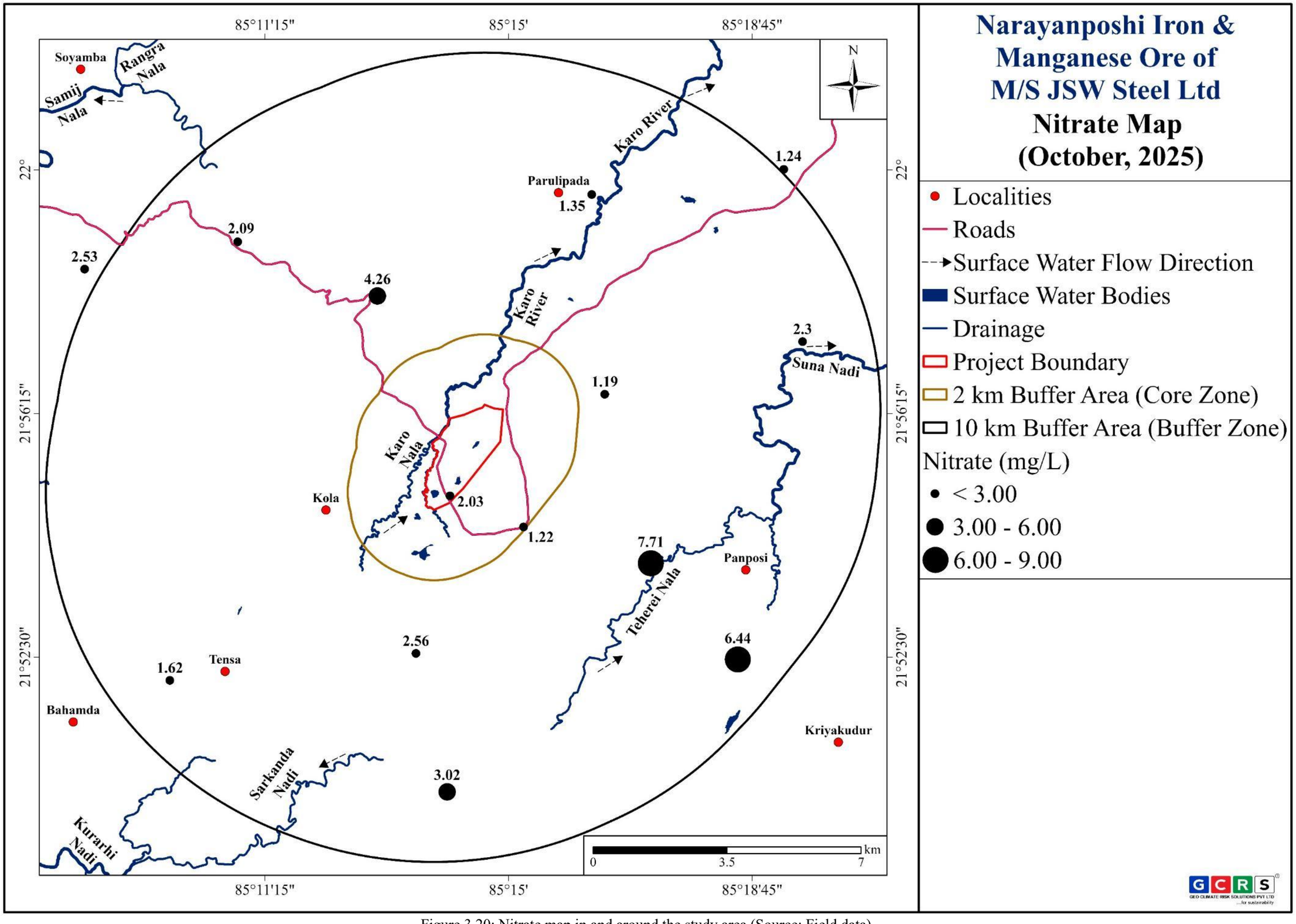
Chloride Map (October, 2025)

- Groundwater Quality Monitoring Location
- Localities
- Roads
- Surface Water Flow Direction
- Surface Water Bodies
- Drainage
- Project Boundary
- 2 km Buffer Area (Core Zone)
- 10 km Buffer Area (Buffer Zone)

Chloride (mg/L)

- < 5
- 5 - 10
- 10 - 15
- 15 - 20

Figure 3.19: Chloride map in and around the study area (Source: Field data).



Narayanposhi Iron & Manganese Ore of M/S JSW Steel Ltd

Nitrate Map (October, 2025)

- Localities
- Roads
- Surface Water Flow Direction
- Surface Water Bodies
- Drainage
- Project Boundary
- 2 km Buffer Area (Core Zone)
- 10 km Buffer Area (Buffer Zone)

Nitrate (mg/L)

- < 3.00
- 3.00 - 6.00
- 6.00 - 9.00

Figure 3.20: Nitrate map in and around the study area (Source: Field data).

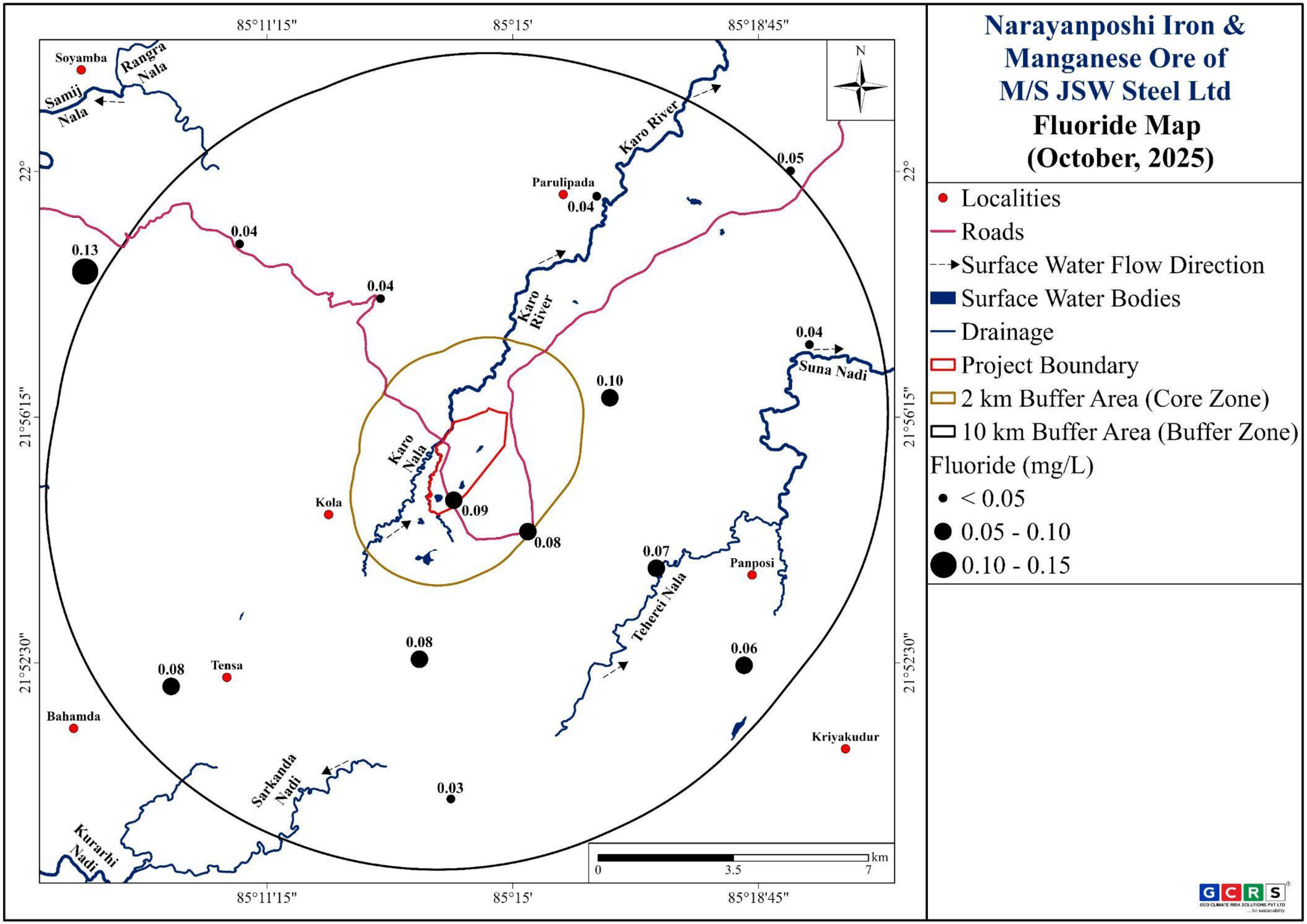


Figure 3.21: Fluoride map in and around the study area (Source: Field data).

4 APPROVED MINE PLAN

The Review of Mining Plan along with Progressive Mine Closure Plan (PMCP) in respect of Narayanposhi Iron & Manganese Ore Block/Mine over an area of 347.008 ha. (as per DGPS) of M/s JSW Steel Limited situated in Village- Koida (Ct), Tahsil- Koida, District–Sundargarh of Odisha State, has been approved by the Indian Bureau of Mines (IBM), Office of The Regional Controller of Mines, Bhubaneshwar via Letter No. RMP-2309/2024-25-IBM_RO_BBS dated 06.12.2024 (Annexure-III). Total forest area involved in the lease is 257.451 ha, out of which diverted forest area is 238.195 ha. balance area i.e. is 19.256 ha have been applied for diversion.

Method of mining

Narayanposhi Iron & Manganese Ore Mine is an "A" category mine and mining operation will execute by fully mechanized & opencast, using shovel-dumper combination and various processes involved are drilling, blasting, excavation, quality control, ore processing (crushing & screening), loading of finished products and waste disposal. Production capacity of the mine has been kept at 10MTPA and 36000TPA respectively.

As per the mineralogical and chemical analysis of Narayanposhi Iron & Manganese Ore Mines, the Fe content in the bulk sample is 60.76%. The alumina, silica and LOI of the sample are 4.16%, 2.75% and 6.18% respectively.

Bench height and width will be kept at 9mand 10 to 15m for iron and 6m and 7m for manages. The detail of the in-situ mining is given in Table 4.1.

Table 4.1: In-situ mining.

SI. No.	Year	Waste Quantity (t)	ROM Quantity (t)	Total Handling (t)	ROM Quantity Saleable Mineral (t)	ROM Quantity Mineral Reject (t)	OB Ratio to Ore (Waste Quantity/ ROM Quantity)	Grade Range (%)
1	2025-26	2378600.00	10035999.00	12414599.00	10035999.00	0	0.24	Fe Range 45-65% having avg. grade of Fe% 59.47 Mn Range 10-25% having avg. grade of Mn% 23.9
2	2026-27	3719000.00	10036000.00	13755000.00	10036000.00	0	0.37	Fe Range 45-65% having avg. grade of Fe% 59.41 Mn Range 10-25% having avg. grade of Mn% 23.89
3	2027-28	3409600.00	10036000.00	13445600.00	9136000.00	900000.00	0.34	Fe Range 45-65% having avg. grade of Fe% 59.98 Mn Range 10-25% having avg. grade of Mn% 23.91 Proposed
4	2028-29	4636000.00	10036000.00	14672000.00	9136000.00	900000.00	0.46	Fe Range 45-65% having avg. grade of Fe% 60.02 Mn Range 10-25% having avg. grade of Mn% 23.88 Proposed
5	2029-30	4044600.00	10036000.00	14080600.00	9136000.00	900000.00	0.4	Fe Range 45-65% having avg. grade of Fe% 60.05 Mn Range 10-25% having avg. grade of Mn% 23.91 Proposed
	Total	**18187800.00**	**50179999.00**	**68367799.00**	**47479999.00**	**2700000.00**		

(Source: Approved review of mining plan)

5 ESTIMATION OF MINE SEEPAGE AND ADVANCED DEWATERING PLAN

5.1 ESTIMATION OF MINE SEEPAGE

During mining, seepage (water-inrush) is mostly considered. Fractures are developed and expanded in the surrounding rock and connected with the fractured geological structure, then water flow channels are formed, and finally, water-inrush happens indirectly. Numerical modelling helps a lot in evaluating this seepage by a result of numerical modelling to predict the quantity of inflow & provides valuable information for an appropriate dewatering system. The water inflow to the tunnel is mainly from a confined aquifer, mainly by horizontal flow in the upper layers and vertical flow at the tunnel bottom.

The groundwater seepages start in the mining as the water table of the area is encountered. The quantum of water that accumulates in the mine sump is quite large and varies with time and season. Any mining activity would require pumping of this water to allow mining activity.

The mine seepage has been estimated using Darcy's equation which states that flow is directly proportional to the surface area of the aquifer exposed in the tunnel face and the gradient of the water table.

Q α K I A

Where,

Q = rate of flow

I = water table gradient

A= cross section area of aquifer exposed in tunnel

The above relationship may be written as Q = KIA or Q = (Kb)IL

where k is permeability, b is aquifer thickness.

The estimated mine seepage is given in Table 5.1. The mine seepage is calculated both RF quarry & Q-3&4 pit for plan period 2025-26 to 2027-28 and merger of RF quarry & Q-3&4 for plan period 2028-29 to 2029-30. The estimated quantity of mine seepage during the 5-years period varies from 873 to 1388 m^3/day. During the end of the NOC period, the maximum estimated mine seepage will be **1095 m^3/day**. The estimated seepage from mine face, mine bottom & the summered year wise total dewatering including borewell abstraction & rainwater quantum is given in Table 5.1, Table 5.2 & Table **5.3** respectively.

Table 5.1: Estimated mine seepage from faces.

Year	Quarry Name	Season	mRL of Bench (mamsl)		Thickness of Bench (m)	Perimeter (m)	DTW (mamsl)	Saturated Aquifer thickness (b,m)	Hydraulic Conductivity (K) (m/day)	Hydraulic Gradient (I, m/m)	Saturated Area (A, m^2)	Seepage (Q, m^3/day)	Average Seepage (m^3/day)
2025-26	RF Quarry	Pre-Monsoon	630	624	6	184	560	0	0.98	0.0075	0	0	0
		Post-Monsoon	630	624	6	184	565	0	0.98	0.0075	0	0	
		Pre-Monsoon	624	615	9	183	560	0	0.98	0.0075	0	0	0
		Post-Monsoon	624	615	9	183	565	0	0.98	0.0075	0	0	
		Pre-Monsoon	615	606	9	323	560	0	0.98	0.0075	0	0	0
		Post-Monsoon	615	606	9	323	565	0	0.98	0.0075	0	0	
		Pre-Monsoon	606	597	9	302	560	0	0.98	0.0075	0	0	0
		Post-Monsoon	606	597	9	302	565	0	0.98	0.0075	0	0	
		Pre-Monsoon	597	588	9	679	560	0	0.98	0.0075	0	0	0
		Post-Monsoon	597	588	9	679	565	0	0.98	0.0075	0	0	
		Pre-Monsoon	588	579	9	1226	560	0	0.98	0.0075	0	0	0
		Post-Monsoon	588	579	9	1226	565	0	0.98	0.0075	0	0	
		Pre-Monsoon	579	570	9	1203	560	0	0.98	0.0075	0	0	0
		Post-Monsoon	579	570	9	1203	565	0	0.98	0.0075	0	0	

		Pre-Monsoon	570	561	9	1304	560	0	0.98	0.0075	0	0	19
		Post-Monsoon	570	561	9	1304	565	4	0.98	0.0075	5216	38	
		Pre-Monsoon	561	552	9	1765	560	8	0.98	0.0075	14120	104	110
		Post-Monsoon	561	552	9	1765	565	9	0.98	0.0075	15885	117	
		Pre-Monsoon	552	543	9	1561	560	9	0.98	0.0075	14049	103	103
		Post-Monsoon	552	543	9	1561	565	9	0.98	0.0075	14049	103	
		Pre-Monsoon	543	534	9	1324	560	9	0.98	0.0075	11916	88	88
		Post-Monsoon	543	534	9	1324	565	9	0.98	0.0075	11916	88	
		Pre-Monsoon	534	525	9	1029	560	9	0.98	0.0075	9261	68	68
		Post-Monsoon	534	525	9	1029	565	9	0.98	0.0075	9261	68	
		Pre-Monsoon	525	516	9	938	560	9	0.98	0.0075	8442	62	62
		Post-Monsoon	525	516	9	938	565	9	0.98	0.0075	8442	62	
		Pre-Monsoon	516	507	9	767	560	9	0.98	0.0075	6903	51	51
		Post-Monsoon	516	507	9	767	565	9	0.98	0.0075	6903	51	
		Sub-Total											**501**
	Q-3&4	Pre-Monsoon	606	597	9	451	560	0	0.98	0.0075	0	0	**0**
		Post-Monsoon	606	597	9	451	565	0	0.98	0.0075	0	0	
		Pre-Monsoon	597	588	9	828	560	0	0.98	0.0075	0	0	**0**

		Post-Monsoon	597	588	9	828	565	0	0.98	0.0075	0	0	
		Pre-Monsoon	588	579	9	917	560	0	0.98	0.0075	0	0	**0**
		Post-Monsoon	588	579	9	917	565	0	0.98	0.0075	0	0	
		Pre-Monsoon	579	570	9	1022	560	0	0.98	0.0075	0	0	**0**
		Post-Monsoon	579	570	9	1022	565	0	0.98	0.0075	0	0	
		Pre-Monsoon	570	561	9	1004	560	0	0.98	0.0075	0	0	**15**
		Post-Monsoon	570	561	9	1004	565	4	0.98	0.0075	4016	30	
		Pre-Monsoon	561	552	9	1598	560	8	0.98	0.0075	12784	94	**100**
		Post-Monsoon	561	552	9	1598	565	9	0.98	0.0075	14382	106	
		Pre-Monsoon	552	543	9	1325	560	9	0.98	0.0075	11925	88	**88**
		Post-Monsoon	552	543	9	1325	565	9	0.98	0.0075	11925	88	
		Pre-Monsoon	543	534	9	1186	560	9	0.98	0.0075	10674	78	**78**
		Post-Monsoon	543	534	9	1186	565	9	0.98	0.0075	10674	78	
		Pre-Monsoon	534	529	5	410	560	9	0.98	0.0075	3690	27	**27**
		Post-Monsoon	534	529	5	410	565	9	0.98	0.0075	3690	27	
		Sub-Total											**308**
	Total												**809**
2026-27	**RF Quarry**	Pre-Monsoon	630	624	6	183	560	0	0.98	0.0076	0	0	0

		Post-Monsoon	630	624	6	183	565	0	0.98	0.0076	0	0	
		Pre-Monsoon	624	615	9	323	560	0	0.98	0.0076	0	0	0
		Post-Monsoon	624	615	9	323	565	0	0.98	0.0076	0	0	
		Pre-Monsoon	615	606	9	386	560	0	0.98	0.0076	0	0	0
		Post-Monsoon	615	606	9	386	565	0	0.98	0.0076	0	0	
		Pre-Monsoon	606	597	9	430	560	0	0.98	0.0076	0	0	0
		Post-Monsoon	606	597	9	430	565	0	0.98	0.0076	0	0	
		Pre-Monsoon	597	588	9	643	560	0	0.98	0.0076	0	0	0
		Post-Monsoon	597	588	9	643	565	0	0.98	0.0076	0	0	
		Pre-Monsoon	588	579	9	1202	560	0	0.98	0.0076	0	0	0
		Post-Monsoon	588	579	9	1202	565	0	0.98	0.0076	0	0	
		Pre-Monsoon	579	570	9	1179	560	0	0.98	0.0076	0	0	0
		Post-Monsoon	579	570	9	1179	565	0	0.98	0.0076	0	0	
		Pre-Monsoon	570	561	9	1293	560	0	0.98	0.0076	0	0	19
		Post-Monsoon	570	561	9	1293	565	4	0.98	0.0076	5172	39	
		Pre-Monsoon	561	552	9	1765	560	8	0.98	0.0076	14120	105	112
		Post-Monsoon	561	552	9	1765	565	9	0.98	0.0076	15885	118	

		Pre-Monsoon	552	543	9	1561	560	9	0.98	0.0076	14049	105	105
		Post-Monsoon	552	543	9	1561	565	9	0.98	0.0076	14049	105	
		Pre-Monsoon	543	534	9	1329	560	9	0.98	0.0076	11961	89	89
		Post-Monsoon	543	534	9	1329	565	9	0.98	0.0076	11961	89	
		Pre-Monsoon	534	525	9	1217	560	9	0.98	0.0076	10953	82	82
		Post-Monsoon	534	525	9	1217	565	9	0.98	0.0076	10953	82	
		Pre-Monsoon	525	516	9	1154	560	9	0.98	0.0076	10386	77	77
		Post-Monsoon	525	516	9	1154	565	9	0.98	0.0076	10386	77	
		Pre-Monsoon	516	507	9	980	560	9	0.98	0.0076	8820	66	66
		Post-Monsoon	516	507	9	980	565	9	0.98	0.0076	8820	66	
		Sub-Total											**549**
	Q-3&4	Pre-Monsoon	615	606	9	238	560	0	0.98	0.0076	0	0	**0**
		Post-Monsoon	615	606	9	238	565	0	0.98	0.0076	0	0	
		Pre-Monsoon	606	597	9	756	560	0	0.98	0.0076	0	0	**0**
		Post-Monsoon	606	597	9	756	565	0	0.98	0.0076	0	0	
		Pre-Monsoon	597	588	9	705	560	0	0.98	0.0076	0	0	**0**
		Post-Monsoon	597	588	9	705	565	0	0.98	0.0076	0	0	
		Pre-Monsoon	588	579	9	1028	560	0	0.98	0.0076	0	0	**0**

		Post-Monsoon	588	579	9	1028	565	0	0.98	0.0076	0	0	
		Pre-Monsoon	579	570	9	1064	560	0	0.98	0.0076	0	0	**0**
		Post-Monsoon	579	570	9	1064	565	0	0.98	0.0076	0	0	
		Pre-Monsoon	570	561	9	1130	560	0	0.98	0.0076	0	0	**17**
		Post-Monsoon	570	561	9	1130	565	4	0.98	0.0076	4520	34	
		Pre-Monsoon	561	552	9	1407	560	8	0.98	0.0076	11256	84	**89**
		Post-Monsoon	561	552	9	1407	565	9	0.98	0.0076	12663	94	
		Pre-Monsoon	552	543	9	1346	560	9	0.98	0.0076	12114	90	**90**
		Post-Monsoon	552	543	9	1346	565	9	0.98	0.0076	12114	90	
		Pre-Monsoon	543	534	9	478	560	9	0.98	0.0076	4302	32	**32**
		Post-Monsoon	543	534	9	478	565	9	0.98	0.0076	4302	32	
		Pre-Monsoon	534	529	5	410	560	9	0.98	0.0076	3690	27	**27**
		Post-Monsoon	534	529	5	410	565	9	0.98	0.0076	3690	27	
		Sub-Total											**256**
	Total												**805**
2027-28	**RF Quarry**	Pre-Monsoon	630	624	6	184	560	0	0.98	0.0077	0	0	0
		Post-Monsoon	630	624	6	184	565	0	0.98	0.0077	0	0	
		Pre-Monsoon	624	615	9	183	560	0	0.98	0.0077	0	0	0

		Post-Monsoon	624	615	9	183	565	0	0.98	0.0077	0	0	
		Pre-Monsoon	615	606	9	323	560	0	0.98	0.0077	0	0	0
		Post-Monsoon	615	606	9	323	565	0	0.98	0.0077	0	0	
		Pre-Monsoon	606	597	9	386	560	0	0.98	0.0077	0	0	0
		Post-Monsoon	606	597	9	386	565	0	0.98	0.0077	0	0	
		Pre-Monsoon	597	588	9	673	560	0	0.98	0.0077	0	0	0
		Post-Monsoon	597	588	9	673	565	0	0.98	0.0077	0	0	
		Pre-Monsoon	588	579	9	1232	560	0	0.98	0.0077	0	0	0
		Post-Monsoon	588	579	9	1232	565	0	0.98	0.0077	0	0	
		Pre-Monsoon	579	570	9	1136	560	0	0.98	0.0077	0	0	0
		Post-Monsoon	579	570	9	1136	565	0	0.98	0.0077	0	0	
		Pre-Monsoon	570	561	9	1247	560	0	0.98	0.0077	0	0	19
		Post-Monsoon	570	561	9	1247	565	4	0.98	0.0077	4988	38	
		Pre-Monsoon	561	552	9	1563	560	8	0.98	0.0077	12504	94	100
		Post-Monsoon	561	552	9	1563	565	9	0.98	0.0077	14067	106	
		Pre-Monsoon	552	543	9	1801	560	9	0.98	0.0077	16209	122	122
		Post-Monsoon	552	543	9	1801	565	9	0.98	0.0077	16209	122	

		Pre-Monsoon	543	534	9	1629	560	9	0.98	0.0077	14661	111	111
		Post-Monsoon	543	534	9	1629	565	9	0.98	0.0077	14661	111	
		Pre-Monsoon	534	525	9	1506	560	9	0.98	0.0077	13554	102	102
		Post-Monsoon	534	525	9	1506	565	9	0.98	0.0077	13554	102	
		Pre-Monsoon	525	516	9	1257	560	9	0.98	0.0077	11313	85	85
		Post-Monsoon	525	516	9	1257	565	9	0.98	0.0077	11313	85	
		Pre-Monsoon	516	507	9	1005	560	9	0.98	0.0077	9045	68	68
		Post-Monsoon	516	507	9	1005	565	9	0.98	0.0077	9045	68	
		Pre-Monsoon	507	498	9	666	560	9	0.98	0.0077	5994	45	45
		Post-Monsoon	507	498	9	666	565	9	0.98	0.0077	5994	45	
		Sub-Total											**653**
	Q-3&4	Pre-Monsoon	615	606	9	195	560	0	0.98	0.0077	0	0	**0**
		Post-Monsoon	615	606	9	195	565	0	0.98	0.0077	0	0	
		Pre-Monsoon	606	597	9	621	560	0	0.98	0.0077	0	0	**0**
		Post-Monsoon	606	597	9	621	565	0	0.98	0.0077	0	0	
		Pre-Monsoon	597	588	9	705	560	0	0.98	0.0077	0	0	**0**
		Post-Monsoon	597	588	9	705	565	0	0.98	0.0077	0	0	
		Pre-Monsoon	588	579	9	1028	560	0	0.98	0.0077	0	0	**0**

		Post-Monsoon	588	579	9	1028	565	0	0.98	0.0077	0	0	
		Pre-Monsoon	579	570	9	1081	560	0	0.98	0.0077	0	0	**0**
		Post-Monsoon	579	570	9	1081	565	0	0.98	0.0077	0	0	
		Pre-Monsoon	570	561	9	1088	560	0	0.98	0.0077	0	0	**16**
		Post-Monsoon	570	561	9	1088	565	4	0.98	0.0077	4352	33	
		Pre-Monsoon	561	552	9	1355	560	8	0.98	0.0077	10840	82	**87**
		Post-Monsoon	561	552	9	1355	565	9	0.98	0.0077	12195	92	
		Pre-Monsoon	552	543	9	1477	560	9	0.98	0.0077	13293	100	**100**
		Post-Monsoon	552	543	9	1477	565	9	0.98	0.0077	13293	100	
		Pre-Monsoon	543	534	9	1154	560	9	0.98	0.0077	10386	78	**78**
		Post-Monsoon	543	534	9	1154	565	9	0.98	0.0077	10386	78	
		Pre-Monsoon	534	529	5	926	560	9	0.98	0.0077	8334	63	**63**
		Post-Monsoon	534	529	5	926	565	9	0.98	0.0077	8334	63	
		Pre-Monsoon	529	516	13	736	560	9	0.98	0.0077	6624	50	**50**
		Post-Monsoon	529	516	13	736	565	9	0.98	0.0077	6624	50	
		Sub-Total											**395**
	Total												**1048**
2028-29	**Merged (RF**	Pre-Monsoon	624	615	9	785	560	0	0.98	0.0078	0	0	0

	Quarry and Q-3&4)	Post-Monsoon	624	615	9	785	565	0	0.98	0.0078	0	0	
		Pre-Monsoon	615	606	9	1043	560	0	0.98	0.0078	0	0	0
		Post-Monsoon	615	606	9	1043	565	0	0.98	0.0078	0	0	
		Pre-Monsoon	606	597	9	1332	560	0	0.98	0.0078	0	0	0
		Post-Monsoon	606	597	9	1332	565	0	0.98	0.0078	0	0	
		Pre-Monsoon	597	588	9	1651	560	0	0.98	0.0078	0	0	0
		Post-Monsoon	597	588	9	1651	565	0	0.98	0.0078	0	0	
		Pre-Monsoon	588	579	9	2341	560	0	0.98	0.0078	0	0	0
		Post-Monsoon	588	579	9	2341	565	0	0.98	0.0078	0	0	
		Pre-Monsoon	579	570	9	2790	560	0	0.98	0.0078	0	0	0
		Post-Monsoon	579	570	9	2790	565	0	0.98	0.0078	0	0	
		Pre-Monsoon	570	561	9	3441	560	0	0.98	0.0078	0	0	53
		Post-Monsoon	570	561	9	3441	565	4	0.98	0.0078	13764	105	
		Pre-Monsoon	561	552	9	3640	560	8	0.98	0.0078	29120	223	237
		Post-Monsoon	561	552	9	3640	565	9	0.98	0.0078	32760	250	
		Pre-Monsoon	552	543	9	3687	560	9	0.98	0.0078	33183	254	254
		Post-Monsoon	552	543	9	3687	565	9	0.98	0.0078	33183	254	

		Pre-Monsoon	543	534	9	3454	560	9	0.98	0.0078	31086	238	238
		Post-Monsoon	543	534	9	3454	565	9	0.98	0.0078	31086	238	
		Pre-Monsoon	534	525	9	2582	560	9	0.98	0.0078	23238	178	178
		Post-Monsoon	534	525	9	2582	565	9	0.98	0.0078	23238	178	
		Pre-Monsoon	525	516	9	2189	560	9	0.98	0.0078	19701	151	151
		Post-Monsoon	525	516	9	2189	565	9	0.98	0.0078	19701	151	
		Pre-Monsoon	516	507	9	1843	560	9	0.98	0.0078	16587	127	127
		Post-Monsoon	516	507	9	1843	565	9	0.98	0.0078	16587	127	
		Pre-Monsoon	507	498	9	688	560	9	0.98	0.0078	6192	47	47
		Post-Monsoon	507	498	9	688	565	9	0.98	0.0078	6192	47	
		Pre-Monsoon	498	489	9	517	560	9	0.98	0.0078	4653	36	36
		Post-Monsoon	498	489	9	517	565	9	0.98	0.0078	4653	36	
	Total												**1318**
2029-30	**Merged (RF Quarry and Q-3&4)**	Pre-Monsoon	624	615	9	465	560	0	0.98	0.0078	0	0	0
		Post-Monsoon	624	615	9	465	565	0	0.98	0.0078	0	0	
		Pre-Monsoon	615	606	9	634	560	0	0.98	0.0078	0	0	0
		Post-Monsoon	615	606	9	634	565	0	0.98	0.0078	0	0	
		Pre-Monsoon	606	597	9	1018	560	0	0.98	0.0078	0	0	0

		Post-Monsoon	606	597	9	1018	565	0	0.98	0.0078	0	0	
		Pre-Monsoon	597	588	9	1631	560	0	0.98	0.0078	0	0	0
		Post-Monsoon	597	588	9	1631	565	0	0.98	0.0078	0	0	
		Pre-Monsoon	588	579	9	2218	560	0	0.98	0.0078	0	0	0
		Post-Monsoon	588	579	9	2218	565	0	0.98	0.0078	0	0	
		Pre-Monsoon	579	570	9	3862	560	0	0.98	0.0078	0	0	0
		Post-Monsoon	579	570	9	3862	565	0	0.98	0.0078	0	0	
		Pre-Monsoon	570	561	9	3991	560	0	0.98	0.0078	0	0	61
		Post-Monsoon	570	561	9	3991	565	4	0.98	0.0078	15964	122	
		Pre-Monsoon	561	552	9	3994	560	8	0.98	0.0078	31952	244	260
		Post-Monsoon	561	552	9	3994	565	9	0.98	0.0078	35946	275	
		Pre-Monsoon	552	543	9	3687	560	9	0.98	0.0078	33183	254	254
		Post-Monsoon	552	543	9	3687	565	9	0.98	0.0078	33183	254	
		Pre-Monsoon	543	534	9	3455	560	9	0.98	0.0078	31095	238	238
		Post-Monsoon	543	534	9	3455	565	9	0.98	0.0078	31095	238	
		Pre-Monsoon	534	525	9	2582	560	9	0.98	0.0078	23238	178	178
		Post-Monsoon	534	525	9	2582	565	9	0.98	0.0078	23238	178	

		Pre-Monsoon	525	516	9	2189	560	9	0.98	0.0078	19701	151	151
		Post-Monsoon	525	516	9	2189	565	9	0.98	0.0078	19701	151	
		Pre-Monsoon	516	507	9	1843	560	9	0.98	0.0078	16587	127	127
		Post-Monsoon	516	507	9	1843	565	9	0.98	0.0078	16587	127	
		Pre-Monsoon	507	498	9	688	560	9	0.98	0.0078	6192	47	47
		Post-Monsoon	507	498	9	688	565	9	0.98	0.0078	6192	47	
		Pre-Monsoon	498	489	9	517	560	9	0.98	0.0078	4653	36	36
		Post-Monsoon	498	489	9	517	565	9	0.98	0.0078	4653	36	
	Total												**1350**

Table 5.2: Estimated mine seepage from bottom.

Year	Pit Name	Bottom Area (m2)	Hydraulic Conductivity (K, m/day)	Hydraulic Gradient (I, m/m)	Seepage m^3/day
2025-26	RF Quarry	**38613**	0.098	0.0075	28
	Q-3&4	43572	0.098	0.0075	32
	Total				**64**
2026-27	RF Quarry	44148	0.098	0.0076	33
	Q-3&4	49695	0.098	0.0076	37
	Total				**70**
2027-28	**RF Quarry**	**33700**	**0.098**	**0.0077**	**25**
	Q-3&4	**28402**	**0.098**	**0.0077**	**21**
	Total				**47**
2028-29	Merged (RF Quarry and Q-3 & 4)	46754	0.098	0.0078	36
	Total				**38**
2029-30	Merged (RF Quarry and Q-3 & 4)	46754	0.098	0.0078	36
	Total				**38**

Note: K for that area about 0.98 m/day based on pumping test data.

GW gradient is considered from 0.0075 to 0.0078.

Seepage estimation is based on constant parameters. So, the actual seepage quantity may vary from the estimated seepage quantity.

Table 5.3: Summarised year wise total dewatering

Year	Seepage from Faces (m3/day)	Seepage from Bottom (m3/day)	Total Seepage (m3/day)
2025-26	809	64	873
2026-27	805	70	875
2027-28	**1048**	**47**	**1095**
2028-29	1318	38	1356
2029-30	1350	38	1388

5.2 ESTIMATION OF RAINWATER QUANTUM DEWATERED

For the estimation of rainwater quantum available for dewatering, the total working pit area (Catchment area), water spread area (sump surface area) and bottom area are taken from the data provided by the project proponent.

Table 5.4: Detail of catchment area and sump surface area considered for rainwater quantum estimation.

RF Quarry		Q-3&4	
Catchment area (Pit Boundary) (m^2)	**Sump Surface area (m^2)**	**Catchment area (Pit Boundary) (m^2)**	**Sump Surface area (m^2)**
3,54,814	18,354	2,67,590	13, 840

The rainfall data (2015 to 2024) of for the area are taken from the IMD data. The available rainwater quantum has been estimated based on the 10 years rainfall and evaporation data. The detailed month wise estimation of rain water quantum for 10 years is given in Annexure IV.

The evaporation and recharge losses are considered as 0 (zero), where there is no rainfall in the month i.e. 0 (zero) rainfall months.

Rainwater Quantum (m^3) = Rainfall (m) x Quarry area (m^2)

Evaporation Losses (m^3) = Water Spread area (m^2) x Evaporation (m)

Recharge loss (m^3) = 40% of Rainwater Quantum

So,

Total available rainwater = Total cumulative rainwater quantum − (Evaporation loss + Recharge loss)

The cumulative accumulated rainwater quantum available for dewatering in RF Quarry is about 2,43,259 m^3/year or **666 m^3/day.**

The cumulative accumulated rainwater quantum available for dewatering in Q-3&4 is about 1,83,463 m^3/year or 502.64 ~ **503 m^3/day.**

So, the total rainfall accumulated for both the pits available for dewatering is about **1169 m^3/day.**

5.3 ADVANCED DEWATERING PLAN IN CASE OF COAL/LIGNITE MINES

Not applicable as this is a metal mine project.

5.4 GROUNDWATER MODELLING

The groundwater modelling has been prepared as a separate report.

6 MINE WATER MANAGEMENT

The total groundwater NOC quantum involve in Narayanposhi Iron & Manganese Ore Mines is 2,884 m^3/day, out of which fresh water from borewells will be 620 m^3/day 1095 m^3/day of mine seepage, and 1169 m^3/day of rainwater. The total water utilization for different activities will be 1715 m^3/day and the remaining water of about 1169 m^3/day will be left in the pit for recharge. The fresh water abstracted water will be used for drinking & domestic as well as for some mining activities, whereas, the mine dewatering water will be dedicatedly utilised for various mining related activities only. The fresh drinking & domestic water requirement of operators' colony, security barrack, mines office & CPU office is 60 m^3/day, 30 m^3/day, 40 m^3/day& 60 m^3/day respectively. For Supply to village, crushing screening unit (CPU) & plantation the water demand is 160 m^3/day, 376 m^3/day & 10 m^3/day, which also be sourced from borewell. Out of 2264 m^3/day of mine dewatering, 220 m^3/day of water will be required for each fixed sprinkler and proposed fixed sprinkler. The 50KL mobile sprinkler, ETP & wheel washing needs 750 m^3/day, 6 m^3/day & 3 m^3/day of water that will also be fulfilled from mine dewatering water. The water source of water & its utilization details are briefed in Table 6.1 & Table 6.2 respectively. The water balance chart for the same is presented as Figure 6.1.

Table 6.1: Details of source of water.

Sl. No.	Source	Withdrawal Quantum (m^3/day)	Withdrawal Quantum (m^3/year)
1	Borewell	620	2,26,300
2	Seepage	1,095	3,99,675
3	Rainwater	1,169	4,26,685
Total		**2,884**	**10,52,660**

Table 6.2: Details of water utilization.

Sl. No.	Activities	Water utilization (m^3/day)	Water utilization (m^3/year)
Drinking & domestic			
1	Operators Colony	60	21,900
2	Security Barrack	30	10,950
3	Mines Office	40	14,600
4	CPU Office	60	21,900
Mining & other activity			
5	Plantation	10	3,650
6	Crushing Screening Unit (CPU)	376	1,37,240

7	Fixed Sprinkler	220	80,300
8	50KL Mobile Sprinkler	750	2,73,750
9	ETP	6	2,190
10	Wheel Washing	3	1,095
11	Supply to villages	160	58,400
12	Remaining water left in mine pit	1169	4,26,685
Total		**2,884**	**10,52,660**

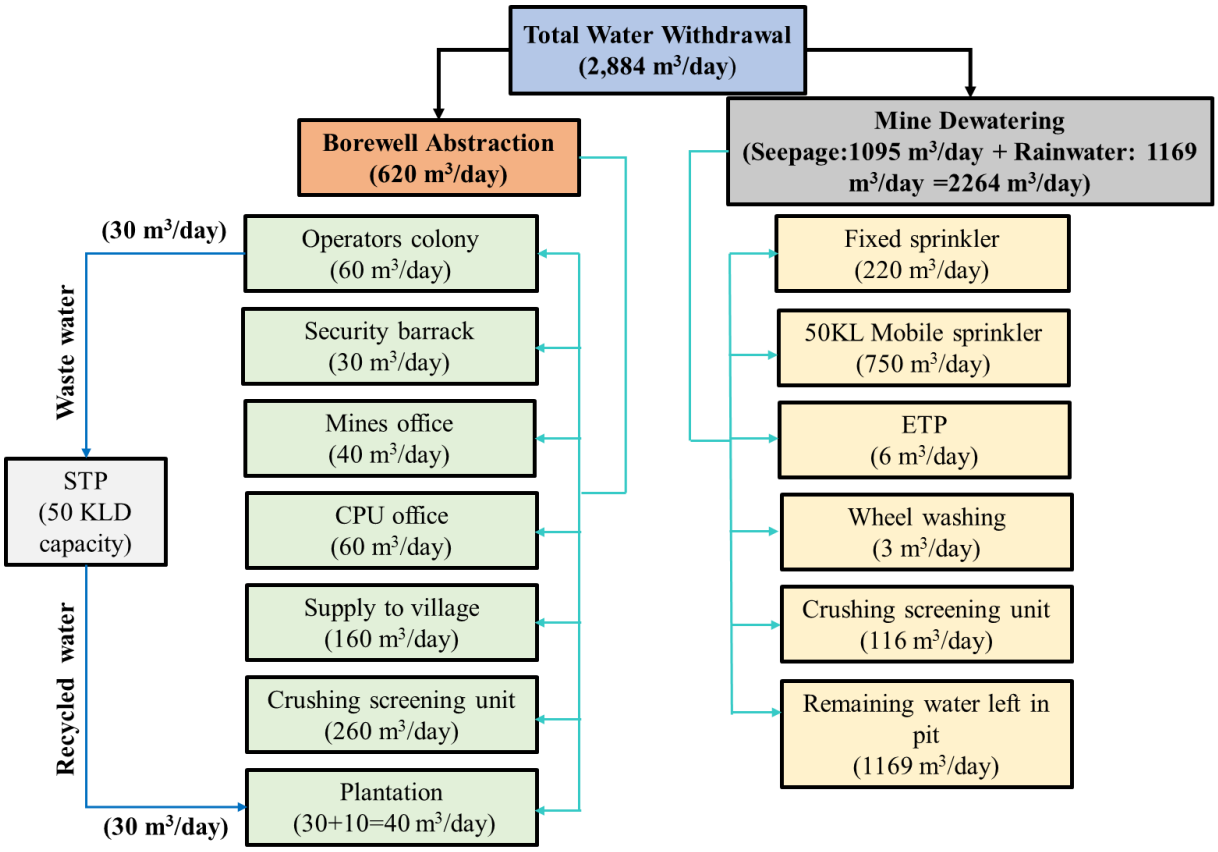


Figure 6.1: Water balance.

There are 05 numbers of borewells has been constructed and 01 number of mine pumps are engaged in mine dewatering. Further, to meet the ground water requirement for this project, construction of another 04 numbers of borewells have been proposed.

6.1 IMPACT OF MINE DEWATERING/ABSTRACTION AND MITIGATION MEASURES.

Groundwater resources which constitute the main use for the extraction and different mining activities are accompanied by a strong withdrawal affecting quantitative and qualitative parameters. Indeed, without preventive measurements, the mining activities can have a negative effect on the environment: hazardous tailings, the mine drainage, infiltration of the polluted liquid effluents, the degradation of the water quality, and the ecological environment. Proper mitigation measure can reduce these impacts.

6.2 IMPACT ON THE GROUNDWATER REGIME

Extraction of huge amount of ground water pumping water may leads to ground water depletion within aquifers. It also effects the ground water flow and the rate of extraction. A cone of depression in the ground water table is created due to excess pumping of ground water which will reduce the efficiency of the adjacent well in the nearby areas.

Water level data of piezometer

There were two piezometers installed in the mine. One piezometer is fitted with DWLR telemetry system and another one is fitted with DWLR without telemetry system (Table 6.3). The water level data of installed piezometer without telemetry system used for the preparation of hydrographs and the same is presented as Figure 6.2 & Figure 6.3.

Table 6.3: Details of Piezometers.

Sl. No.	Description	Longitude	Latitude
1	Piezometer (near Gate-1)	85.23498	21.91621
2	Piezometer (Operator colony)	85.23488	21.93251

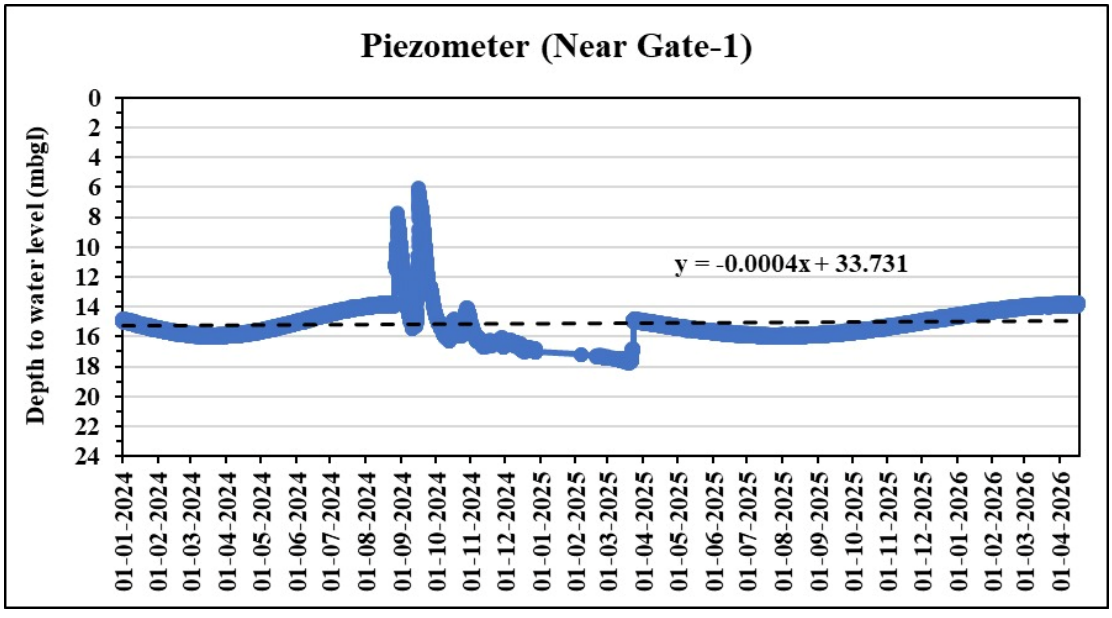


Figure 6.2: Hydrograph of Piezometer (near Gate-1).

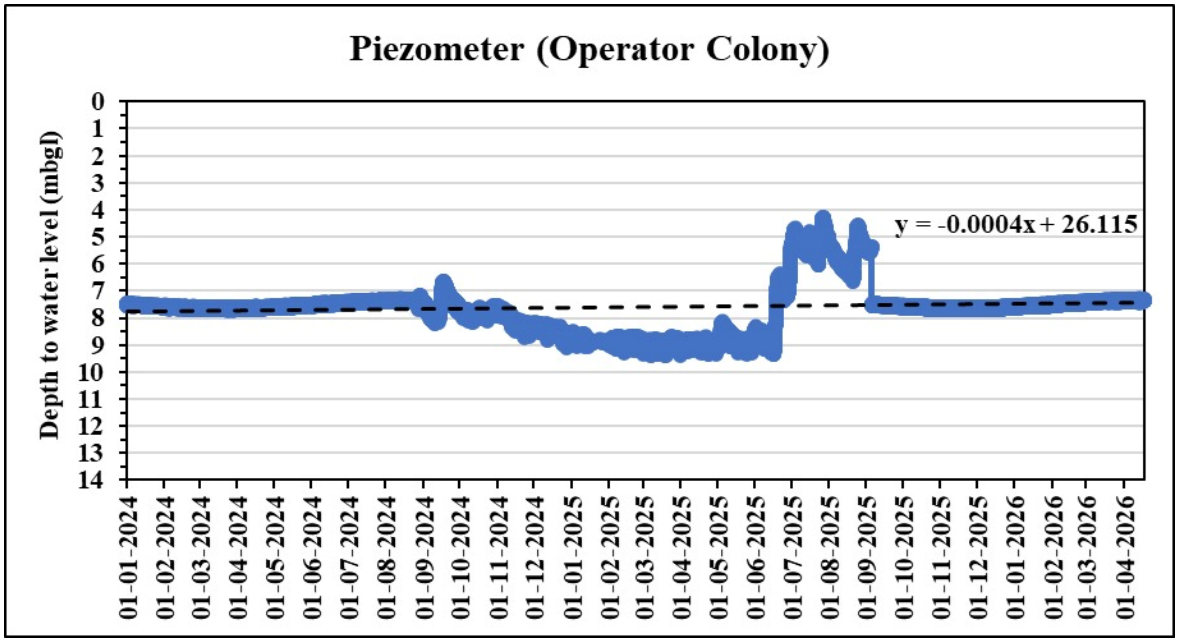


Figure 6.3: Hydrograph of Piezometer (Operator colony).

The extraction of groundwater at the Narayanposi Iron & Manganese Ore mines is expected to lead to a decline in groundwater levels within lease area as well as in 10 km buffer zone surrounding the mine The groundwater modelling study depicts that, the estimated drawdown in the lease area is 1.90 m with 0.80 km radius of influence in 2026 due to the regional abstraction and abstraction from the bore wells. The projected scenarios show that the drawdown would be about 2.14 m during January 2028 in the lease area, and the radius of influence is 0.90 km. The maximum drawdown in the lease area would be 2.97 m with the radius of influence of 1.05 km during December 2036.

6.3 IMPACT ON SURFACE WATER SOURCES

When the groundwater is overused, the Lakes, Streams and Rivers connected to groundwater can also have their supply diminished time to time. Mine discharge may impact the surface water on both qualitatively and quantitatively. It degrades the quality of surface water as it contains pollutants. Precautionary measures such as constructing check dams & settling sumps at appropriate places will help in making the discharge water free from any silt during rains. Toe walls & garland drains around & dumps will be provided to check the run-off. To arrest the surface runoff into the quarry, garland drains with suitable dimensions to carry the peak discharge to be planned.

Karo Nala is flowing along the north-western boundary and Kashira Nala is passing through the north-eastern part of the mine lease area/project area. These Nalas & nearby surface water bodies both gaining and losing nature due to shallow water levels and drainage pattern of the water channels will not be changes due to this project as per the current scenario.

6.4 IMPACT ON WATER QUALITY

The impact on water quality causes from leaching of acidic mine tailings or run-offs known as acid mine drainage, discharged into the surroundings with suspended solids and pollute both surface and ground water. The dumps and stock piles contain harmful chemical substances, get leached by precipitation of water and percolate to the ground water table, thus causing water pollution. Other sources of pollution are spillage of oil & grease resulting contamination to the nearby water, if appropriate control measures are not adopted.

The percolation of sewerage waste from the pit head and the colony area can also pollute the groundwater. The sanitary waste generated from various facilities will be adequately treated through septic tanks and soak pits and causes water pollution. So proper mitigation measures be adopted to minimize these impacts on the water quality.

During rainy season, if required the surplus water from mine shall be treated before being released into the environment to minimize their impact. Groundwater samples collected in and around the study area indicates that all measured parameters fall within permissible limits, suggesting that the project is unlikely to cause any adverse effects on water quality (Annexure-III).

6.5 MITIGATION MEASURES

Dewatering of mine seepage is an important mitigation measure that should be followed strictly. This water is used for various mining activities, so it should be pollutant-free. The presence of these pollutants will impact the quality of the water body present in the nearby areas due to the presence of suspended solids. Some of the measures that should be adopted is given below:

- Oil and grease traps must be planned in HEMM workshop for removal of TSS and Oil and Grease from vehicle wash needed to completely collect, store, treat, and redeliver. Treated water can be used for dust suppression and for raising plantations within the workshop premises.
- The mine discharge, after passing through sedimentation tanks for removal of suspended solids will be used for dust suppression, greenbelt development, etc. and excess water will be let out into nearby streams after proper treatment.
- Mandatory cleaning of the settling pits and drains shall be cleaned periodically.
- Proper groundwater recharge measures have been implemented in the study area to reduce impacts on groundwater.
- Regular monitoring is being carried out in the study area to access the impact the mining on groundwater quality.

MITIGATION MEASURES ADOPTED:

Existing rooftop rainwater-harvesting and Artificial Recharge structures:

To augment the ground water recharge, the project proponent has adopted various groundwater recharge measures to increase the ground water recharge potential in the area. The structures like Roof-top rainwater harvesting & Artificial recharge which not only serve as water conservation mechanisms but also help in overcoming problems caused by overdraft of ground water.

The runoff has been calculated according to GEC norms based on the available rooftop harvesting structures and the information shared by the proponent. There are Roof top and sheds having rain water harvesting structures constructed around the mine area is estimated to be 1488 m^3/year and expected to contribute to groundwater recharge (Table 6.4).

Table 6.4: Estimation of ground water recharge from roof top rain water harvesting structures.

Sl. No.	Location	Area (m^2)	Annual rainfall (m)	Runoff Coefficient	Estimated yearly recharge (m^3/year)
1	Rooftop Rainwater Harvesting Structure at Operator's colony	1306	1.34	0.85	1488
Total					**1488**

Artificial recharge structure:

Artificial recharge structures not only serve as water conservation mechanisms but also help in overcoming problems caused by overdraft of ground water. There are overriding advantages of storing surplus water to reduce the vulnerability of natural ground water regime. So, the ground water recharge from artificial recharge structures has been estimated according to GEC norms as per the information shared by the proponent. There are 04 existing recharge ponds situated in project area for groundwater recharge purpose (Table 6.5). The total estimated recharge from these recharge ponds is 17274.60 m^3/year (Table 6.6).

So, the cumulative ground water recharge from roof-top harvesting and artificial recharge is 18,762.6 m^3/year, which is much less the quantum of ground water withdrawal by this project.

Table 6.5: Details of recharge ponds.

Sl. No.	Structure type	Latitude	Longitude	Area (m^2)
1	Pond 1	21.929072°	85.232970°	2462
2	Pond 2	21.915503°	85.229861°	1796
3	Pond 3	21.930826°	85.247031°	2586
4	Pond 4	21.936861°	85.238171°	2753

Table 6.6: Estimation of ground water recharge from recharge ponds.

Sl. No.	Structure type	Water spread area	Depth	Storage capacity volume	No. of fillings in a year	Recharge Factor (40 %)	Evaporation Factor (5 %)	Gross Water Storage	Annual Recharge due to Water Conservation Structures	Evaporation Losses	Storage Available after Recharge and Evaporation Loss
		m^2	m	m^3		%	%	m^3	m^3	m^3	m^3
1	Pond-1	2462.00	1.50	3693.00	3.00	0.40	0.05	11079.00	4431.60	553.95	6093.45
2	Pond-2	1796.00	1.50	2694.00	3.00	0.40	0.05	8082.00	3232.80	404.10	4445.10
3	Pond-3	2586.00	1.50	3879.00	3.00	0.40	0.05	11637.00	4654.80	581.85	6400.35
4	Pond-4	2753.00	1.50	4129.50	3.00	0.40	0.05	12388.50	4955.40	619.43	6813.68
Total								43186.50	**17274.60**	2159.33	23752.58

7 SALINE WATER DISPOSAL STRATEGIES (IN CASE OF SALINE WATER ABSTRACTION)

In the mine lease area and surrounding there is no saline water as a source of groundwater. Accordingly, the mine has no interaction with saline water therefore this section is not applicable in the instance assessment.

8 OTHER DETAILS PERTAINING TO THE PROJECT

Not Applicable

9 SUMMARY AND CONCLUSION

Narayanposhi Iron and Manganese Ore Mines of M/s JSW Steel Ltd spread over an area of 347.008 Ha (As per DGPS) /349.254 Ha (As per ROR) & located in Village: Koida, Tahsil: Koida, District: Sundargarh of Odisha State. The mine lease area falls under Survey of India Toposheet No. 73 G/1 and 73 G/5 and bounded by the indicative coordinates of latitudes: 21° 54' 46.0836"- 21° 56' 23.0928" and longitudes: 85° 13' 41.2176"- 85° 14' 54.9996".

The predominant land use in the study is forest (74.77%), followed by crop land (13.80%), mining (4.26%), current fallow (2.99%), built-up (2.27%), scrub land (1.56%), river (0.16%), water bodies (0.16%) and barren land (0.04%). Topographically, the study area exhibits highly undulating terrain forming uneven elevation with presence of hills, valleys and mounds. Ridges can also be observed that extended laterally in south-west to north-east direction and creates a water divide in this region. These rolling uneven surface character of the study area also guides the surface water flow. The southern & south-eastern part of the study area exhibits higher altitude as compared to others. The elevation in the overall study area ranges from 346 to 1070 mamsl, whereas it ranges from 547 to 648 mamsl in the project area.

The significant geomorphological features of the study area are moderately dissected hills and valleys of structural origin & subsequently followed by pediment of denudational origin, ridge of structural origin, active quarry of anthropogenic origin, residual hill of denudational origin, intermontane valley of denudational origin and others. The drainage system of this region is mainly regulated by the Karo River, which originates from the central part of the study area & flows due north-east direction, close to the western boundary outside the lease area. In addition to that, Suna Nadi also influences the drainage system at the eastern part of the study area. Major tributaries like Teherei Nala, Sarkanda Nadi, Samij Nala & Suna Nala play a significant role in the drainage system. Rather than these, numerous small streams/nalas like Kukarha Jora, Lekerapani Nala, Topadihi Nala, Kalmang Nala, Gahirajala Nala, Kundra Nala, Geria Nala, Bacha Nala, Korei Nala & others enhances the drainage intensity of the study area and contribute their water to form major streams/nalas. One seasonal nala i.e. Kashira Nala is flowing inside the project area.

The Narayanposi Iron and Manganese Ore Mines belong to Bonai-Keonjhar belt of Sundargarh district. The feebly metamorphosed Precambrian volcano-sedimentary rocks exposed in this belt between the Singhbhum granite on the east and Bonai granite on the west and are classified as 'Iron ore Group'. The main rock types found in this mine are BHQ, Iron ore (Massive, Laminated), Lateritic Iron Ore and ferruginous laterite and

Manganiferous shale. In the ML area, Iron ore found as mainly hard massive and laminated and powdery variety.

The predominant aquifer of the study area is Slate, Phyllite, Mica Schist with yield capacity 1 to 5 lps & subsequently followed by Banded Hematite Quartzite (yield: 3 to 10 lps), Amphibolite, Hornblende Schist, Chlorite Schist (yield: 1 to 5 lps) , Quartzite (yield: 3 to 10 lps), Basic Meta – Volcanics (yield:10 to 15 lps), Newer Dolerite (yield:0.5 to 1.5 lps) and lastly, Granite (yield: 3 to 10 lps).

The water table in & around the study area varies from 2025369.33 to 905.56 mamsl during October, 2025, whereas it varies from 367.02 to 894.88 mamsl during April 2026. The groundwater flow direction in the project area is in north-east direction, whereas, in the overall study area is towards north-east as well as north-west direction.

The depth to water level in and around the study area varies from 4.01 to 31.44 mbgl during October, 2025 and it varies from 7.98 to 42.12 mbgl during April, 2026. The water level fluctuation varies from 2.31 to 11.39m in the overall study area & its periphery.

The long-term water level data shows, only seasonal fluctuation with cyclic and sinusoidal changes representing the recharge and discharge of ground water during the different period has been observed, which can be due to variations in rainfall patterns and no significant decline in water level is identical during observation period.

From the qualitative water sample monitored in & around the study area, it is observed that all the water quality parameters are within the permissible limits as per the IS standard 10500:2012: Drinking water.

The estimated quantity of mine seepage during the 5-years period varies from 873 to 1388 m^3/day. During the end of the NOC period, the maximum estimated mine seepage will be 1095 m^3/day**.** The total groundwater NOC quantum involve in Narayanposhi Iron & Manganese Ore Mines is 2,884 m^3/day, out of which fresh water from borewells will be 620 m^3/day 1095 m^3/day of mine seepage, and 1169 m^3/day of rainwater. The total water utilization for different activities will be 1715 m^3/day and the remaining water of about 1169 m^3/day will be left in the pit for recharge. The fresh water abstracted water will be used for drinking & domestic as well as for some mining activities, whereas, the mine dewatering water will be dedicatedly utilised for various mining related activities only.

As per the criteria for categorization of area made by Central Ground Water Authority for the development point of view (GWRE, 2025) the present study area falls under 'Safe Category'. So, enough scope exists for withdrawal of quantum (**2,884** m^3/ day) of ground water. It will not have any appreciable impact on ground water resources in the area.

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11 ACCREDITATION CERTIFICATE

Accreditation Board of CGWA

Certificate of Accreditation

M/s. Geoclimate Risk Solutions
Vishakhapatnam, A.P.

Has been accredited as a Ground Water Professionals to prepare reports in the Functional Areas of

- *Impact Assessment of Existing / Proposed GW Extraction*
- *GW Modelling*
- *Hydrogeological conditions in mining projects.*

Valid from : 15.02.2021 *Certificate No. : CGWA/RGI/005*

Valid thru : 14.02.2026 *Dated : 07.07.2021*

क्षेत्रीय निदेशक
Regional Director
आरजीएनजीडब्ल्यूटीआरआई
RGNGWT&RI

सदस्य
Member
आरजीएनजीडब्ल्यूटीआरआई
RGNGWT&RI

ANNEXURE – I: Long-term water level data of CGWB used for preparation of hydrograph

Location	Bhadrasahi	Guali	Rugudi
Latitude	22.05556	21.97917	22.00833
Longitude	85.39083	85.28611	85.33472
Apr-2014	6.11	5.88	
Nov-2014	4	4.1	3.9
Apr-2015	6.18	5.95	7.34
Nov-2015	4.5	4.2	4.1
Apr-2016	6.01	5.85	7
Nov-2016	4.6	4.5	4.5
Apr-2017	6.11	6.8	7.44
Nov-2017	6	6.4	5
Apr-2018	7.78	7.8	5.54
Nov-2018	4.9		
Apr-2019	7.45		5.24
Nov-2019	6.7		
Apr-2020	6.46		7.2
Nov-2020	4.4	5.4	4.5
Apr-2021	6.46		7.2
Nov-2021	3.6	3.9	4.4
Apr-2022	6.31	6.2	5.44
Nov-2022	3.8	3.7	4.1
Apr-2023	8.16	7.38	9.2
Nov-2023	6.9		6.4
Apr-2024	6.81	6.59	6
Nov-2024	8.4	6.6	9.5

(All given values are in meters below ground level)

ANNEXURE – II: Groundwater quality analysis reports

Advanced Environmental Testing And Research Lab P. Ltd.

CIN: U73100MP2002PTC015352 GSTIN: 23AAECA9188L1Z8
Approved: by Ministry of Environment, Forest and Climate Change (MoEF&CC)
Approved: by National Accreditation Board for Testing and Calibration Laboratories
Approved: by Bureau of International Quality Standards (ISO 45001:2018)
Registered Office: 63/1, Kailash Vihar, Near Income Tax Office, City Center-II
Gwalior-474 011 (M.P.), India
0751- 4099916, 223217
Email: aetrl2016@gmail.com,

TC-12780

Test Certificate

ULR No. TC127802500004011F

Test Report No.	AETRL/161025W0005	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle
Nature of Sample	Water		
Sample Collected By	Customer	**D/o Sample Collection**	16/10/2025
Sample Description	Water Sample	**Sample Received by**	AETRL LAB
Sample Location	Inside Mine	**Sampling Method**	NA
Coordinates	21.916385° 85.234999°	**Sample Condition**	Satisfactory
D/o Sample Analysis	16/10/2025	**D/o Analysis Completion**	29/10/2025

Results

S.No.	Test Parameters	Units	Results	Requirement as per IS:10500-2018		Test Method
				Acceptable Limits	Permissible Limits	
1	pH (at 25°C)	-	5.5	6.5 to 8.5	No Relaxation	IS:3025 (Part-11) 2022
2	Electrical Conductivity	µS/cm	81.7	-	-	IS:3025(Part-14) 2013
3	Total Dissolved Solids	mg/l	51.5	500	2000	IS:3025 (Part-16) 2023
4	Total Hardness as CaCO3	mg/l	14	200	600	IS:3025 (Part-21)
5	Calcium as Ca	mg/l	3.2	75	200	IS:3025 (Part-40) 1991
6	Magnesium as Mg	mg/l	1.45	30	100	IS:3025 (Part-46) 2023
7	Chloride as Cl	mg/l	1.99	250	1000	IS:3025 (Part-32)1988
8	Total Alkalinity as CaCO3	mg/l	16	200	600	IS:3025 (Part-23) 2023
9	Sulphate as SO4	mg/l	34.2	200	400	IS:3025 (Part-24)
10	Nitrate as NO3	mg/l	2.03	45.0	No Relaxation	IS:3025 (Part-34)
11	Sodium as Na	mg/l	1.51	-	-	IS:3025 (Part-45)
12	Potassium as K	mg/l	0.99	-	-	IS:3025 (Part-45)
13	Fluoride as F	mg/l	0.09	1.0	1.5	IS:3025 (Part-60)2023
14	Iron as Fe	mg/l	BDL (LOD 0.02)	0.3	No Relaxation	IS:3025 (Part-65) 2022
15	Manganese as Mn	mg/l	BDL (LOD 0.01)	0.1	0.3	IS:3025 (Part-59)

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2. The sample will be destroyed after 15 days from the date of issue of test certificate unless otherwise specified.
3. Any discrepancy in test result should be reported within 15days.
4. The above Results are related to the tested Sample Only.
5. The result listed refers only to the tested samples and applicable Parameters. Endorsement of product is neither inferred nor implied.

Doc. No. : AETRL-R-032 Page No. 1/2

Advanced Environmental Testing And Research Lab P. Ltd.

CIN: U73100MP2002PTC015352 GSTIN: 23AAECA9188L1Z8
Approved: by Ministry of Environment, Forest and Climate Change (MoEF&CC)
Approved: by National Accreditation Board for Testing and Calibration Laboratories
Approved: by Bureau of International Quality Standards (ISO 45001:2018)
Registered Office: 63/1, Kailash Vihar, Near Income Tax Office, City Center-II
Gwalior-474 011 (M.P.), India
0751- 4099916, 223217
Email: aetrl2016@gmail.com,

TC-12780

Test Certificate

ULR No. TC1278025000004011F

Test Report No.	AETRL/161025W0005	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle

Reviewed By
Dr. Dinesh Uchchariya

* End of Report *

Advanced Environmental Testing And Research Lab P. Ltd. Gwalior

Authorised Signatory
Rajesh Jain

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Page No. 2/2

Advanced Environmental Testing And Research Lab P. Ltd.

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Registered Office: 63/1, Kailash Vihar, Near Income Tax Office, City Center-II
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0751- 4099916, 223217
Email: aetrl2016@gmail.com,

TC-12780

Test Certificate

ULR No. TC1278025000004012F

Test Report No.	AETRL/161025W0006	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle
Nature of Sample	Water		
Sample Collected By	Customer	**D/o Sample Collection**	16/10/2025
Sample Description	Water Sample NPWQ2	**Sample Received by**	AETRL LAB
Sample Location	Koida	**Sampling Method**	NA
Coordinates	21.908418° 85.253871°	**Sample Condition**	Satisfactory
D/o Sample Analysis	16/10/2025	**D/o Analysis Completion**	29/10/2025

Results

S.No.	Test Parameters	Units	Results	Requirement as per IS:10500-2018		Test Method
				Acceptable Limits	Permissible Limits	
1	pH (at 25°C)	-	6.1	6.5 to 8.5	No Relaxation	IS:3025 (Part-11) 2022
2	Electrical Conductivity	µS/cm	98.5	-	-	IS:3025(Part-14) 2013
3	Total Dissolved Solids	mg/l	62.2	500	2000	IS:3025 (Part-16) 2023
4	Total Hardness as CaCO3	mg/l	42	200	600	IS:3025 (Part-21)
5	Calcium as Ca	mg/l	11.2	75	200	IS:3025 (Part-40) 1991
6	Magnesium as Mg	mg/l	3.4	30	100	IS:3025 (Part-46) 2023
7	Chloride as Cl	mg/l	4.99	250	1000	IS:3025 (Part-32)1988
8	Total Alkalinity as CaCO3	mg/l	42	200	600	IS:3025 (Part-23) 2023
9	Sulphate as SO4	mg/l	0.89	200	400	IS:3025 (Part-24)
10	Nitrate as NO3	mg/l	1.22	45.0	No Relaxation	IS:3025 (Part-34)
11	Sodium as Na	mg/l	2.83	-	-	IS:3025 (Part-45)
12	Potassium as K	mg/l	0.61	-	-	IS:3025 (Part-45)
13	Fluoride as F	mg/l	0.08	1.0	1.5	IS:3025 (Part-60)2023
14	Iron as Fe	mg/l	BDL (LOD 0.02)	0.3	No Relaxation	IS:3025 (Part-65) 2022
15	Manganese as Mn	mg/l	BDL (LOD 0.01)	0.1	0.3	IS:3025 (Part-59)

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Doc. No. : AETRL-R-032

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Advanced Environmental Testing And Research Lab P. Ltd.

CIN: U73100MP2002PTC015352 GSTIN: 23AAECA9188L1Z8
Approved: by Ministry of Environment, Forest and Climate Change (MoEF&CC)
Approved: by National Accreditation Board for Testing and Calibration Laboratories
Approved: by Bureau of International Quality Standards (ISO 45001:2018)
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0751- 4099916, 223217
Email: aetrl2016@gmail.com,

TC-12780

Test Certificate

ULR No. TC1278025000004014F

Test Report No.	AETRL/161025W0008	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle
Nature of Sample	Water		
Sample Collected By	Customer	**D/o Sample Collection**	16/10/2025
Sample Description	Water Sample NPWQ5	**Sample Received by**	AETRL LAB
Sample Location	Segasahi	**Sampling Method**	NA
Coordinates	21.942444° 85.274691°	**Sample Condition**	Satisfactory
D/o Sample Analysis	16/10/2025	**D/o Analysis Completion**	29/10/2025

Results

S.No.	Test Parameters	Units	Results	Requirement as per IS:10500-2018		Test Method
				Acceptable Limits	Permissible Limits	
1	pH (at 25°C)	-	5.1	6.5 to 8.5	No Relaxation	IS:3025 (Part-11) 2022
2	Electrical Conductivity	µS/cm	33.9	-	-	IS:3025(Part-14) 2013
3	Total Dissolved Solids	mg/l	21.3	500	2000	IS:3025 (Part-16) 2023
4	Total Hardness as CaCO3	mg/l	16	200	600	IS:3025 (Part-21)
5	Calcium as Ca	mg/l	4.0	75	200	IS:3025 (Part-40) 1991
6	Magnesium as Mg	mg/l	1.45	30	100	IS:3025 (Part-46) 2023
7	Chloride as Cl	mg/l	2.99	250	1000	IS:3025 (Part-32)1988
8	Total Alkalinity as CaCO3	mg/l	14	200	600	IS:3025 (Part-23) 2023
9	Sulphate as SO4	mg/l	1.27	200	400	IS:3025 (Part-24)
10	Nitrate as NO3	mg/l	1.19	45.0	No Relaxation	IS:3025 (Part-34)
11	Sodium as Na	mg/l	1.13	-	-	IS:3025 (Part-45)
12	Potassium as K	mg/l	8.57	-	-	IS:3025 (Part-45)
13	Fluoride as F	mg/l	0.101	1.0	1.5	IS:3025 (Part-60)2023
14	Iron as Fe	mg/l	BDL (LOD 0.02)	0.3	No Relaxation	IS:3025 (Part-65) 2022
15	Manganese as Mn	mg/l	BDL (LOD 0.01)	0.1	0.3	IS:3025 (Part-59)

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Test Certificate

ULR No. TC127802500004014F

Test Report No.	AETRL/161025W0008	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle

Reviewed by
Dr. Dinesh Uchchariya

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Advanced Environmental Testing And Research Lab P. Ltd. Gwalior

Authorised Signatory
Rajesh Jain

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Test Certificate

ULR No. TC1278025000004015F

Test Report No.	AETRL/161025W0009	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle
Nature of Sample	Water		
Sample Collected By	Customer	**D/o Sample Collection**	16/10/2025
Sample Description	Water Sample NPWQ6	**Sample Received by**	AETRL LAB
Sample Location	Teherei	**Sampling Method**	NA
Coordinates	21.899102° 85.286515°	**Sample Condition**	Satisfactory
D/o Sample Analysis	16/10/2025	**D/o Analysis Completion**	29/10/2025

Results

S.No.	Test Parameters	Units	Results	Requirement as per IS:10500-2018		Test Method
				Acceptable Limits	Permissible Limits	
1	pH (at 25°C)	-	5.5	6.5 to 8.5	No Relaxation	IS:3025 (Part-11) 2022
2	Electrical Conductivity	µS/cm	123.7	-	-	IS:3025(Part-14) 2013
3	Total Dissolved Solids	mg/l	78	500	2000	IS:3025 (Part-16) 2023
4	Total Hardness as CaCO3	mg/l	32	200	600	IS:3025 (Part-21)
5	Calcium as Ca	mg/l	8.8	75	200	IS:3025 (Part-40) 1991
6	Magnesium as Mg	mg/l	2.43	30	100	IS:3025 (Part-46) 2023
7	Chloride as Cl	mg/l	5.99	250	1000	IS:3025 (Part-32)1988
8	Total Alkalinity as CaCO3	mg/l	24	200	600	IS:3025 (Part-23) 2023
9	Sulphate as SO4	mg/l	5.98	200	400	IS:3025 (Part-24)
10	Nitrate as NO3	mg/l	17.71	45.0	No Relaxation	IS:3025 (Part-34)
11	Sodium as Na	mg/l	3.73	-	-	IS:3025 (Part-45)
12	Potassium as K	mg/l	4.28	-	-	IS:3025 (Part-45)
13	Fluoride as F	mg/l	0.07	1.0	1.5	IS:3025 (Part-60)2023
14	Iron as Fe	mg/l	BDL (LOD 0.02)	0.3	No Relaxation	IS:3025 (Part-65) 2022
15	Manganese as Mn	mg/l	BDL (LOD 0.01)	0.1	0.3	IS:3025 (Part-59)

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TC-12780

Test Certificate

ULR No. TC1278025000004015F

Test Report No.	AETRL/161025W0009	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle

Reviewed by
Dr. Dinesh Uchchariya

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Advanced Environmental Testing And Research Lab P. Ltd. Gwalior

Authorised Signatory
Rajesh Jain

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Test Certificate

ULR No. TC1278025000004016F

Test Report No.	AETRL/161025W0010	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle
Nature of Sample	Water		
Sample Collected By	Customer	**D/o Sample Collection**	16/10/2025
Sample Description	Water Sample NPWQ7	**Sample Received by**	AETRL LAB
Sample Location	Patmunda	**Sampling Method**	NA
Coordinates	21.874423° 85.308836°	**Sample Condition**	Satisfactory
D/o Sample Analysis	16/10/2025	**D/o Analysis Completion**	29/10/2025

Results

S.No.	Test Parameters	Units	Results	Requirement as per IS:10500-2018		Test Method
				Acceptable Limits	Permissible Limits	
1	pH (at 25°C)	-	5.4	6.5 to 8.5	No Relaxation	IS:3025 (Part-11) 2022
2	Electrical Conductivity	µS/cm	117	-	-	IS:3025(Part-14) 2013
3	Total Dissolved Solids	mg/l	74	500	2000	IS:3025 (Part-16) 2023
4	Total Hardness as CaCO3	mg/l	34	200	600	IS:3025 (Part-21)
5	Calcium as Ca	mg/l	8.96	75	200	IS:3025 (Part-40) 1991
6	Magnesium as Mg	mg/l	2.43	30	100	IS:3025 (Part-46) 2023
7	Chloride as Cl	mg/l	7.99	250	1000	IS:3025 (Part-32)1988
8	Total Alkalinity as CaCO3	mg/l	22	200	600	IS:3025 (Part-23) 2023
9	Sulphate as SO4	mg/l	1.99	200	400	IS:3025 (Part-24)
10	Nitrate as NO3	mg/l	16.4	45.0	No Relaxation	IS:3025 (Part-34)
11	Sodium as Na	mg/l	5.14	-	-	IS:3025 (Part-45)
12	Potassium as K	mg/l	1.00	-	-	IS:3025 (Part-45)
13	Fluoride as F	mg/l	0.068	1.0	1.5	IS:3025 (Part-60)2023
14	Iron as Fe	mg/l	BDL (LOD 0.02)	0.3	No Relaxation	IS:3025 (Part-65) 2022
15	Manganese as Mn	mg/l	BDL (LOD 0.01)	0.1	0.3	IS:3025 (Part-59)

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Test Certificate

ULR No. TC1278025000004016F

Test Report No.	AETRL/161025W0010	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle

Reviewed by
Dr. Dinesh Uchchariya

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Authorised Signatory
Rajesh Jain

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ULR No. TC1278025000004017F

Test Report No.	AETRL/161025W0011	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle
Nature of Sample	Water		
Sample Collected By	Customer	**D/o Sample Collection**	16/10/2025
Sample Description	Water Sample NPWQ8	**Sample Received by**	AETRL LAB
Sample Location	Deoghar	**Sampling Method**	NA
Coordinates	21.929401° 85.353868°	**Sample Condition**	Satisfactory
D/o Sample Analysis	16/10/2025	**D/o Analysis Completion**	29/10/2025

Results

S.No.	Test Parameters	Units	Results	Requirement as per IS:10500-2018		Test Method
				Acceptable Limits	Permissible Limits	
1	pH (at 25°C)	-	5.8	6.5 to 8.5	No Relaxation	IS:3025 (Part-11) 2022
2	Electrical Conductivity	µS/cm	80	-	-	IS:3025(Part-14) 2013
3	Total Dissolved Solids	mg/l	50	500	2000	IS:3025 (Part-16) 2023
4	Total Hardness as CaCO3	mg/l	32	200	600	IS:3025 (Part-21)
5	Calcium as Ca	mg/l	8.8	75	200	IS:3025 (Part-40) 1991
6	Magnesium as Mg	mg/l	2.43	30	100	IS:3025 (Part-46) 2023
7	Chloride as Cl	mg/l	3.99	250	1000	IS:3025 (Part-32)1988
8	Total Alkalinity as CaCO3	mg/l	26	200	600	IS:3025 (Part-23) 2023
9	Sulphate as SO4	mg/l	5.45	200	400	IS:3025 (Part-24)
10	Nitrate as NO3	mg/l	3.56	45.0	No Relaxation	IS:3025 (Part-34)
11	Sodium as Na	mg/l	1.52	-	-	IS:3025 (Part-45)
12	Potassium as K	mg/l	1.91	-	-	IS:3025 (Part-45)
13	Fluoride as F	mg/l	0.068	1.0	1.5	IS:3025 (Part-60)2023
14	Iron as Fe	mg/l	BDL (LOD 0.02)	0.3	No Relaxation	IS:3025 (Part-65) 2022
15	Manganese as Mn	mg/l	BDL (LOD 0.01)	0.1	0.3	IS:3025 (Part-59)

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TC-12780

Test Certificate

ULR No. TC1278025000004017F

Test Report No.	AETRL/161025W0011	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle

Reviewed by
Dr. Dinesh Uchchariya

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Advanced Environmental Testing And Research Lab P. Ltd. Gwalior

Authorised Signatory
Rajesh Jain

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Test Report No.	AETRL/161025W0012	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle
Nature of Sample	Water		
Sample Collected By	Customer	**D/o Sample Collection**	16/10/2025
Sample Description	Water Sample NPWQ9	**Sample Received by**	AETRL LAB
Sample Location	Katesahi	**Sampling Method**	NA
Coordinates	21.955939° 85.325435°	**Sample Condition**	Satisfactory
D/o Sample Analysis	16/10/2025	**D/o Analysis Completion**	29/10/2025

Results

S.No.	Test Parameters	Units	Results	Requirement as per IS:10500-2018		Test Method
				Acceptable Limits	Permissible Limits	
1	pH (at 25°C)	-	4.8	6.5 to 8.5	No Relaxation	IS:3025 (Part-11) 2022
2	Electrical Conductivity	µS/cm	90	-	-	IS:3025(Part-14) 2013
3	Total Dissolved Solids	mg/l	57	500	2000	IS:3025 (Part-16) 2023
4	Total Hardness as CaCO3	mg/l	28	200	600	IS:3025 (Part-21)
5	Calcium as Ca	mg/l	7.3	75	200	IS:3025 (Part-40) 1991
6	Magnesium as Mg	mg/l	2.43	30	100	IS:3025 (Part-46) 2023
7	Chloride as Cl	mg/l	5.22	250	1000	IS:3025 (Part-32)1988
8	Total Alkalinity as CaCO3	mg/l	14	200	600	IS:3025 (Part-23) 2023
9	Sulphate as SO4	mg/l	0.65	200	400	IS:3025 (Part-24)
10	Nitrate as NO3	mg/l	24.30	45.0	No Relaxation	IS:3025 (Part-34)
11	Sodium as Na	mg/l	4.66	-	-	IS:3025 (Part-45)
12	Potassium as K	mg/l	0.82	-	-	IS:3025 (Part-45)
13	Fluoride as F	mg/l	0.048	1.0	1.5	IS:3025 (Part-60)2023
14	Iron as Fe	mg/l	BDL (LOD 0.02)	0.3	No Relaxation	IS:3025 (Part-65) 2022
15	Manganese as Mn	mg/l	BDL (LOD 0.01)	0.1	0.3	IS:3025 (Part-59)

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Doc. No. : AETRL-R-032 Page No. 1/2

Advanced Environmental Testing And Research Lab P. Ltd.

CIN: U73100MP2002PTC015352 GSTIN: 23AAECA9188L1Z8
Approved: by Ministry of Environment, Forest and Climate Change (MoEF&CC)
Approved: by National Accreditation Board for Testing and Calibration Laboratories
Approved: by Bureau of International Quality Standards (ISO 45001:2018)
Registered Office: 63/1, Kailash Vihar, Near Income Tax Office, City Center-II
Gwalior-474 011 (M.P.), India
0751- 4099916, 223217
Email: aetrl2016@gmail.com,

TC-12780

Test Certificate

ULR No. TC1278025000004018F

Test Report No.	AETRL/161025W0012	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle

Reviewed By
Dr. Dinesh Uchchariya

* End of Report *

Advanced Environmental Testing And Research Lab P. Ltd. Gwalior

Authorised Signatory
Rajesh Jain

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TC-12780

Test Certificate

ULR No. TC1278025000004019F

Test Report No.	AETRL/161025W0013	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle
Nature of Sample	Water		
Sample Collected By	Customer	**D/o Sample Collection**	16/10/2025
Sample Description	Water Sample NPWQ10	**Sample Received by**	AETRL LAB
Sample Location	Rugudi	**Sampling Method**	NA
Coordinates	22.000132° 85.320621°	**Sample Condition**	Satisfactory
D/o Sample Analysis	16/10/2025	**D/o Analysis Completion**	29/10/2025

Results

S.No.	Test Parameters	Units	Results	Requirement as per IS:10500-2018		Test Method
				Acceptable Limits	Permissible Limits	
1	pH (at 25°C)	-	5.7	6.5 to 8.5	No Relaxation	IS:3025 (Part-11) 2022
2	Electrical Conductivity	µS/cm	83	-	-	IS:3025(Part-14) 2013
3	Total Dissolved Solids	mg/l	52	500	2000	IS:3025 (Part-16) 2023
4	Total Hardness as CaCO3	mg/l	18	200	600	IS:3025 (Part-21)
5	Calcium as Ca	mg/l	7.2	75	200	IS:3025 (Part-40) 1991
6	Magnesium as Mg	mg/l	2.43	30	100	IS:3025 (Part-46) 2023
7	Chloride as Cl	mg/l	0.99	250	1000	IS:3025 (Part-32)1988
8	Total Alkalinity as CaCO3	mg/l	42	200	600	IS:3025 (Part-23) 2023
9	Sulphate as SO4	mg/l	1.04	200	400	IS:3025 (Part-24)
10	Nitrate as NO3	mg/l	1.24	45.0	No Relaxation	IS:3025 (Part-34)
11	Sodium as Na	mg/l	1.41	-	-	IS:3025 (Part-45)
12	Potassium as K	mg/l	0.94	-	-	IS:3025 (Part-45)
13	Fluoride as F	mg/l	0.054	1.0	1.5	IS:3025 (Part-60)2023
14	Iron as Fe	mg/l	BDL (LOD 0.02)	0.3	No Relaxation	IS:3025 (Part-65) 2022
15	Manganese as Mn	mg/l	BDL (LOD 0.01)	0.1	0.3	IS:3025 (Part-59)

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TC-12780

Test Certificate

ULR No. TC1278025000004019F

Test Report No.	AETRL/161025W0013	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle

Reviewed by
Dr. Dinesh Uchchariya

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Advanced Environmental Testing And Research Lab P. Ltd. Gwalior

Authorised Signatory
Rajesh Jain

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TC-12780

Test Certificate

ULR No. TC1278025000004020F

Test Report No.	AETRL/161025W0014	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle
Nature of Sample	Water		
Sample Collected By	Customer	**D/o Sample Collection**	16/10/2025
Sample Description	Water Sample NPWQ11	**Sample Received by**	AETRL LAB
Sample Location	Kendudihi	**Sampling Method**	NA
Coordinates	21.993664° 85.271352°	**Sample Condition**	Satisfactory
D/o Sample Analysis	16/10/2025	**D/o Analysis Completion**	29/10/2025

Results

S.No.	Test Parameters	Units	Results	Requirement as per IS:10500-2018		Test Method
				Acceptable Limits	Permissible Limits	
1	pH (at 25°C)	-	5.2	6.5 to 8.5	No Relaxation	IS:3025 (Part-11) 2022
2	Electrical Conductivity	µS/cm	54	-	-	IS:3025(Part-14) 2013
3	Total Dissolved Solids	mg/l	34	500	2000	IS:3025 (Part-16) 2023
4	Total Hardness as CaCO3	mg/l	22	200	600	IS:3025 (Part-21)
5	Calcium as Ca	mg/l	6.40	75	200	IS:3025 (Part-40) 1991
6	Magnesium as Mg	mg/l	1.45	30	100	IS:3025 (Part-46) 2023
7	Chloride as Cl	mg/l	3.99	250	1000	IS:3025 (Part-32)1988
8	Total Alkalinity as CaCO3	mg/l	10	200	600	IS:3025 (Part-23) 2023
9	Sulphate as SO4	mg/l	0.82	200	400	IS:3025 (Part-24)
10	Nitrate as NO3	mg/l	1.35	45.0	No Relaxation	IS:3025 (Part-34)
11	Sodium as Na	mg/l	1.26	-	-	IS:3025 (Part-45)
12	Potassium as K	mg/l	1.09	-	-	IS:3025 (Part-45)
13	Fluoride as F	mg/l	0.048	1.0	1.5	IS:3025 (Part-60)2023
14	Iron as Fe	mg/l	BDL (LOD 0.02)	0.3	-	IS:3025 (Part-65) 2022
15	Manganese as Mn	mg/l	BDL (LOD 0.01)	0.1	0.3	IS:3025 (Part-59)

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Test Certificate

ULR No. TC127802500004020F

Test Report No.	AETRL/161025W0014	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle

Reviewed by
Dr. Dinesh Uchchariya

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Advanced Environmental Testing And Research Lab P. Ltd. Gwalior

Authorised Signatory
Rajesh Jain

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Test Certificate

ULR No. TC1278025000004021F

Test Report No.	AETRL/161025W0015	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle
Nature of Sample	Water		
Sample Collected By	Customer	**D/o Sample Collection**	16/10/2025
Sample Description	Water Sample NPWQ12	**Sample Received by**	AETRL LAB
Sample Location	Kalta	**Sampling Method**	NA
Coordinates	21.967644° 85.216379°	**Sample Condition**	Satisfactory
D/o Sample Analysis	16/10/2025	**D/o Analysis Completion**	29/10/2025

Results

S.No.	Test Parameters	Units	Results	Requirement as per IS:10500-2018		Test Method
				Acceptable Limits	Permissible Limits	
1	pH (at 25°C)	-	5.4	6.5 to 8.5	No Relaxation	IS:3025 (Part-11) 2022
2	Electrical Conductivity	µS/cm	66	-	-	IS:3025(Part-14) 2013
3	Total Dissolved Solids	mg/l	42	500	2000	IS:3025 (Part-16) 2023
4	Total Hardness as CaCO3	mg/l	26	200	600	IS:3025 (Part-21)
5	Calcium as Ca	mg/l	7.2	75	200	IS:3025 (Part-40) 1991
6	Magnesium as Mg	mg/l	1.94	30	100	IS:3025 (Part-46) 2023
7	Chloride as Cl	mg/l	5.99	250	1000	IS:3025 (Part-32)1988
8	Total Alkalinity as CaCO3	mg/l	20	200	600	IS:3025 (Part-23) 2023
9	Sulphate as SO4	mg/l	2.21	200	400	IS:3025 (Part-24)
10	Nitrate as NO3	mg/l	4.26	45.0	No Relaxation	IS:3025 (Part-34)
11	Sodium as Na	mg/l	3.30	-	-	IS:3025 (Part-45)
12	Potassium as K	mg/l	1.61	-	-	IS:3025 (Part-45)
13	Fluoride as F	mg/l	0.043	1.0	1.5	IS:3025 (Part-60)2023
14	Iron as Fe	mg/l	BDL (LOD 0.02)	0.3	No Relaxation	IS:3025 (Part-65) 2022
15	Manganese as Mn	mg/l	BDL (LOD 0.01)	0.1	0.3	IS:3025 (Part-59)

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TC-12780

Test Certificate

ULR No. TC1278025000004021F

Test Report No.	AETRL/161025W0015	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle

Reviewed by
Dr. Dinesh Uchchariya

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Advanced Environmental Testing And Research Lab P. Ltd. Gwalior

Authorised Signatory
Rajesh Jain

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Test Certificate

ULR No. TC1278025000004022F

Test Report No.	AETRL/161025W0016	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle
Nature of Sample	Water		
Sample Collected By	Customer	**D/o Sample Collection**	16/10/2025
Sample Description	Water Sample NPWQ13	**Sample Received by**	AETRL LAB
Sample Location	Tada Bhuyan basi	**Sampling Method**	NA
Coordinates	21.981534° 85.180558°	**Sample Condition**	Satisfactory
D/o Sample Analysis	16/10/2025	**D/o Analysis Completion**	29/10/2025

Results

S.No.	Test Parameters	Units	Results	Requirement as per IS:10500-2018		Test Method
				Acceptable Limits	Permissible Limits	
1	pH (at 25°C)	-	5.7	6.5 to 8.5	No Relaxation	IS:3025 (Part-11) 2022
2	Electrical Conductivity	µS/cm	40	-	-	IS:3025(Part-14) 2013
3	Total Dissolved Solids	mg/l	64	500	2000	IS:3025 (Part-16) 2023
4	Total Hardness as CaCO3	mg/l	30	200	600	IS:3025 (Part-21)
5	Calcium as Ca	mg/l	8.0	75	200	IS:3025 (Part-40) 1991
6	Magnesium as Mg	mg/l	2.43	30	100	IS:3025 (Part-46) 2023
7	Chloride as Cl	mg/l	1.99	250	1000	IS:3025 (Part-32)1988
8	Total Alkalinity as CaCO3	mg/l	24	200	600	IS:3025 (Part-23) 2023
9	Sulphate as SO4	mg/l	1.75	200	400	IS:3025 (Part-24)
10	Nitrate as NO3	mg/l	2.097	45.0	No Relaxation	IS:3025 (Part-34)
11	Sodium as Na	mg/l	2.17	-	-	IS:3025 (Part-45)
12	Potassium as K	mg/l	1.11	-	-	IS:3025 (Part-45)
13	Fluoride as F	mg/l	0.048	1.0	1.5	IS:3025 (Part-60)2023
14	Iron as Fe	mg/l	BDL (LOD 0.02)	0.3	No Relaxation	IS:3025 (Part-65) 2022
15	Manganese as Mn	mg/l	BDL (LOD 0.01)	0.1	0.3	IS:3025 (Part-59)

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Test Certificate

ULR No. TC127802500004022F

Test Report No.	AETRL/161025W0016	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle

Reviewed by
Dr. Dinesh Uchchariya

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Advanced Environmental Testing And Research Lab P. Ltd. Gwalior

Authorised Signatory
Rajesh Jain

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Test Certificate

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Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle
Nature of Sample	Water		
Sample Collected By	Customer	**D/o Sample Collection**	16/10/2025
Sample Description	Water Sample NPWQ14	**Sample Received by**	AETRL LAB
Sample Location	Kubduruduru	**Sampling Method**	NA
Coordinates	21.974534° 85.141266°	**Sample Condition**	Satisfactory
D/o Sample Analysis	16/10/2025	**D/o Analysis Completion**	29/10/2025

Results

S.No.	Test Parameters	Units	Results	Requirement as per IS:10500-2018		Test Method
				Acceptable Limits	Permissible Limits	
1	pH (at 25°C)	-	5.6	6.5 to 8.5	No Relaxation	IS:3025 (Part-11) 2022
2	Electrical Conductivity	µS/cm	335	-	-	IS:3025(Part-14) 2013
3	Total Dissolved Solids	mg/l	211	500	2000	IS:3025 (Part-16) 2023
4	Total Hardness as CaCO3	mg/l	152	200	600	IS:3025 (Part-21)
5	Calcium as Ca	mg/l	42.4	75	200	IS:3025 (Part-40) 1991
6	Magnesium as Mg	mg/l	11.1	30	100	IS:3025 (Part-46) 2023
7	Chloride as Cl	mg/l	17.99	250	1000	IS:3025 (Part-32)1988
8	Total Alkalinity as CaCO3	mg/l	190	200	600	IS:3025 (Part-23) 2023
9	Sulphate as SO4	mg/l	2.3	200	400	IS:3025 (Part-24)
10	Nitrate as NO3	mg/l	2.53	45.0	No Relaxation	IS:3025 (Part-34)
11	Sodium as Na	mg/l	21.29	-	-	IS:3025 (Part-45)
12	Potassium as K	mg/l	0.63	-	-	IS:3025 (Part-45)
13	Fluoride as F	mg/l	0.134	1.0	1.5	IS:3025 (Part-60)2023
14	Iron as Fe	mg/l	BDL (LOD 0.02)	0.3	No Relaxation	IS:3025 (Part-65) 2022
15	Manganese as Mn	mg/l	BDL (LOD 0.01)	0.1	0.3	IS:3025 (Part-59)

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Doc. No. : AETRL-R-032

Page No. 1/2

Advanced Environmental Testing And Research Lab P. Ltd.

CIN: U73100MP2002PTC015352 GSTIN: 23AAECA9188L1Z8
Approved: by Ministry of Environment, Forest and Climate Change (MoEF&CC)
Approved: by National Accreditation Board for Testing and Calibration Laboratories
Approved: by Bureau of International Quality Standards (ISO 45001:2018)
Registered Office: 63/1, Kailash Vihar, Near Income Tax Office, City Center-II
Gwalior-474 011 (M.P.), India
0751- 4099916, 223217
Email: aetrl2016@gmail.com,

TC-12780

Test Certificate

ULR No. TC1278025000004023F

Test Report No.	AETRL/161025W0017	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle

Reviewed by
Dr. Dinesh Uchchariya

* End of Report *

Advanced Environmental Testing And Research Lab P. Ltd. Gwalior

Authorised Signatory
Rajesh Jain

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TC-12780

Test Certificate

ULR No. TC1278025000004024F

Test Report No.	AETRL/161025W0018	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle
Nature of Sample	Water		
Sample Collected By	Customer	**D/o Sample Collection**	16/10/2025
Sample Description	Water Sample NPWQ15	**Sample Received by**	AETRL LAB
Sample Location	Tensa nature Camp Gate	**Sampling Method**	NA
Coordinates	21.869059° 85.163138°	**Sample Condition**	Satisfactory
D/o Sample Analysis	16/10/2025	**D/o Analysis Completion**	29/10/2025

Results

S.No.	Test Parameters	Units	Results	Requirement as per IS:10500-2018		Test Method
				Acceptable Limits	Permissible Limits	
1	pH (at 25°C)	-	6.0	6.5 to 8.5	No Relaxation	IS:3025 (Part-11) 2022
2	Electrical Conductivity	µS/cm	88	-	-	IS:3025(Part-14) 2013
3	Total Dissolved Solids	mg/l	55	500	2000	IS:3025 (Part-16) 2023
4	Total Hardness as CaCO3	mg/l	26	200	600	IS:3025 (Part-21)
5	Calcium as Ca	mg/l	6.4	75	200	IS:3025 (Part-40) 1991
6	Magnesium as Mg	mg/l	2.43	30	100	IS:3025 (Part-46) 2023
7	Chloride as Cl	mg/l	0.99	250	1000	IS:3025 (Part-32)1988
8	Total Alkalinity as CaCO3	mg/l	28	200	600	IS:3025 (Part-23) 2023
9	Sulphate as SO4	mg/l	1.02	200	400	IS:3025 (Part-24)
10	Nitrate as NO3	mg/l	1.62	45.0	No Relaxation	IS:3025 (Part-34)
11	Sodium as Na	mg/l	1.64	-	-	IS:3025 (Part-45)
12	Potassium as K	mg/l	8.36	-	-	IS:3025 (Part-45)
13	Fluoride as F	mg/l	0.082	1.0	1.5	IS:3025 (Part-60)2023
14	Iron as Fe	mg/l	BDL (LOD 0.02)	0.3	No Relaxation	IS:3025 (Part-65) 2022
15	Manganese as Mn	mg/l	BDL (LOD 0.01)	0.1	0.3	IS:3025 (Part-59)

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TC-12780

Test Certificate

ULR No. TC1278025000004024F

Test Report No.	AETRL/161025W0018	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle

Reviewed By,
Dr. Dinesh Uchchariya

* End of Report *

Advanced Environmental Testing And Research Lab P Ltd. Gwalior

Authorised Signatory
Rajesh Jain

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TC-12780

Test Certificate

ULR No. TC1278025000004025F

Test Report No.	AETRL/161025W0019	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle
Nature of Sample	Water		
Sample Collected By	Customer	**D/o Sample Collection**	16/10/2025
Sample Description	Water Sample NPWQ16	**Sample Received by**	AETRL LAB
Sample Location	Jaldihi	**Sampling Method**	NA
Coordinates	21.840467° 85.234268°	**Sample Condition**	Satisfactory
D/o Sample Analysis	16/10/2025	**D/o Analysis Completion**	29/10/2025

Results

S.No.	Test Parameters	Units	Results	Requirement as per IS:10500-2018		Test Method
				Acceptable Limits	Permissible Limits	
1	pH (at 25°C)	-	5.8	6.5 to 8.5	No Relaxation	IS:3025 (Part-11) 2022
2	Electrical Conductivity	µS/cm	134.9	-	-	IS:3025(Part-14) 2013
3	Total Dissolved Solids	mg/l	85	500	2000	IS:3025 (Part-16) 2023
4	Total Hardness as CaCO3	mg/l	30	200	600	IS:3025 (Part-21)
5	Calcium as Ca	mg/l	8.8	75	200	IS:3025 (Part-40) 1991
6	Magnesium as Mg	mg/l	1.94	30	100	IS:3025 (Part-46) 2023
7	Chloride as Cl	mg/l	7.99	250	1000	IS:3025 (Part-32)1988
8	Total Alkalinity as CaCO3	mg/l	16	200	600	IS:3025 (Part-23) 2023
9	Sulphate as SO4	mg/l	2.64	200	400	IS:3025 (Part-24)
10	Nitrate as NO3	mg/l	36.02	45.0	No Relaxation	IS:3025 (Part-34)
11	Sodium as Na	mg/l	5.43	-	-	IS:3025 (Part-45)
12	Potassium as K	mg/l	1.33	-	-	IS:3025 (Part-45)
13	Fluoride as F	mg/l	0.039	1.0	1.5	IS:3025 (Part-60)2023
14	Iron as Fe	mg/l	BDL (LOD 0.02)	0.3	No Relaxation	IS:3025 (Part-65) 2022
15	Manganese as Mn	mg/l	BDL (LOD 0.01)	0.1	0.3	IS:3025 (Part-59)

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TC-12780

Test Certificate

ULR No. TC1278025000004025F

Test Report No.	AETRL/161025W0019	**D/o Report Issue**	29/10/2025
Dispatch No	1882	**D/o Sample received**	16/10/2025
Company Name	M/s, Geo Climate Risk Solution Pvt. Ltd	**Qty of sample**	1.0 Ltr
Address	Innovation Valley,GCRS, APIS/NASSCOM, Hill No-3 IT Sez, Madhurawada Pin. 530048 Visakhapatnam Andhra	**Sample bottle**	Poly Bottle

Reviewed by
Dr. Dinesh Uchchariya

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Advanced Environmental Testing And Research Lab P. Ltd. Gwalior

Authorised Signatory
Rajesh Jain

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Page No. 2/2

ANNEXURE – III: Copy of Mine plan approval letter.

NARAYANPOSHI IRON AND MANGANESE MINE (30ORI13068) (38480302)

By e-mail

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES
OFFICE OF THE REGIONAL CONTROLLER OF MINES, BHUBANESHWAR

No. RMP-2309/2024-25-IBM_RO_BBS Dt : 06/12/2024

Shri/M/s. JSW STEEL LIMITED ,
JSW CENTRE BANDRA KURLA COMPLEX BANDRA (EAST)

Sub : Approval of the Review of Mining Plan along with Progressive Mine Closure Plan (PMCP) in respect of Narayanposhi Iron & Manganese Ore Block/Mine over an area of 347.008 ha. (as per DGPS) of M/s JSW Steel Limited situated in Village- Koida (Ct), Tahsil- Koida, District–Sundargarh of Odisha State.

Approved

Sir,

In exercise of the powers conferred by clause (b) of sub-section (2) of section 5 of the Mines & Minerals (Development & Regulation) Act, 1957 and Rule 16, clause (2) of Rule 17 of the Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rules, 2016 read with Government of India Order No. S.O. 1857(E) dated 18th May, 2016; I hereby **Approve** the Review of Mining Plan along with Progressive Mine Closure Plan (PMCP) in respect of Narayanposhi Iron & Manganese Ore Block/Mine over an area of 347.008 ha. (as per DGPS) of M/s JSW Steel Limited situated in Village- Koida (Ct), Tahsil- Koida, District–Sundargarh of Odisha State. This approval is subject to the following conditions:-

(1). The Review of Mining Plan is approved without prejudice to any other law applicable to the mine area from time to time whether made by the Central Government, State Government or any other authority and without prejudice to any order or direction from any court of competent jurisdiction.

(2). That this approval of aforesaid Review of Mining Plan does not in any way imply the approval of the Government in terms of any other provision of Mines & Minerals (Development & Regulation) Act, 1957, or the Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rules, 2016 and any other laws including Forest (Conservation) Act, 1980, Environment (Protection) Act, 1986 or the rules made there under and other relevant statutes, order and guidelines as may be applicable to the lease area from time to time.

(3). The provisions of the Mines Act, 1952 and Rules and Regulations made thereunder including submission of notices of opening, appointment of manager and other statutory officials as required by the Mines Act, 1952 shall be complied with.

(4).The execution of Review of Mining Plan shall be subjected to vacations of prohibitory orders / notices, if any.

(5). If anything is found to be concealed as required by the Mines Act in the contents of the mining plan and the proposal for rectification has not been made, the approval shall be deemed to have been withdrawn with immediate effect.

(6). This approval for proposed mining operations and associated activities is restricted to the mining lease area only from this date. The mining lease area is as shown on the statutory plans by the Lessee/QP/Applicant and Indian Bureau of Mines has not undertaken any survey verification of mining lease boundary on the ground.

(7). Your attention is invited to the Supreme Court interim order in W.P. (C) No. 202 dated 12.12.1996 for compliance. The approval of above said Mining Plan is therefore, issued without prejudice to and is subject to the said directions of the Supreme Court as applicable.

(8).This department does not undertake any responsibility regarding correctness of the boundaries of the lease area shown on the ground.

(9).At any stage, if it is observed that the information furnished in the document are incorrect or misrepresent facts, the approval of the document shall be revoked with immediate effect.

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

(11). It shall be mandatory for the project proponent, abstracting ground water, to obtain "No Objection Certificate" from Central Ground Water Authority or, the concerned State/Union Territory Ground Water Authority, as the case may be.

NARAYANPOSHI IRON AND MANGANESE MINE (30ORI13068) (38480302)

(12). Lessee shall ensure grassing/re-grassing of worked out mining lease area in accordance with Hon'ble Supreme Court Order dated 08/01/2020.

(13). This approval has been given for mining proposal for the year 2025-26 to 2029-30 and are subject to the validity of lease period.

(14).The next Review of Mining Plan for the subsequent period of five years shall become due 180 days before expiry of this document proposal period.

(15). The validity period of the performance surety shall be renewed before the expiry of the same and should be submitted to State Government with a copy to this office.

(16). The feasibility/pre-feasibility report considered for reserve/resource estimation as per UNFC is submitted by the preferred bidder / lessee which is prepared based on the current data as reported and it may not establishes the future economic viability of mining project, which may be affected by the market dynamics and other related factors.

(17) Disposal of OB/Waste as minor mineral shall be carried out only after obtaining permission under Rule 12(1)(k) of Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rules, 2016.

Yours Faithfully

(ARUN KUMAR)

Regional Controller of Mines,

Copy for information to :-

(1).The Controller of Mines (EZ), Indian Bureau of Mines, E-mail. zo.kol@ibm.gov.in

(2).The Director of Mines, Directorate of Mines, Government of Odisha, Email- directorateofmines@orissaminerals.gov.in.

(3).Qualified Person, Email – padma.tumati@jsw.in

Approved

ANNEXURE – IV: Month wise rainwater estimation.

RF Quarry

Month_Year	Rainfall (m)	Evaporation (m)	Rainwater Quantum (m^3)	Evaporation loss (m^3)	Recharge Losses (m^3/day)	Total cumulative Accumulated Rainwater quantum (m^3)
January_2015	0.012	0.175	4277	3212	1711	0
February_2015	0.005	0.223	1887	4093	755	0
March_2015	0.022	0.313	7781	5745	3112	0
April_2015	0.051	0.312	18064	5726	7226	5112
May_2015	0.072	0.362	25427	6644	10171	13724
June_2015	0.232	0.217	82289	3983	32915	59114
July_2015	0.317	0.137	112572	2514	45029	124143
August_2015	0.114	0.163	40458	2992	16183	145426
September_2015	0.076	0.178	26955	3267	10782	158332
October_2015	0.011	0.194	3811	3561	1524	157058
November_2015	0.000	0.181	0	0	0	157058
December_2015	0.037	0.146	13046	2680	5218	162206
January_2016	0.001	0.200	496	3671	199	158833
February_2016	0.069	0.217	24584	3983	9834	169600
March_2016	0.021	0.320	7360	5873	2944	168143
April_2016	0.003	0.435	1234	7984	494	160900
May_2016	0.162	0.381	57565	6993	23026	188446
June_2016	0.127	0.258	45122	4735	18049	210784
July_2016	0.307	0.132	108894	2423	43558	273698
August_2016	0.365	0.136	129487	2496	51795	348894
September_2016	0.190	0.128	67329	2349	26932	386942
October_2016	0.040	0.185	14359	3395	5744	392162
November_2016	0.000	0.185	36	3395	15	388788
December_2016	0.000	0.186	0	0	0	388788
January_2017	0.004	0.202	1422	3708	569	385934
February_2017	0.000	0.240	0	0	0	385934
March_2017	0.015	0.321	5355	5892	2142	383255
April_2017	0.002	0.410	806	7525	322	376214
May_2017	0.109	0.378	38654	6938	15462	392469
June_2017	0.176	0.227	62517	4166	25007	425813
July_2017	0.530	0.124	187892	2276	75157	536272
August_2017	0.232	0.154	82266	2827	32906	582805
September_2017	0.159	0.153	56361	2808	22545	613813
October_2017	0.078	0.160	27626	2937	11050	627452
November_2017	0.011	0.161	4076	2955	1631	626943
December_2017	0.000	0.162	0	0	0	626943
January_2018	0.000	0.208	0	0	0	626943
February_2018	0.000	0.236	116	4332	46	622681
March_2018	0.001	0.334	179	6130	72	616658
April_2018	0.110	0.318	38971	5837	15588	634204

May_2018	0.113	0.332	40242	6094	16097	652256
June_2018	0.158	0.233	56038	4276	22415	681602
July_2018	0.320	0.125	113410	2294	45364	747354
August_2018	0.339	0.138	120349	2533	48140	817031
September_2018	0.274	0.156	97132	2863	38853	872447
October_2018	0.075	0.194	26753	3561	10701	884938
November_2018	0.000	0.169	0	0	0	884938
December_2018	0.092	0.152	32607	2790	13043	901712
January_2019	0.000	0.164	0	0	0	901712
February_2019	0.081	0.205	28794	3763	11517	915226
March_2019	0.037	0.262	13013	4809	5205	918225
April_2019	0.046	0.339	16151	6222	6461	921694
May_2019	0.109	0.351	38755	6442	15502	938505
June_2019	0.092	0.263	32500	4827	13000	953178
July_2019	0.202	0.166	71743	3047	28697	993177
August_2019	0.245	0.123	87080	2258	34832	1043167
September_2019	0.240	0.129	85146	2368	34058	1091887
October_2019	0.163	0.140	57991	2570	23197	1124112
November_2019	0.000	0.162	0	0	0	1124112
December_2019	0.006	0.148	2235	2716	894	1122737
January_2020	0.024	0.160	8655	2937	3462	1124993
February_2020	0.030	0.179	10779	3285	4312	1128175
March_2020	0.072	0.243	25570	4460	10228	1139057
April_2020	0.156	0.299	55391	5488	22156	1166804
May_2020	0.169	0.310	60113	5690	24045	1197182
June_2020	0.195	0.178	69256	3267	27702	1235469
July_2020	0.157	0.157	55614	2882	22246	1265956
August_2020	0.574	0.134	203735	2459	81494	1385738
September_2020	0.157	0.165	55727	3028	22291	1416145
October_2020	0.051	0.176	18096	3230	7239	1423773
November_2020	0.003	0.186	969	3414	388	1420941
December_2020	0.000	0.174	0	0	0	1420941
January_2021	0.002	0.187	792	3432	317	1417984
February_2021	0.004	0.224	1297	4111	519	1414651
March_2021	0.018	0.340	6255	6240	2502	1412164
April_2021	0.024	0.356	8401	6534	3360	1410670
May_2021	0.492	0.298	174714	5469	69885	1510029
June_2021	0.211	0.174	74743	3194	29897	1551681
July_2021	0.276	0.162	97962	2973	39185	1607485
August_2021	0.149	0.164	52803	3010	21121	1636157
September_2021	0.373	0.147	132198	2698	52879	1712778
October_2021	0.137	0.170	48514	3120	19405	1738766
November_2021	0.056	0.141	19948	2588	7979	1748146
December_2021	0.064	0.133	22869	2441	9147	1759427
January_2022	0.058	0.138	20680	2533	8272	1769301
February_2022	0.039	0.196	13692	3597	5477	1773919
March_2022	0.003	0.321	1125	5892	450	1768703
April_2022	0.013	0.388	4737	7121	1895	1764424

May_2022	0.069	0.353	24560	6479	9824	1772681
June_2022	0.126	0.262	44681	4809	17872	1794681
July_2022	0.255	0.168	90449	3083	36180	1845867
August_2022	0.487	0.159	172824	2918	69130	1946643
September_2022	0.182	0.161	64651	2955	25860	1982478
October_2022	0.053	0.175	18935	3212	7574	1990627
November_2022	0.000	0.173	0	0	0	1990627
December_2022	0.000	0.172	0	0	0	1990627
January_2023	0.000	0.190	6	3487	2	1987143
February_2023	0.000	0.236	0	0	0	1987143
March_2023	0.038	0.281	13398	5157	5359	1990025
April_2023	0.066	0.310	23314	5690	9326	1998324
May_2023	0.076	0.364	26807	6681	10723	2007727
June_2023	0.160	0.307	56778	5635	22711	2036159
July_2023	0.266	0.182	94221	3340	37688	2089351
August_2023	0.359	0.154	127487	2827	50995	2163017
September_2023	0.242	0.131	85690	2404	34276	2212027
October_2023	0.067	0.183	23698	3359	9479	2222887
November_2023	0.007	0.177	2517	3249	1007	2221148
December_2023	0.038	0.139	13586	2551	5434	2226748
January_2024	0.046	0.145	16326	2661	6531	2233883
February_2024	0.013	0.197	4645	3616	1858	2233054
March_2024	0.060	0.276	21414	5066	8565	2240837
April_2024	0.004	0.363	1506	6663	602	2235078
May_2024	0.092	0.346	32770	6350	13108	2248390
June_2024	0.064	0.295	22789	5414	9116	2256649
July_2024	0.151	0.142	53661	2606	21465	2286239
August_2024	0.391	0.111	138854	2037	55542	2367514
September_2024	0.225	0.149	79871	2735	31948	2412702
October_2024	0.104	0.162	36755	2973	14702	2431782
November_2024	0.017	0.167	6044	3065	2417	2432343
December_2024	0.013	0.136	4568	2496	1827	2432587
Total (m^3)			4766657	432090	1906663	2432587
Total (m^3/year)			13059	1184	190666	243259
Average (m^3/day)						**666**

Total available rainwater = Total cumulative rainwater quantum − (Evaporation loss + Recharge loss)

The cumulative accumulated rainwater quantum available for dewatering in RF Quarry is about 2,43,259 m^3/year or **666 m^3/day**

Q-3&4

Month_Year	Rainfall (m)	Evaporation (m)	Rainwater Quantum (m^3)	Evaporation loss (m^3)	Recharge Losses (m^3/day)	Total cumulative Accumulated Rainwater quantum (m^3)
January_2015	0.012	0.175	3226	2422	1290	0
February_2015	0.005	0.223	1423	3086	569	0
March_2015	0.022	0.313	5868	4332	2347	0
April_2015	0.051	0.312	13623	4318	5449	3856
May_2015	0.072	0.362	19176	5010	7671	10352
June_2015	0.232	0.217	62060	3003	24824	44584
July_2015	0.317	0.137	84899	1896	33959	93627
August_2015	0.114	0.163	30512	2256	12205	109679
September_2015	0.076	0.178	20329	2464	8131	119412
October_2015	0.011	0.194	2874	2685	1150	118452
November_2015	0.000	0.181	0	0	0	118452
December_2015	0.037	0.146	9839	2021	3935	122334
January_2016	0.001	0.2	374	2768	150	119791
February_2016	0.069	0.217	18540	3003	7416	127912
March_2016	0.021	0.32	5551	4429	2220	126813
April_2016	0.003	0.435	931	6020	372	121352
May_2016	0.162	0.381	43414	5273	17365	142127
June_2016	0.127	0.258	34030	3571	13612	158974
July_2016	0.307	0.132	82125	1827	32850	206422
August_2016	0.365	0.136	97655	1882	39062	263133
September_2016	0.190	0.128	50778	1772	20311	291828
October_2016	0.040	0.185	10829	2560	4332	295765
November_2016	0.000	0.185	27	2560	11	293221
December_2016	0.000	0.186	0	0	0	293221
January_2017	0.004	0.202	1073	2796	429	291069
February_2017	0.000	0.24	0	0	0	291069
March_2017	0.015	0.321	4038	4443	1615	289049
April_2017	0.002	0.41	608	5674	243	283740
May_2017	0.109	0.378	29152	5232	11661	295999
June_2017	0.176	0.227	47149	3142	18859	321147
July_2017	0.530	0.124	141702	1716	56681	404452
August_2017	0.232	0.154	62043	2131	24817	439546
September_2017	0.159	0.153	42506	2118	17002	462932
October_2017	0.078	0.16	20835	2214	8334	473219
November_2017	0.011	0.161	3074	2228	1230	472835
December_2017	0.000	0.162	0	0	0	472835
January_2018	0.000	0.208	0	0	0	472835
February_2018	0.000	0.236	87	3266	35	469621
March_2018	0.001	0.334	135	4623	54	465080
April_2018	0.110	0.318	29391	4401	11756	478313
May_2018	0.113	0.332	30349	4595	12140	491928

June_2018	0.158	0.233	42262	3225	16905	514060
July_2018	0.320	0.125	85531	1730	34212	563649
August_2018	0.339	0.138	90764	1910	36306	616197
September_2018	0.274	0.156	73254	2159	29301	657990
October_2018	0.075	0.194	20176	2685	8070	667411
November_2018	0.000	0.169	0	0	0	667411
December_2018	0.092	0.152	24591	2104	9837	680062
January_2019	0.000	0.164	0	0	0	680062
February_2019	0.081	0.205	21715	2837	8686	690254
March_2019	0.037	0.262	9814	3626	3926	692516
April_2019	0.046	0.339	12181	4692	4872	695133
May_2019	0.109	0.351	29228	4858	11691	707812
June_2019	0.092	0.263	24511	3640	9804	718879
July_2019	0.202	0.166	54107	2297	21643	749045
August_2019	0.245	0.123	65673	1702	26269	786747
September_2019	0.240	0.129	64214	1785	25686	823490
October_2019	0.163	0.14	43735	1938	17494	847793
November_2019	0.000	0.162	0	0	0	847793
December_2019	0.006	0.148	1685	2048	674	846756
January_2020	0.024	0.16	6528	2214	2611	848458
February_2020	0.030	0.179	8129	2477	3252	850859
March_2020	0.072	0.243	19284	3363	7714	859066
April_2020	0.156	0.299	41774	4138	16710	879992
May_2020	0.169	0.31	45336	4290	18134	902903
June_2020	0.195	0.178	52231	2464	20892	931778
July_2020	0.157	0.157	41943	2173	16777	954771
August_2020	0.574	0.134	153651	1855	61460	1045107
September_2020	0.157	0.165	42028	2284	16811	1068040
October_2020	0.051	0.176	13648	2436	5459	1073793
November_2020	0.003	0.186	731	2574	292	1071657
December_2020	0.000	0.174	0	0	0	1071657
January_2021	0.002	0.187	598	2588	239	1069428
February_2021	0.004	0.224	978	3100	391	1066915
March_2021	0.018	0.34	4717	4706	1887	1065040
April_2021	0.024	0.356	6336	4927	2534	1063914
May_2021	0.492	0.298	131764	4124	52706	1138848
June_2021	0.211	0.174	56369	2408	22548	1170261
July_2021	0.276	0.162	73880	2242	29552	1212347
August_2021	0.149	0.164	39822	2270	15929	1233971
September_2021	0.373	0.147	99700	2034	39880	1291756
October_2021	0.137	0.17	36588	2353	14635	1311356
November_2021	0.056	0.141	15044	1951	6018	1318431
December_2021	0.064	0.133	17247	1841	6899	1326938
January_2022	0.058	0.138	15596	1910	6238	1334386
February_2022	0.039	0.196	10326	2713	4130	1337869
March_2022	0.003	0.321	849	4443	340	1333935
April_2022	0.013	0.388	3573	5370	1429	1330709
May_2022	0.069	0.353	18522	4886	7409	1336937

June_2022	0.126	0.262	33697	3626	13479	1353529
July_2022	0.255	0.168	68214	2325	27286	1392132
August_2022	0.487	0.159	130339	2201	52135	1468135
September_2022	0.182	0.161	48758	2228	19503	1495161
October_2022	0.053	0.175	14280	2422	5712	1501307
November_2022	0.000	0.173	0	0	0	1501307
December_2022	0.000	0.172	0	0	0	1501307
January_2023	0.000	0.19	4	2630	2	1498680
February_2023	0.000	0.236	0	0	0	1498680
March_2023	0.038	0.281	10105	3889	4042	1500854
April_2023	0.066	0.31	17583	4290	7033	1507113
May_2023	0.076	0.364	20217	5038	8087	1514206
June_2023	0.160	0.307	42820	4249	17128	1535649
July_2023	0.266	0.182	71059	2519	28423	1575765
August_2023	0.359	0.154	96147	2131	38459	1631322
September_2023	0.242	0.131	64625	1813	25850	1668284
October_2023	0.067	0.183	17872	2533	7149	1676475
November_2023	0.007	0.177	1898	2450	759	1675164
December_2023	0.038	0.139	10246	1924	4098	1679388
January_2024	0.046	0.145	12313	2007	4925	1684769
February_2024	0.013	0.197	3503	2726	1401	1684144
March_2024	0.060	0.276	16150	3820	6460	1690014
April_2024	0.004	0.363	1136	5024	454	1685672
May_2024	0.092	0.346	24714	4789	9886	1695712
June_2024	0.064	0.295	17187	4083	6875	1701941
July_2024	0.151	0.142	40470	1965	16188	1724257
August_2024	0.391	0.111	104720	1536	41888	1785553
September_2024	0.225	0.149	60236	2062	24094	1819632
October_2024	0.104	0.162	27720	2242	11088	1834022
November_2024	0.017	0.167	4558	2311	1823	1834446
December_2024	0.013	0.136	3445	1882	1378	1834630
Total (m^3)			3594869	325821	1437948	1834630
Total (m^3/year)			9849	893	143795	183463
Average (m^3/day)						**503**

Total available rainwater = Total cumulative rainwater quantum − (Evaporation loss + Recharge loss)

The cumulative accumulated rainwater quantum available for dewatering in Q-3&4 is about 1,83,463 m^3/year or 502.64 ~ **503 m^3/day.**

ANNEXURE-V: Copy of Work Order

JSW Steel

SERVICE ORDER

JSW Steel Limited
Odisha Mines
Shinghania Tower, Bhusugoan 15,,,Tehsil-Barbil 02,
Bhadrasahi-758051
Keonjhar-Odisha (India)
Tel No: 7325843227

Vendor Code	: 0020053278
Name	: GEO CLIMATE RISK SOLUTIONS PVT LTD
Address	: Waltair Main Road,Rama Nagar VISAKHAPATNAM-530002-Andhra Pradesh-India
Ph.No	: 00919810708901
E-mail	: BUSINESS@GCRS.CO.IN
PAN NO	: AAFCG8137J
GST No.	: 37AAFCG8137J1Z9
Bank Account	: 34585495630

P.O.No.:Odisha Mines/118408/SER/4500193482
P.O.Date:14.08.2024
Type:SER-DOM
Contact:PI_RFCADMIN

LD applicable:YES

Hydro Geology Service at Nuagaon, NarayanPoshi, Jajang and Gonua mines.
Dear Sir/Madam,

We are pleased to place order against your Ref. Quote No. 3100715220 Dated: ARIBA , as per below mentioned PRICE, terms & conditions.

ALL THE PRICES MENTIONED BELOW ARE IN #INR#

SR. NO.	SERVICE SHORT DESCRIPTION	UOM	QTY.	TOTAL	COMPLETION DATE
1	HYDRO GEOLOGY SERVICE AT NUAGAON MINE	AU	1.000	[illegible]	04.08.2025

The above work contains following Services:

SR.NO.	SERVICE CODE SERVICE DESCRIPTION	QTY.	UoM	UNIT PRICE	TOTAL PRICE
1.1	SCR8010150800929 PRVD:CONSLTNCY SERVS;HYDROGEOLOGY STUDY	1.000	EA	[illegible]	[illegible]

PROVIDE: CONSULTANCY SERVICES;TYPE:CONSULTANCY SERVICES;SUB TYPE:HYDROGEOLOGY STUDY;DOCUMENT PREPARATION:VENDOR SCOPE;WORKING HOURS PER DAY:NEED BASIS;RATE TYPE:EA;OPERATING AREA:NORMAL;MANPOWER PROVIDED BY:VENDOR;TRANSPORTATION ARRANGEMENT:VENDOR;LODGING AND BOARDING BY:VENDOR;GENERAL TOOLS PROVIDED BY:VENDOR;SPECIAL TOOLS PROVIDED BY:VENDOR;MATERIAL/ SPARES PROVIDED BY:VENDOR;CONSUMABLE PROVIDED BY:VENDOR;MATERIAL HANDLING BY:VENDOR;MATERIAL HANDLING EQUIPMENT PROVIDED BY:VENDOR;PROCESS EQUIPMENT PROVIDED BY:VENDOR;SCAFFOLDING PROVIDED BY:VENDOR;WORKING HEIGHT:GROUND LEVEL;NORMAL PPES PROVIDED BY:VENDOR;SPECIAL PPES PROVIDED BY:VENDOR;STATUTORY OBLIGATION BY:VENDOR

Thanking You
Yours sincerely,
FOR JSW STEEL LIMITED

AUTHORISED SIGNATORY

Plant GST No : 21AAACJ4323N2ZR ; PAN : AAACJ4323N ; CIN :L27102MH1994PLC152925

JSW Centre, Bandra Kurla Complex, Bandra (East), Mumbai 400 051

JSW Steel

Odisha Mines/118408/SER/4500193482

SR. NO.	SERVICE SHORT DESCRIPTION	UOM	QTY.	TOTAL	COMPLETION DATE
2	HYDRO GEOLOGY SERVICE AT NARAYANPOSHI	AU	1.000	410000.0000	04.08.2025
	The above work contains following Services:				
	SR.NO. SERVICE CODE / SERVICE DESCRIPTION		QTY. UoM	UNIT PRICE	TOTAL PRICE
	2.1 SCR8010150800929 PRVD:CONSLTNCY SERVS;HYDROGEOLOGY STUDY		1.000 EA	0.0000	1000
	PROVIDE: CONSULTANCY SERVICES;TYPE:CONSULTANCY SERVICES;SUB TYPE:HYDROGEOLOGY STUDY;DOCUMENT PREPARATION:VENDOR SCOPE;WORKING HOURS PER DAY:NEED BASIS;RATE TYPE:EA;OPERATING AREA:NORMAL;MANPOWER PROVIDED BY:VENDOR;TRANSPORTATION ARRANGEMENT:VENDOR;LODGING AND BOARDING BY:VENDOR;GENERAL TOOLS PROVIDED BY:VENDOR;SPECIAL TOOLS PROVIDED BY:VENDOR;MATERIAL/ SPARES PROVIDED BY:VENDOR;CONSUMABLE PROVIDED BY:VENDOR;MATERIAL HANDLING BY:VENDOR;MATERIAL HANDLING EQUIPMENT PROVIDED BY:VENDOR;PROCESS EQUIPMENT PROVIDED BY:VENDOR;SCAFFOLDING PROVIDED BY:VENDOR;WORKING HEIGHT:GROUND LEVEL;NORMAL PPES PROVIDED BY:VENDOR;SPECIAL PPES PROVIDED BY:VENDOR;STATUTORY OBLIGATION BY:VENDOR				
3	HYDRO GEOLOGY SERVICE AT JAJANG MINE	AU	1.000	00	04.08.2025
	The above work contains following Services:				
	SR.NO. SERVICE CODE / SERVICE DESCRIPTION		QTY. UoM	UNIT PRICE	TOTAL PRICE
	3.1 SCR8010150800929 PRVD:CONSLTNCY SERVS;HYDROGEOLOGY STUDY		1.000 EA	-	0
	PROVIDE: CONSULTANCY SERVICES;TYPE:CONSULTANCY SERVICES;SUB TYPE:HYDROGEOLOGY STUDY;DOCUMENT PREPARATION:VENDOR SCOPE;WORKING HOURS PER DAY:NEED BASIS;RATE TYPE:EA;OPERATING AREA:NORMAL;MANPOWER PROVIDED BY:VENDOR;TRANSPORTATION ARRANGEMENT:VENDOR;LODGING AND BOARDING BY:VENDOR;GENERAL TOOLS PROVIDED BY:VENDOR;SPECIAL TOOLS PROVIDED BY:VENDOR;MATERIAL/ SPARES PROVIDED BY:VENDOR;CONSUMABLE PROVIDED BY:VENDOR;MATERIAL HANDLING BY:VENDOR;MATERIAL HANDLING EQUIPMENT PROVIDED BY:VENDOR;PROCESS EQUIPMENT PROVIDED BY:VENDOR;SCAFFOLDING PROVIDED BY:VENDOR;WORKING HEIGHT:GROUND LEVEL;NORMAL PPES PROVIDED BY:VENDOR;SPECIAL PPES PROVIDED BY:VENDOR;STATUTORY OBLIGATION BY:VENDOR				

Thanking You
Yours sincerely,
FOR JSW STEEL LIMITED

AUTHORISED SIGNATORY

Plant GST No : 21AAACJ4323N2ZR ; PAN : AAACJ4323N ; CIN :L27102MH1994PLC152925

JSW Centre, Bandra Kurla Complex, Bandra (East), Mumbai 400 051

ANNEXURE XV

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास
और गंगा संरक्षण विभाग
केन्द्रीय भूमि जल प्राधिकरण
Government of India
Ministry of Jal Shakti
Department of Water Resources,
River Development & Ganga Rejuvenation
Central Ground Water Authority

(भूजल निकासी हेतु अनापत्ति प्रमाण पत्र)
NO OBJECTION CERTIFICATE (NOC) FOR GROUND WATER ABSTRACTION

CENTRAL GROUND WATER AUTHORITY

Project Name:	Jsw Steel Ltd.-narayanposhi Iron And Manganese Ore Mines		
Project Address:	At/po- Koira, Dist- Sundargarh, Odisha-770048		
Village:	Kasira	Block:	Koida
District:	Sundargarh	State:	Odisha
Pin Code:			
Communication Address:	M/s Jsw Steel Limited, Narayanposhi Iron And Manganese Ore Mines, Village: Kasira, Block/taluka: Koida, Distt.: Sundargarh, Odisha, Koida, Sundargarh, Odisha - 770048		
Address of CGWB Regional Office :	Central Ground Water Board South Eastern Region, Bhujal Bhawan, Khandagiri Square, Nh-5, Bhubaneshwar, Khordha, Odisha - 751030		

1.	**NOC No.:**	CGWA/NOC/MIN/REN/2/2024/10057	2.	**Date of Issuence**	17/10/2024
3.	Application No.:	21-4/859/OR/MIN/2016	4.	Category: (GWRE 2023)	Safe
5.	Project Status:	Existing Ground Water	6.	NOC Type:	Renewal
7.	**Valid from:**	19/01/2022	8.	**Valid up to:**	18/01/2026(Extended Validity)

9. Ground Water Abstraction Permitted:

Fresh Water		Saline Water		Dewatering		Total	
m³/day	m³/year	m³/day	m³/year	m³/day	m³/year	m³/day	m³/year
980.00	35770.00			1102.00	402230.00	2082.00	438000.00

10. Details of ground water abstraction /Dewatering structures

	Total Existing No.:4						Total Proposed No.:4					
	DW	DCB	BW	TW	MP	MPu	DW	DCB	BW	TW	MP	MPu
Abstraction Structure*	0	0	3	0	0	0	0	0	4	0	0	0
Dewatering Structure*	0	0	0	0	1	0	0	0	0	0	0	0

*DW- Dug Well; DCB-Dug-cum-Bore Well; BW-Bore Well; TW-Tube Well; MP-Mine Pit;MPu-Mine Pumps

11.	Ground Water Abstraction/Restoration Charges paid (Rs.):	9587400.00
12.	Environment Compensation (if applicable) paid (Rs.):	0.00

13.	Number of Piezometers(Observation wells) to be constructed/ monitored & Monitoring mechanism.	No. of Piezometers	Monitoring Mechanism		
			Manual	DWLR**	DWLR With Telemetry
	**DWLR - Digital Water Level Recorder	2	0	1	1

18/11, जामनगर हाउस, मानसिंह रोड, नई दिल्ली - 110011 / 18/11, Jamnagar House, Mansingh Road, New Delhi-110011
Phone: (011) 23383561 Fax: 23382051, 23386743
Website: cgwa-noc.gov.in

(Compliance Conditions given overleaf)

This is an auto generated document & need not to be signed.

CENTRAL GROUND WATER AUTHORITY

18/11, जामनगर हाउस, मानसिंह रोड, नई दिल्ली - 110011 / 18/11, Jamnagar House, Mansingh Road, New Delhi-110011
Phone: (011) 23383561 Fax: 23382051, 23386743
Website: cgwa-noc.gov.in

Validity of this NOC shall be subject to compliance of the following conditions:

Mandatory conditions:

1) Installation of tamper proof digital water flow meter with telemetry on all the abstraction structure(s) shall be mandatory for all users seeking No Objection Certificate and intimation regarding their installation shall be communicated to the CGWA within 30 days of grant of No Objection Certificate.

2) Proponents shall mandatorily get water flow meter calibrated from an authorized agency once in a year.

3) Construction of purpose-built observation wells (piezometers) for ground water level monitoring shall be mandatory as per Section 14 of Guidelines. Water level data shall be made available to CGWA through web portal. Detailed guidelines for construction of piezometers are given in Annexure-II of the guidelines.

4) Proponents shall monitor quality of ground water from the abstraction structure(s) once in a year. Water samples from bore wells/ tube wells / dug wells shall be collected during April/May every year and analysed in NABL accredited laboratories for basic parameters (cations and anions), heavy metals, pesticides/ organic compounds etc. Water quality data shall be made available to CGWA through the web portal.

5) In case of mining projects, additional key wells shall be established in consultation with the Regional Director, CGWB for ground water level monitoring four (4) times a year (January, May, August and November) in core as well as buffer zones of the mine.

6) In case of mining project the firm shall submit water quality report of mine discharge/ seepage from Govt. approved/ NABL accredited lab.

7) The firm shall report compliance of the NOC conditions online in the website (www.cgwa-noc.gov.in) within one year from the date of issue of this NOC.

8) Industries abstracting ground water in excess of 100 m 3 /d shall undertake annual water audit through certified auditors and submit audit reports within three months of completion of the same to CGWA. All such industries shall be required to reduce their ground water use by at least 20% over the next three years through appropriate means.

9) Application for renewal can be submitted online from 90 days before the expiry of NOC. Ground water withdrawal, if any, after expiry of NOC shall be illegal & liable for legal action as per provisions of Environment (Protection) Act, 1986.

10) This NOC is subject to prevailing Central/State Government rules/laws/norms or Court orders related to construction of tube well/ground water abstraction structure / recharge or conservation structure/discharge of effluents or any such matter as applicable.

General conditions:

11) No additional ground water abstraction and/or de-watering structures shall be constructed for this purpose without prior approval of the Central Ground Water Authority (CGWA).

12) The proponent shall seek prior permission from CGWA for any increase in quantum of groundwater abstraction (more than that permitted in NOC for specific period).

13) Proponents shall install roof top rain water harvesting in the premise as per the existing building bye laws in the premise.

14) The project proponent shall take all necessary measures to prevent contamination of ground water in the premises failing which the firm shall be responsible for any consequences arising thereupon.

15) In case of industries that are likely to contaminate the ground water, no recharge measures shall be taken up by the firm inside the plant premises. The runoff generated from the rooftop shall be stored and put to beneficial use by the firm.

16) Wherever feasible, requirement of water for greenbelt (horticulture) shall be met from recycled / treated waste water.

17) Wherever the NOC is for abstraction of saline water and the existing wells (s) is /are yielding fresh water, the same shall be sealed and new tubewell(s) tapping saline water zone shall be constructed within 3 months of the issuance of NOC. The firm shall also ensure safe disposal of saline residue, if any.

18) Unexpected variations in inflow of ground water into the mine pit, if any, shall be reported to the concerned Regional Director, Central Ground Water Board.

19) In case of violation of any NOC conditions, the applicant shall be liable to pay the penalties as per Section 16 of Guidelines.

20) This NOC does not absolve the proponents of their obligation / requirement to obtain other statutory and administrative clearances from appropriate authorities.

21) The issue of this NOC does not imply that other statutory / administrative clearances shall be granted to the project by the concerned authorities. Such authorities would consider the project on merits and take decisions independently of the NOC.

22) In case of change of ownership, new owner of the industry will have to apply for incorporation of necessary changes in the No Objection Certificate with documentary proof within 60 days of taking over possession of the premises.

23) This NOC is being issued without any prejudice to the directions of the Hon'ble NGT/court orders in cases related to ground water or any other related matters.

24) Proponents, who have installed/constructed artificial recharge structures in compliance of the NOC granted to them previously and have availed rebate of upto 50% (fifty percent) in the ground water abstraction charges/ground water restoration charges, shall continue to regularly maintain artificial recharge structures.

25) Industries which are likely to cause ground water pollution e.g. Tanning, Slaughter Houses, Dye, Chemical/ Petrochemical, Coal washeries, pharmaceutical, other hazardous units etc. (as per CPCB list) need to undertake necessary well head protection measures to ensure prevention of ground water pollution as per Annexure III of the guidelines.

26) In case of new infrastructure projects having ground water abstraction of more than 20 m3/day, the firm/entity shall ensure implementation of dual water supply system in the projects.

27) In case of infrastructure projects, paved/parking area must be covered with interlocking/perforated tiles or other suitable measures to ensure groundwater infiltration/harvesting.

28) In case of coal and other base metal mining projects, the project proponent shall use the advance dewatering technology (by construction of series of dewatering abstraction structures) to avoid contamination of surface water.

29) The NOC issued is conditional subject to the conditions mentioned in the Public notice dated 27.01.2021 failing which penalty/EC/cancellation of NOC shall be imposed as the case may be.
30) This NOC is issued subject to the clearance of Expert Appraisal Committee (EAC) (if applicable).
31) In the self-compliance report, the PP shall submit details of Drilling Agency/ Agencies, which has/ have constructed BW(s)/ TW(s) along with undertaking to the effect that all necessary measures have been taken as per directions of Hon'ble Supreme Court provided in Annexure-VII of guidelines dated 24.09.2020 in respect of abandoned/ failed BW(s)/ TW(s)/Piezometer(s), if any. The PP is advised to engage registered drilling agency/ agencies. In the event of any mishap/ unfortunate incident due to negligence in taking measures for prevention of accident due to falling in Bore Well, both PP and concerned drilling agency shall jointly be held responsible and penal action as per extant Government rules shall be taken.

(Non-compliance of the conditions mentioned above is likely to result in the cancellation of NOC and legal action against the proponent.)

CENTRAL GROUND WATER AUTHORITY

CENTRAL GROUND WATER AUTHORITY

Department of Water Resources, River Development and Ganga Rejuvenation
Ministry of Jal Shakti, Govt. of India

Receipt

(As per the guideline Gazette Notification S.O. 3281(E) regarding the New Guidelines dated 24.09.2020 of CGWA, MoJS, Govt. of India)
https://cgwa-noc.gov.in

Application No,:	21-4/859/OR/MIN/2016	Date of Issuence:17/10/2024
Name of Firm:	JSW Steel Ltd.-NARAYANPOSHI IRON AND MANGANESE ORE MINES	
AppType Category:	*Iron ore*	
Application Type:	*Mining*	
PAN/GSTIN No. of Firm/Individual:	/	

SN	Description			Amount (Rs.)
1.	Application Processing Fee			5000.00
2.	Ground Water Abstraction charges			9587400.00
3.	Ground Water Restoration charges			0
4.	Environmental Compensation Charges (ECRGW) *(Date From to) Days-*			
5.	Penalty for non-Compliance of NOC conditions *Condition to be mentioned*			100000.00
6.	Adjustment Charges			
7.	Rebate			
8.	Charges for correction/modification in the existing issued No Objection Certificate			
	S.No.	Description	Rate	
	(i)	Change in User ID	Rs. 1000	
	(ii)	Change in firm Name	Rs. 5000	
	(iii)	Extension of No Objection Certificate	Rs. 5000	
	(iv)	Issuance of duplicate No Objection Certificate	Rs. 5000	
	(v)	Issuance of corrigendum to No Objection Certificate	Rs. 5000	
	(vi)	Any other items/correction etc.	Rs. 500	
Rs. Rupees Ninty Six Lakh Ninty Two Thousand Four Hundred Only				**9692400.00**

This is an system generated invoice, hence, does not require ink signed.

CENTRAL GROUND WATER AUTHORITY

Term and conditions:

i. All disputes are subject to Delhi Jurisdiction.
ii. Any complaint in regard to the rates will not be entertained.

Member-Secretary
CGWA, New Delhi

CENTRAL GROUND WATER AUTHORITY

ANNEXURE XVI

Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

No. JSW/S/CO/2026/101

Date: 23/02/2026

To,
The Member Secretary
State Pollution Control Board, Odisha,
Paribesh Bhawan, A/118, Nilakantha Nagar, Unit-8,
BHUBANESWAR- 751012

Sub: - Submission of Quarterly Ground Water Level and Quality Monitoring Reports in compliance of CTO and NEERI Conditions for **Narayanposhi Iron & Manganese Ore Mine of M/s JSW Steel Ltd.**

Ref: - Consent Order No 2944 vide letter no 4651/IND-I-CON-2258 dated 30.03.2024.

Dear Sir,

With reference to aforesaid subject, please find enclosed herewith the Quarterly Ground Water Level and Quality Monitoring Reports for Jan 2026 in compliance of CTO and NEERI Conditions for **Narayanposhi Iron & Manganese Ore Mine of M/s JSW Steel Ltd**.

Seeking your co-operation as always.

Thanking you,

Yours Faithfully
For JSW Steel Ltd

Vijay Kumar 23/02/2026

Vijay Kumar

(Authorized Signatory) Encl:

As above

Copy to- The Regional Officer, Regional Office, Rourkela, Office of the State Pollution Control Board, At- Near Panposh Hockey Chowk, AT/PO. - Panposh, Rourkela – 769 004, Dist – Sundargarh, Odisha

Ref. No: Envlab/25-26/TR-20985 **Date: 06.02.2026**

TEST REPORT

Customer Name & Address	:	**Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd, Sundargarh**

SAMPLE DETAILS

Sample Location & Code	**GW-1: Gate No-1 (Security Barrack) GW-2: Quarry-1 (Borewell)**	**Sampled by**	**VCSPL'S Representative**
Sample Description	**Ground Water**	**Sampling Procedure**	**APHA 1060**
Sample Condition	**Sealed Plastic & Sterilized Glass Bottle**	**Sample Received on**	**10.01.2026**
Sampling Date	**09.01.2026**	**Test Completed on**	**10.01.2026 TO 16.01.2026**

Sl. No	Parameters	Unit	Standard as per IS 10500:2012, Amnd. 2015 & 2018		Test methods	GW-1	GW-2
			Acceptable Limit	Permissible Limit			
1	Color	Hazen	5	15	APHA 2120 B,C	<5.0	<5.0
2	Odour	--	Agreeable	Agreeable	APHA 2120 B	Agreeable	Agreeable
3	pH value	--	6.5-8.5	No relaxation	APHA 4500 H+B	7.25	7.19
4	Turbidity	NTU, max	1.0	5.0	APHA 2130 B	<1.0	<1.0
5	Total Dissolved Solids	mg/l	500	2000	APHA 2540 C	32.8	40.4
6	Temperature	^{0}C	-	-	--	21.9	22.5
7	Conductivity	µS/cm	-	-	APHA 2510 C	52.9	46.8
8	Calcium (as Ca)	mg/l	75	200	APHA 3500Ca B	17.2	15.8
9	Chloride (as Cl)	mg/l	250	1000	APHA 4500Cl- B	10.1	6.8
10	Copper (as Cu)	mg/l	0.05	1.5	APHA 3111B,C	<0.02	<0.02
11	Fluoride (as F)	mg/l	1.0	1.5	APHA 4500F-C	0.11	0.13
12	Free residual Chlorine	mg/l	0.2	1.0	APHA 4500Cl B	ND	ND
13	Iron (as Fe)	mg/l	1.0	No relaxation	APHA 3500Fe B	0.25	0.33
14	Magnesium (as Mg)	mg/l	30	100	APHA 3500Mg,B	5.92	4.99
15	Manganese (as Mn)	mg/l	0.1	0.3	APHA 3500Mn B	<0.05	<0.05
16	Aluminium (as Al)	mg/l	0.03	0.2	APHA 3500Al B	<1.0	<1.0
17	Mineral oil	mg/l	0.5	No relaxation	APHA 5220 B	<0.02	<0.02
18	Acidity	mg/l	-	-	APHA 2310 B	<1.0	<1.0
19	Phenolic Compounds	mg/l	0.001	0.002	APHA 5530 B,C	<0.05	<0.05
20	Selenium(as Se)	mg/l	0.01	No relaxation	APHA 3114B	<0.001	<0.001
21	Sulphate (as SO_4)	mg/l	200	400	APHA 4500SO42-B	4.2	3.5
22	Total Alkalinity	mg/l	200	600	APHA 2320 B	34.2	36.1
23	Total Hardness	mg/l	200	600	APHA 2340 C	53.7	60.2
24	Zinc(as Zn)	mg/l	5.0	15.0	APHA 3111B,C	0.13	0.11
25	Nitrate (as NO3)	mg/l	45	No relaxation	APHA 4500 NO-B	1.36	1.58
26	Anion detergents (as MBAS)	mg/l	0.2	1.0	APHA:4500 NO3- B	ND	ND
27	Boron	mg/l	0.5	1.0	APHA 4500 B,B	<0.1	<0.1
28	Cadmium (as Cd)	mg/l	0.003	No relaxation	APHA 3111B,C	<0.01	<0.01
29	Total Chromium (as TCr)	mg/l	0.05	No relaxation	IS3025(P44)1993	<0.05	<0.05
30	Cyanide (as CN)	mg/l	0.05	No relaxation	APHA 4500CN-C,D	<0.01	<0.01
31	Lead (as Pb)	mg/l	0.01	No relaxation	APHA 3111B,C	<0.01	<0.01
32	Mercury (as Hg)	mg/l	0.001	No relaxation	APHA 3500 Hg	<0.004	<0.004
33	Total arsenic	mg/l	0.01	No relaxation	APHA 3114B	<0.004	<0.004
34	Pesticide	mg/l	0.0005	No relaxation	APHA 6630 B	<0.0001	<0.0001
35	Polyaromatic hydrocarbons (PAH)	mg/l	0.001	0.002	APHA 6440 B	<0.0001	<0.0001
36	Total Coli forms	MPN/100ml	Shall not be detected in any 100 ml sample		APHA 9221 B	Absent	Absent
37	E. Coli	MPN/100ml	Shall not be detected in any 100 ml sample		APHA 9221 F	Absent	Absent

Reviewed by

VISIONTEK CONSULTANCY SERVICES PVT. LTD. BBSR

Approved by

VISIONTEK CONSULTANCY SERVICES PVT. LTD. BBSR

Ref. No: Envlab/25-26/TR-20986 **Date: 06.02.2026**

TEST REPORT

Customer Name & Address	:	**Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd, Sundargarh**

SAMPLE DETAILS

Sample Location & Code	**GW-3: Operator Colony (Borewell) GW-4: Koira Basti**	**Sampled by**	**VCSPL'S Representative**
Sample Description	**Ground Water**	**Sampling Procedure**	**APHA 1060**
Sample Condition	**Sealed Plastic & Sterilized Glass Bottle**	**Sample Received on**	**10.01.2026**
Sampling Date	**09.01.2026**	**Test Completed on**	**10.01.2026 TO 16.01.2026**

Sl. No	Parameters	Unit	Standard as per IS 10500:2012, Amnd. 2015 & 2018		Test methods	GW-3	GW-4
			Acceptable Limit	Permissible Limit			
1	Color	Hazen	5	15	APHA 2120 B,C	<5.0	<5.0
2	Odour	--	Agreeable	Agreeable	APHA 2120 B	Agreeable	Agreeable
3	pH value	--	6.5-8.5	No relaxation	APHA 4500 H+B	6.95	7.03
4	Turbidity	NTU, max	1.0	5.0	APHA 2130 B	<1.0	<1.0
5	Total Dissolved Solids	mg/l	500	2000	APHA 2540 C	45.9	42.3
6	Temperature	^{0}C	-	-	--	24.1	23.9
7	Conductivity	µS/cm	-	-	APHA 2510 C	50.7	56.2
8	Calcium (as Ca)	mg/l	75	200	APHA 3500Ca B	19.2	18.6
9	Chloride (as Cl)	mg/l	250	1000	APHA 4500Cl- B	7.0	7.1
10	Copper (as Cu)	mg/l	0.05	1.5	APHA 3111B,C	<0.02	<0.02
11	Fluoride (as F)	mg/l	1.0	1.5	APHA 4500F-C	0.14	0.21
12	Free residual Chlorine	mg/l	0.2	1.0	APHA 4500Cl B	ND	ND
13	Iron (as Fe)	mg/l	1.0	No relaxation	APHA 3500Fe B	0.21	0.29
14	Magnesium (as Mg)	mg/l	30	100	APHA 3500Mg,B	5.63	4.17
15	Manganese (as Mn)	mg/l	0.1	0.3	APHA 3500Mn B	<0.05	<0.05
16	Aluminium (as Al)	mg/l	0.03	0.2	APHA 3500Al B	<1.0	<1.0
17	Mineral oil	mg/l	0.5	No relaxation	APHA 5220 B	<0.02	<0.02
18	Acidity	mg/l	-	-	APHA 2310 B	<1.0	<1.0
19	Phenolic Compounds	mg/l	0.001	0.002	APHA 5530 B,C	<0.05	<0.05
20	Selenium(as Se)	mg/l	0.01	No relaxation	APHA 3114B	<0.001	<0.001
21	Sulphate (as SO_4)	mg/l	200	400	APHA 4500SO42-B	3.0	3.8
22	Total Alkalinity	mg/l	200	600	APHA 2320 B	30.9	38.5
23	Total Hardness	mg/l	200	600	APHA 2340 C	61.9	56.3
24	Zinc(as Zn)	mg/l	5.0	15.0	APHA 3111B,C	0.16	0.15
25	Nitrate (as NO3)	mg/l	45	No relaxation	APHA 4500 NO-B	1.13	1.44
26	Anion detergents (as MBAS)	mg/l	0.2	1.0	APHA:4500 NO3- B	ND	ND
27	Boron	mg/l	0.5	1.0	APHA 4500 B,B	<0.1	<0.1
28	Cadmium (as Cd)	mg/l	0.003	No relaxation	APHA 3111B,C	<0.01	<0.01
29	Total Chromium (as TCr)	mg/l	0.05	No relaxation	IS3025(P44)1993	<0.05	<0.05
30	Cyanide (as CN)	mg/l	0.05	No relaxation	APHA 4500CN-C,D	<0.01	<0.01
31	Lead (as Pb)	mg/l	0.01	No relaxation	APHA 3111B,C	<0.01	<0.01
32	Mercury (as Hg)	mg/l	0.001	No relaxation	APHA 3500 Hg	<0.004	<0.004
33	Total arsenic	mg/l	0.01	No relaxation	APHA 3114B	<0.004	<0.004
34	Pesticide	mg/l	0.0005	No relaxation	APHA 6630 B	<0.0001	<0.0001
35	Polyaromatic hydrocarbons (PAH)	mg/l	0.001	0.002	APHA 6440 B	<0.0001	<0.0001
36	Total Coli forms	MPN/100ml	Shall not be detected in any 100 ml sample		APHA 9221 B	Absent	Absent
37	E. Coli	MPN/100ml	Shall not be detected in any 100 ml sample		APHA 9221 F	Absent	Absent

Reviewed by

VISIONTEK CONSULTANCY SERVICES PVT. LTD. BBSR

VISIONTEK CONSULTANCY SERVICES PVT. LTD. BBSR

Approved by

Ref. No: Envlab/25-26/TR-20987 **Date: 06.02.2026**

TEST REPORT

Customer Name & Address	:	**Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd, Sundargarh**

SAMPLE DETAILS

Sample Location & Code	**GW-5: Kashira Village**	**Sampled by**	**VCSPL'S Representative**
Sample Description	**Ground Water**	**Sampling Procedure**	**APHA 1060**
Sample Condition	**Sealed Plastic & Sterilized Glass Bottle**	**Sample Received on**	**10.01.2026**
Sampling Date	**09.01.2026**	**Test Completed on**	**10.01.2026 TO 16.01.2026**

Sl. No	Parameters	Unit	Standard as per IS 10500:2012, Amnd. 2015 & 2018		Test methods	GW-5
			Acceptable Limit	Permissible Limit		
1	Color	Hazen	5	15	APHA 2120 B,C	<5.0
2	Odour	--	Agreeable	Agreeable	APHA 2120 B	Agreeable
3	pH value	--	6.5-8.5	No relaxation	APHA 4500 H+B	7.21
4	Turbidity	NTU, max	1.0	5.0	APHA 2130 B	<1.0
5	Total Dissolved Solids	mg/l	500	2000	APHA 2540 C	39.8
6	Temperature	^{0}C	-	-	--	25.2
7	Conductivity	µS/cm	-	-	APHA 2510 C	52.1
8	Calcium (as Ca)	mg/l	75	200	APHA 3500Ca B	16.5
9	Chloride (as Cl)	mg/l	250	1000	APHA 4500Cl- B	7.8
10	Copper (as Cu)	mg/l	0.05	1.5	APHA 3111B,C	<0.02
11	Fluoride (as F)	mg/l	1.0	1.5	APHA 4500F-C	0.16
12	Free residual Chlorine	mg/l	0.2	1.0	APHA 4500Cl B	ND
13	Iron (as Fe)	mg/l	1.0	No relaxation	APHA 3500Fe B	0.30
14	Magnesium (as Mg)	mg/l	30	100	APHA 3500Mg,B	7.05
15	Manganese (as Mn)	mg/l	0.1	0.3	APHA 3500Mn B	<0.05
16	Aluminium (as Al)	mg/l	0.03	0.2	APHA 3500Al B	<1.0
17	Mineral oil	mg/l	0.5	No relaxation	APHA 5220 B	<0.02
18	Acidity	mg/l	-	-	APHA 2310 B	<1.0
19	Phenolic Compounds	mg/l	0.001	0.002	APHA 5530 B,C	<0.05
20	Selenium(as Se)	mg/l	0.01	No relaxation	APHA 3114B	<0.001
21	Sulphate (as SO_4)	mg/l	200	400	APHA 4500SO42-B	2.9
22	Total Alkalinity	mg/l	200	600	APHA 2320 B	36.5
23	Total Hardness	mg/l	200	600	APHA 2340 C	49.8
24	Zinc(as Zn)	mg/l	5.0	15.0	APHA 3111B,C	0.12
25	Nitrate (as NO3)	mg/l	45	No relaxation	APHA 4500 NO-B	1.20
26	Anion detergents (as MBAS)	mg/l	0.2	1.0	APHA:4500 NO3- B	ND
27	Boron	mg/l	0.5	1.0	APHA 4500 B,B	<0.1
28	Cadmium (as Cd)	mg/l	0.003	No relaxation	APHA 3111B,C	<0.01
29	Total Chromium (as TCr)	mg/l	0.05	No relaxation	IS3025(P44)1993	<0.05
30	Cyanide (as CN)	mg/l	0.05	No relaxation	APHA 4500CN-C,D	<0.01
31	Lead (as Pb)	mg/l	0.01	No relaxation	APHA 3111B,C	<0.01
32	Mercury (as Hg)	mg/l	0.001	No relaxation	APHA 3500 Hg	<0.004
33	Total arsenic	mg/l	0.01	No relaxation	APHA 3114B	<0.004
34	Pesticide	mg/l	0.0005	No relaxation	APHA 6630 B	<0.0001
35	Polyaromatic hydrocarbons (PAH)	mg/l	0.001	0.002	APHA 6440 B	<0.0001
36	Total Coli forms	MPN/100ml	Shall not be detected in any 100 ml sample		APHA 9221 B	Absent
37	E. Coli	MPN/100ml	Shall not be detected in any 100 ml sample		APHA 9221 F	Absent

Reviewed by

Approved by

Ref. No: Envlab/25-26/TR-20970 Date: 06.02.2026

TEST REPORT

Customer Name & Address	Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd, Sundargarh		
SAMPLE DETAILS			
Sample Location & Code	--	Measured by	VCSPL'S Representative
Sample Name	Ground Water Level	Sampling Procedure	NA
Sample Source	Narayanposhi Iron Ore Mines, JSW	Sample Received on	NA

SL. No	Date of Measuring	Time of Measuring	Name of the Location	Water Level (Mbgr)
1	09.01.2026	8.40 am	Gate No-1	14.68
2	09.01.2026	9.10 am	Operator Colony	10.43
3	09.01.2026	9.20 am	Koira Village	13.01
4	09.01.2026	10.40 am	Quarry-4	9.26
5	09.01.2026	11.10 am	Kashira Village	10.88

Reviewed by

VISIONTEK CONSULTANCY SERVICES PVT. LTD. BBSR

Approved by

VISIONTEK CONSULTANCY SERVICES PVT. LTD. BBSR

ANNEXURE XVII

Rooftop Rainwater Harvesting at Operator Colony







Recharge Pits at Narayanposhi Mines



Recharge Pit at Gate No.2



Recharge Pit at Babamatha



Recharge pit at Manganese Quarry

ANNEXURE XVIII

National Accreditation Board for Testing and Calibration Laboratories

CERTIFICATE OF ACCREDITATION

VISIONTEK CONSULTANCY SERVICES PVT. LTD.

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

PLOT NO : M-22 & M-23, CHANDAKA INDUSTRIAL ESTATE, PATIA, BHUBANESWAR, KHORDHA, ODISHA, INDIA

in the field of

TESTING

Certificate Number: TC-7944

Issue Date: 26/09/2025 **Valid Until:** 25/09/2029

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of thislaboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Entity: VISIONTEK CONSULTANCY SERVICES PVT. LTD.

Signed for and on behalf of NABL

Anita Rani
Director

Chakravarthy T. Kannan
Chief Executive Officer

ANNEXURE XIX

Effluent Treatment Plant








27 Nov 2025 11:52:26 am
21°54'58.914"N 85°14'9.618"E
69 Juruli Jajang Road
Sundergarh
Northern Division
Odisha

ANNEXURE XX

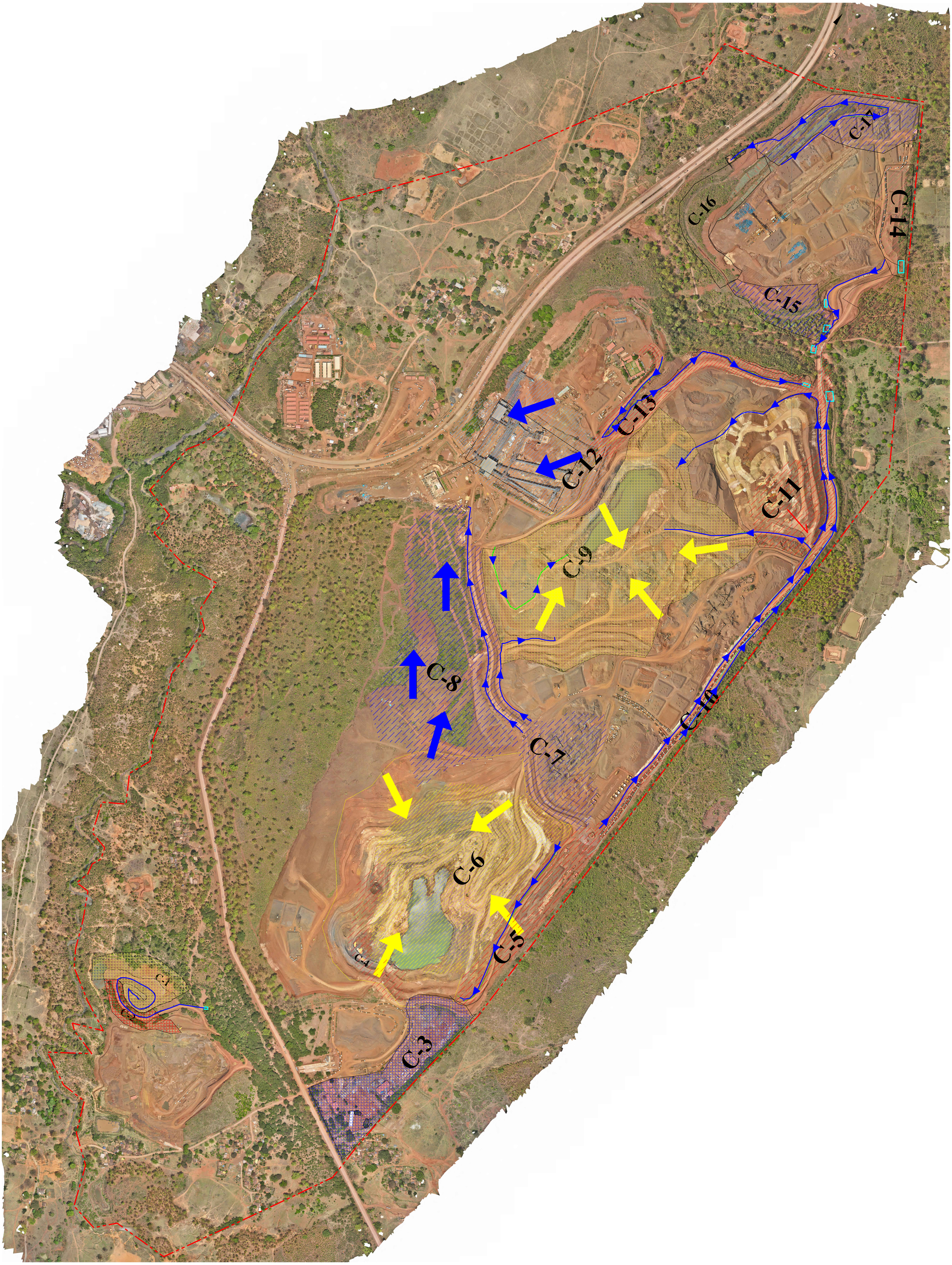
Sewage Treatment Plant





Garden in operator colony

ANNEXURE XXI


C-17
C-16
C-14
C-15
C-12
C-13
C-11
C-9
C-8
C-7
C-10
C-6
C-5
C-4
C-1
C-2
C-3

ANNEXURE XXII

COIR MATTING







VETIVER GRASS PLANTATION




POCO
II ॐ II 5200

ANNEXURE XXIII

WASTE DUMPS





OB Dump plantation, Retaining wall and Garland drain







Manganese Dump coir matting, Retaining wall and Garland drain

Low Grade Stack





ANNEXURE XXIV

Water stored in pits are used for Dust Suppression





ANNEXURE XXV

FODDER PLOTS/ GRAZING LAND IN NON-MINERALIZED AREA





ANNEXURE XXVI

SCIENTIFIC STUDY OF THE STABILITY OF PIT SLOPE and DUMP SLOPE IN IRON ORE MINES OF ODISHA

(Narayanposhi Iron and Manganese Mines, JSW Steel Ltd.)



(Source: https://earth.google.com/web)

Dept. of Mining Engineering
National Institute of Technology, Rourkela

June - 2023

Scientific Study of the Stability of Pit Slope and Dump Slope in Iron Ore Mines of Odisha

(Narayanposhi Iron and Manganese Mines, JSW Steel Ltd.)

(Work order no. Odisha Mines/118402/SER/4500141067 date. 16-04-2022)





AN INVESTIGATION REPORT

Submitted by

Prof Manoj Kumar Mishra, PhD

Dept. of Mining Engineering
National Institute of Technology, Rourkela

June - 2023

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(Prof. M. K. Mishra)
Principal Investigator

Date: 07-09-2023

Disclaimer

This report is a classified document and meant for the internal use of the organization JSW Steel Ltd, Narayanposhi Iron and Manganese Mines, Odisha. This report, in full or part can neither be quoted, nor published anywhere by anybody other than the investigators or the organization. It can however be communicated to Government agencies only on demand.

There is little scope for control of day-to-day activities at the NARAYANPOSHI IRON AND MANGANESE MINES site by NIT Rourkela, nor it is possible to have any such control, and hence NIT Rourkela not responsible for proper implementation of the recommendations.

This investigation on the " Scientific study on Slope Stability of iron and manganese ore mines in Odisha (Location: NARAYANPOSHI Iron and Manganese Mines) was carried out by a team led by Dr. Manoj K. Mishra of N.I.T, Rourkela. Neither Dr. M. K. Mishra, any member of the investigating teams, nor NIT, Rourkela assumes any liabilities with respect to the use of or for damages resulting from the use of, any information, method or process disclosed in this report.

1.0 Introduction

Surface mining operation is a major and popular process to excavate earth materials. Though this approach is relatively simple and fast, yet it often endangers the men and machines, and thus its profitability, unless scientifically planned. Bench mining or slope system is a major part of the surface excavation system. Correct slope design and its stability has been a major challenge to mine operation. The slope design involves knowledge of geotechnical parameters, geological influences, correct slope height, slope angle and overall angle. Government regulation also warrants carrying out slope design as a part of the statutory requirement.

1.1 Brief Background of the Project

NIT Rourkela received a work order vide purchase order no Odisha Mines/118402/SER/4500141067 dated 16-04-2022 from JSW Steel Ltd., Barbil, Odisha for scientific study of the stability of pit slope and dump slope in its Narayanposhi Iron and Manganese Mines, Odisha. This is an assignment that originated in 01-09-2020 from JSW Steel Ltd, Dolvi (Maharastra). NIT Rourkela accepted the order on 2nd June 2022 and initiated investigation. As a part of the investigation, the team initiated the investigation in June-2022 and made many visits to the mine. The team discussed with mine officials, inspected the area, carried out geological study, and identified a few sample location of the iron and manganese ore deposit at the Narayanposhi Iron and Manganese Mines.

1.2 Scope of work

The aim of the investigation was to carry out scientific study of the stability of pit slope and dump slope in iron and manganese ore mines in Odisha, JSW Steel Ltd., Barbil. The scope of work as outlined in the work order was.

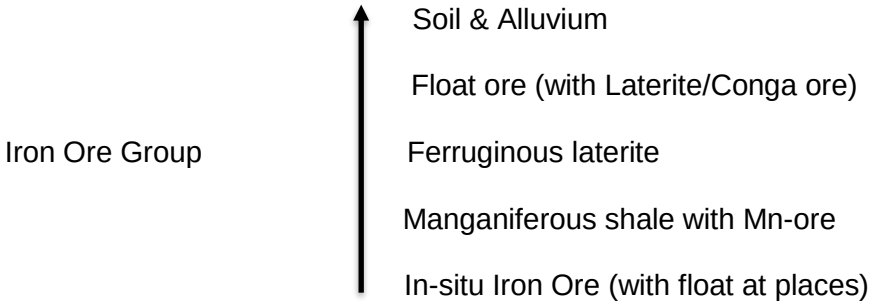
i. To undertake the study of slope stability to arrive ultimate pit slope and dump slope for long term safety.
ii. Suggest methods for dump slope monitoring.
iii. Suggest best practices for slope maintenance and its stabilization.
iv. Optimization of dump slope parameters for capacity maximization.
v. Recommendation for following, considering geotechnical characteristics of deposit:
    a) Slope angle for working and final pit
    b) Dump design parameters (Dump height and slope; bench height and slope angle)
    c) Monitoring method of PIT and dump slope stability

1.3 Geology of the area

Narayanposhi Iron and Manganese Ore Mine are in the southern end of the western limb of the Horse-shoe shaped Iron Ore Range of West Singhbhum-Keonjhar-Sundargarh district of Jharkhand & Odisha. The rock types found within the leasehold belong to Banded Iron Formation of Koira Group. The main litho units mapped in this area are laterite, Banded Hematite Jasper, shale of different nature and cherty phyllite. Alluvium occupies especially the low-lying areas. This is a meta-sedimentary deposit of Bonaisynclinorium.

1.3.1 Geological Setting

Based on the field studies, the stratigraphic sequence of different litho assemblages of the area is interpreted as follows:



Soil & Alluvium: Traverses along and across the leasehold, however, show that alluvial soil covers a sizeable portion of the area. The alluvium occupies especially the low lying area. These areas are appeared to be barren where village site and low yielding agricultural fields are seen.

Ferruginous Laterite: Ferruginous laterites occur as intermediate waste and capping at places on the in-situ Iron ore horizons having Fe content or less than 55% and contain both hematite and goethite.

Float Iron Ore: The float iron ore zones may be considered of two types. The ores are mostly of massive type with big lumps and occur along with lateritic horizons. Float zone continues up to 5-7 m from surface level which is seen in quarry 5 & 6. The second variety of float ore over (+) 10 to (-)40mm size with laterite, which is observed in Quarry-1.

Conga Zone: In the north eastern corner and western part of the area, conga zones are exposed consisting of boulders, cobbles and pebbles of iron ores re-cemented by lateritic materials. These materials are seen in and around Quarry-4 (old) and Quarry-5.

In-situ Iron Ore: Below the float ore zone, in-situ ore exists and proved up to a depth of 60m from surface level. Because of its boulder nature, it is sometimes mistaken as float ore. An in-situ ore zone is delineated covering all in-situ ore working quarries like Q-1, 3, 4, 7 etc.

However, on the basis of depth persistence, in-situ ore zone is delineated around the Q-1, 2, 3, 4, 6 & 7.

Manganiferous Shale: Most of the workable manganese ore deposits occur within this formation. The shale is mostly ferruginous, grey, pink in colour with white streaks. These coloured members do not occur in conspicuous band rather than they are highly mixed up. Manganese bodies usually occur on the crest of the domes in the variegated shale formed due to the superposed folding.

1.3.2 Structure (Dip and Strike)

The litho units of BIF usually trend in a NE-SW to NNE-SSW direction with westerly dips varying from 20˚ to 70˚.



Fig I: Narayanposhi Iron Mine

1.4 Mining Methodology

The mine is operated by opencast fully mechanized method. There are 2 major well-developed mechanized iron-ore and manganese quarries as Quarry-3 and 4 and RF Quarry. In all quarries, bench height is maintained up to 9 m and width up to 18 m, adhering to the MMR-1961 guidelines. During the proposed period of mining operation, excavation for iron ore is done in both of the quarries. Production capacity per annum of the mine is envisaged 6 million tons per year from the in-situ reserve.

Drilling was carried out using 115mm diameter drills with 10% subgrade drilling to avoid toe formation. Blasting was by SME (Site Mixed Emulsion Explosives) and accessories (NONEL) manufactured and supplied by Solar Industries India Ltd., Nagpur, Maharashtra. Its VOD ranges is 4000±500 m/sec, and the final density ranges 1.15±0.005 g/cc. The mines used 17 and 25 milliseconds for the Trunk-Line-Delay and 250 milliseconds for the Down-The-Hole delay. Series pattern was adopted to reduce the maximum charge per delay. Controlled blasting along with a shock tube initiation system/NONEL system was practiced to get optimum blast results and minimize hazards. Boulders generated during blasting were broken

into smaller pieces mainly by using a rock breaker. The design parameters of the mine are in table 1.

Table1: Design Features

Sl. No.	Salient Feature	Description
1	Method of Mining	Fully mechanized
2	Production	6 Mt/yr Iron ore (ROM)
3	Means of Raising	Drilling, blasting, excavation, processing, etc
4	Bench Height	upto 9 m
5	Bench Width	Upto 18 m
6	Bench Angle	85^0
7	Overall Slope	33^0
8	Transportation of ore	Through dumpers and tippers
9	Blasting Practice	Deep hole blasting to the rock mass

1.5 Safety Factor Analysis

The stability of rock slopes depends on behaviour of the shear strength created along the sliding surfaces. In general rock or rock material, is assumed to follow the Mohr Coulomb criteria and the strength is expressed in terms of cohesion 'c' and friction angle $'\emptyset'$and is expressed mathematically as $\tau = c + \sigma' tan\emptyset$ [τ = shear strength, c = cohesion, σ' = effective normal stress, and $\emptyset$ = friction angle]

The effective normal stress is the difference between the stress due to the weight of the rock lying above the sliding plane and the uplift due to any water pressure acting on this surface.

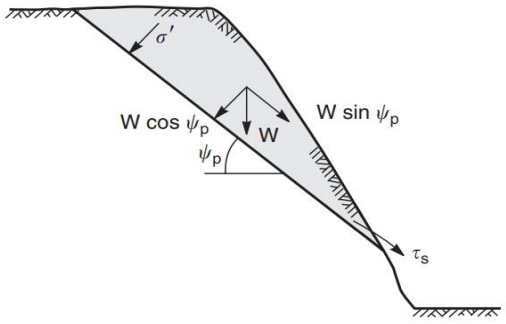


Figure II: Slope Block Analysis

The stability of the block can be quantified by the ratio of the resisting and driving forces, which is termed the factor of safety (FOS). And is given by

$$FOS = \frac{\text{Resisting Forces}}{\text{Driving Forces}}, or$$

$$FOS = \frac{cA + W\cos\psi_p \tan\emptyset}{W\sin\psi_p}$$

The resisting strength is more than the displacing stress for stability of the slope. The FOS equation at equilibrium is

$$FOS = \frac{\cos\psi_p \tan\emptyset}{\sin\psi_p} \text{ or, } FOS = 1 \text{ When } \psi_p = \emptyset$$

It shows that when there are no in-filling materials, the block of rock will slide when the dip angle of the sliding surface equals the friction angle of this surface, and the stability is independent of the size of the sliding block. The block is at a condition of “limiting equilibrium” when the driving forces are exactly equal to the resisting forces and the factor of safety is equal to 1.0. Therefore, the method of slope stability analysis is termed limit equilibrium analysis. For the investigation of stability of the existing slopes, the minimum factor of safety is from 1.3 to 1.5 [3]

The Limit Equilibrium Method (LEM) is a well-known computational methodology for evaluating the Factor of Safety (FOS) and stability degree of slopes (Duncan, 1996; Krahn 2003). Limit equilibrium is the method where limit state conditions are assumed. The limited equilibrium methods (LEMs) are popular to assess the slope stability of mine geological sections.

In this slope stability investigation project, a dedicated software for LEM code Slide2D (RocScience Inc., Canada) used. Slide 2 is a two-dimensional limit equilibrium slope stability analysis program for evaluating the probability of failure of geological transverse and geological sections by identifying circular or non-circular failure-prone surfaces in soil or rock slopes. It analyzes the stability of slip surfaces using vertical slice or non-vertical slice limit equilibrium methods. This code has extensive probabilistic analysis capabilities that can carry out statistical distributions to many parameters, including material properties, support properties, loads, and water table location. The probability of failure/reliability index is determined, providing a measure of the risk factor associated with a slope design.

The evaluation needs geotechnical data were obtained from laboratory testing with the samples available.

1.6 Geotechnical Investigation

It is important that the reaction of the rocks to the changes in stresses due to the proposed excavation should be such that the resultant strain is within the tolerable limit of the engineering design. Typically, the behavior of rocks is determined from unbroken rock pieces, i.e., intact rock or rock core though rocks are heterogenous, anisotropic and inelastic. The geotechnical investigation of core specimen includes the laboratory determination of the pertinent parameters.

1.6.1 Location of sample collection points

Slope stability analysis involves understanding and dealing with the behavior of earth materials at specific locations e.g. face, bench, strata, etc. The behavior of materials are scientifically represented by its geotechnical properties as cohesion, density, angle of internal friction, compressive strength, etc. These needs sample collection and testing by established processes. The locations of samples were collected were carefully chosen depending upon site characteristics. It was made sure that the samples were collected from the bench faces. Fresh samples were collected freshly exposed faces. In absence of regular core logs, boulders of adequate sizes of about 900cm^3 each were collected and transported to the laboratory. NX core samples were prepared from those boulders. Soft material as alluvium, laterite and ochre were collected in air tight bags and processed for shear testing. The following sections discuss the procedure adopted for testing. The test specimens were obtained by cutting the core samples perpendicular to the cylindrical axis with the help of a rock cutting machine fitted (make: AIM 202, AIMIL, India). The length to diameter ratio was kept between 2.0 to 2.5 for the samples for determination of Compressive Strength. The loading surfaces of the test specimen were made flat within ± 0. 01mm.The following photographs are provided below shown are sample collection and prepared test specimens.



Figure III: Sample collection

1.6.2 Testing Procedures:

The determination of different physical and mechanical properties were carried out by IS guidelines as mentioned against each type of test and described below.

a. Density	IS: 13030-1991 (Reaffirmed 1996)
b. Compressive Strength	IS: 9143-1979 (Reaffirmed 1996)
c. Triaxial Strength	IS: 13047-1991 (Reaffirmed 2001)
d. Shear Strength	IS: 2720-part13-1986 (Reaffirmed 2002)



Figure IV: Coring operation and cored specimen

1.6.2.1 Density

Density reflects the information about the mineralogical or grain constituents. For determination of density Indian Standard 13030:1991 has been followed. Each specimen was machined to conform closely to the geometry of a right cylinder. The mass of each specimen was typically more than 600g. Each sample was put in an oven maintained at a temperature of $105^0 \pm 3^0$C for 24 hours. The samples were removed from the oven after 24 hrs and placed in desiccators for cooling. Each sample was brushed to remove loose material sticking to it. The external dimension of each specimen was determined using a digital caliper (make: Mitutoyo, Japan) with an accuracy of 0.01mm. Average of three readings each for the length and diameter were taken for calculation of volume (V). The mass (M) of each specimen was determined using a digital balance (make: Contech, India) with an accuracy of 0.001g. The density (ρ) was determined using the formula $\rho = M/V$ where M and V are Mass and volume of the sample respectively.

1.6.2.2 Uniaxial Compressive Strength

In most of the engineering design the compressive strength (UCS) of rock is one of the most important input parameters. It reflects the ultimate bearing capacity before the rock fails i.e. the total loss of integrity in the sample. The compressive strength of the test specimen was determined following IS:9143-1979. The selected specimen of length to diameter ratio between 2 to 2.5 was wiped clean and the dimensions were measured with the help a digital calliper. The measurement of diameter was carried out by taking the average of four reading obtained at about upper height, two mid-heights and lower height. The cross-sectional area was calculated from this measurement.



Figure V: Determining UCS of rock sample

The surfaces of the two bearing discs and the test specimen were wiped clean. The specimen was placed between the two platens. The upper disc was then gradually lowered onto the specimen. Care was taken to see that the axis of the specimen was properly aligned with the discs. The loading machine was operated at a stress level, typically between 0.5 to 1 MPa/sec so that the sample fails within 5 to 10 minutes of test. Load was then continuously applied at a constant rate till failure occurred and the maximum load on the specimen was recorded. The compressive strength is determined from the relation as given by the equation $\sigma_c = \frac{F}{A}$ where

σ_c is UCS; F is Failure load; and A is the cross-sectional area of the sample.

1.6.2.3 Triaxial Compression Test

Rock exhibits higher bearing capacity when the same is confined. The failure load varies with confinement pressure. Triaxial compression refers to a test with simultaneous compression of a rock sample and application of axisymmetric confining pressure. The triaxial Compressive Strength of rock samples was determined following IS 13047:1991. The result shows the cohesion and friction angle. The test sample was wiped clean and its diameter was measured

at upper, two-mid and lower heights respectively. The average value was used to calculate the cross-sectional area of the test sample. The sample was then put in the triaxial cell (make: AIMIL, India).



Fig VI: Triaxial Setup and Fractured Sample

The specimen, the platens and the spherical seat were accurately aligned to ensure that they are coaxial with others. The cell was then filled up with hydraulic oil, allowing the air to escape through an air bleeder valve. The air bleeder valve was then closed. The cell was then placed into the axial loading device. The axial load and the confining pressure were increased simultaneously in such a way that axial stress and confining pressure were approximately equal and until the predetermined test level for the confining pressure reached. The axial load was then increased continuously without shock to produce an approximately constant rate of load for deformation. The maximum axial load and the corresponding confining pressure were recorded. Then the confining pressure and corresponding longitudinal failure strength were plotted in the same scale to plot Mohr analysis for the determination of cohesion and angle of internal friction. The lateral confinement was provided between 0.98 and 3.92 MPa.

1.6.2.4 Shear Strength Test

The top layers of the strata consist of different varieties of soil as yellow, yellow loamy, brown, of varying grain sizes, etc. These materials as well as laterite, broken shales also constitute the overburden. The parameters that govern its engineering behaviour are cohesion and the angle of internal friction apart from the unit weight. Those are typically determined from the direct shear strength test. Samples from different locations of the overburden dump area were collected as per standard practice in the air tight bags. All the samples were mixed thoroughly discarding pebbles and gravels as per IS: 2770 requirement. Specimen sizes 60x60x25 cm^3

were made and cured as both dry state as well as 95±5% humidity to represent extreme conditions. The test involves applying horizontal load on the soil specimen so as to undergo sharing with a constant the vertical normal load. The relationship between normal stress and shear stress at failure provide the shear strength parameters (cohesion and internal friction angle). The specimen and testing of shear strength parameters was carried out as per IS:2720 (Part # 13, 1986 (Reaffirmed 2002).



Fig VII: Direct Shear test

The joint in rock cores didn't exhibit any regular pattern, thickness, and presence. Hence the shear strength tests of the rock cores have not been performed to know the characteristics of joint filling material.

1.6.2.5 Test Results:

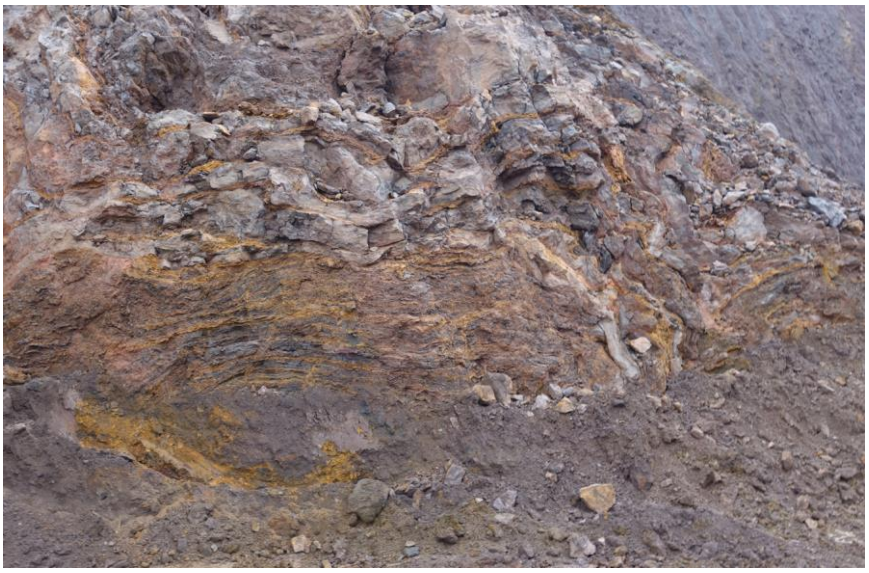
The results of the different tests carried out on the rock cores are reported in following pages. Density values represent the average values of the particular rock type. The photographs of testing arrangement, some typical failure profiles obtained during the testing have been given for the rock in compression, shear, and triaxial testing.

1.6.3 Rock Mass Classification

Cylindrical rock cores or samples of intact rocks are tested in the laboratory to determine their properties. However, such experimentations only reveal the strength of the intact rock masses and the data exhibited in the field often do not confirm to that in the laboratory tests. This is mainly due to the presence of discontinuities that causes instability to the rocks in the form of planes of weaknesses. One such approach by which the strengths of the rocks are reduced by visibly observing the discontinuities present in them is the Geological Strength Index (GSI), wherein the strength parameters of the rocks are considerably reduced to confirm to that of the rock masses exhibited in the field.

1.6.4 GEOLOGICAL STRENGTH INDEX (GSI)

A new rock mass classification scheme was introduced by Hoek and Brown (1997) based on visual observations of geological conditions making it simple, fast and reliable. It is called the Geological Strength Index (GSI). It reflects the property of a discontinuous or jointed rock mass which influences its strength and deformability. GSI considers the shapes of contact rock pieces as represented by its boundaries and degree of interlocking as well as the conditions on the surface separating those. The surface conditions vary from very good to very poor with GSI values between 100 and 0 respectively. The interlocking blocks vary between intact or massive to laminated or sheared. The mine area is constituted of multiple strata types. The upper layer at places exhibits soft laminated ore band but interspersed with laterite. Iron ore +55% is also observed in the outcrop (as in 200N). The observed material consists of majorly laterite with loose shale among others and the overburden is soft, a GSI value corresponding to blocky or many intersecting discontinuities sets with mixture of angular and rounded particles was taken as 40. Similarly, for other ore types – BHJ/BHQ, Iron ore 45-55%, shale, and Iron ore +55%, the GSI values were considered from the chart (*Figure VIII*). Those values are shown in Table 1 to 3.







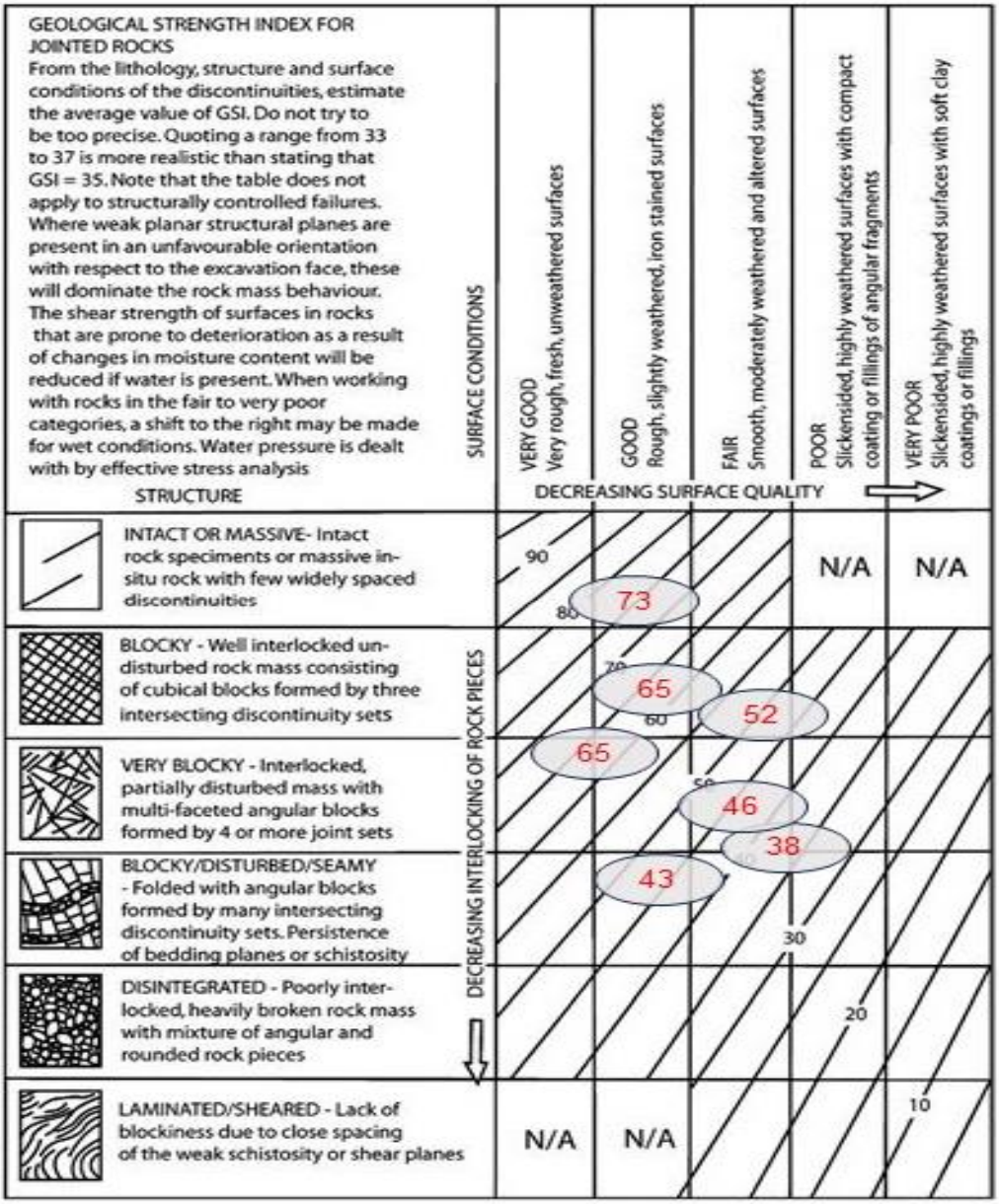


Fig VIII: The Geological Strength Index (GSI) chart used for rock mass

1.7 Slope Design, Modelling and Boundary Conditions

The shear strength of the rock mass including that of the joints and discontinuities typically influence stability of slopes. The determination of the rock behavior subjected to deformation including that of the joint and joint filling materials is a complex phenomenon. Hence, those are determined indirectly involving both laboratory data and test data. A number of such approaches exist for the determination of slope stability, however, intact rock criteria, Mohr-Coulomb (MC) and Hoek-Brown are the most popular approaches that are evaluated here. MC considers a linear relationship between shear strength and gravitational loading whereas HB considers a non-linear relationship. A few of those approaches for slope design are

discussed below are used to find the shear strength as cohesion 'c' and angle of internal friction 'φ'.

I. Mohr-Coulomb Approach:

It used the intact rock strength parameters i.e., cohesion and friction angle to find the factor of safety. It overestimates the rock mass strength or behavior in field conditions.

II. Generalized Hoek-Brown Approach:

It considers rock mass parameters like mineralogy, composition, grain size influence, degree of fracture, site influence, disturbance expected due to blasting and stress relief as well as visual observation data. The following are some of the empirical equations used to predict the rock mass parameters:

$$m_b = m_i \exp\left(\frac{GSI - 100}{28 - 14D}\right)$$

$$s = \exp\left(\frac{GSI - 100}{9 - 3D}\right)$$

$$a = \frac{1}{2} + \frac{1}{6}\left(e^{-\frac{GSI}{15}} - e^{-\frac{20}{3}}\right)$$

$$\sigma_{cm} = \frac{2c'cos\varphi'}{1 - sin\varphi'}$$

$$\sigma_{tm} = \frac{2c'cos\varphi'}{1 + sin\varphi'}$$

$$\sigma_{tm} = -\frac{s.\sigma_{ci}}{m_m}$$

Where, σ_{cm}, σ_{tm}, σ_{ci}, c' and φ' are uniaxial compressive strength of rock mass, tensile strength of rock mass, uniaxial compressive strength of intact rock, cohesion and angle of internal friction of rock mass respectively. The other parameter *D* is a factor for near surface blast damage and stress reduction, m_m, and m_i are Hoek and Brown parameter for rock mass and intact rock respectively depending on mineralogy, composition and grain size influence, *s* is a rock mass characteristic, i.e., how fractured the rock mass is with typical values in the range of 0.001 to 1 and *a* is a site constant for quality of rock, about 0.5. in this investigation. The surface mine would require blasting for excavation process. Therefore, the value of *D* is considered to be 1 for such conditions where production blasting is carried out, and 0.7 where the rock mass can be extracted by mechanical excavations. The compressive and tensile strength values exhibited at the field are much less than that obtained in the laboratory testing. The effective uniaxial compressive strength value of the rock mass is determined from the empirical equation proposed by Marinos and Hoek (2001) as below:

$$\sigma_{cm} = 0.0034 m_i^{0.8} \sigma_{ci} (1.029 + 0.025 e^{-0.1 m_i})^{GSI}$$

III. Mohr-Coulomb Rock Mass Parameter Approach:

Mohr-Coulomb approach is quite popular and the various rock mass parameters such as cohesion, c' and angle of internal friction, φ' have been developed from the Hoek-Brown approach using the following relations (Hoek et al, 2002).

$$sin\varphi' = \frac{6am_m(s + m_m\sigma'_{3n})^{a-1}}{2(1+a)(2+a) + 6am_m(s + m_m\sigma'_{3n})^{a-1}}$$

$$\frac{c'}{\sigma_{ci}} = \frac{[(1+2a)s + (1-a)m_m\sigma'_{3n}](s + m_m\sigma'_{3n})^{a-1}}{(1+a)(2+a)\frac{\sqrt{1 + \left(6am_m\left(s + m_m{\sigma'_{3n}}^{a-1}\right)\right)}}{(1+a)(2+a)}}$$

$$\sigma'_{3n} = \sigma'_{3,\max}/\sigma'_{ci}$$

Where, $\sigma'_{3,\max}$ is maximum value of lateral stress. It is related to slope height H and unit weight γ of the rocks. The effective maximum lateral stress of the rock is given by the relation as below:

$$\frac{\sigma'_{3,\max}}{\sigma'_{cm}} = 0.72\left(\frac{\sigma'_{cm}}{\gamma H}\right)^{-0.91}$$

The design has considered the average values of the geotechnical parameters as determined from various approaches each with respective factor of safety with the application of gravitational force on the models created for analysis. The failure plane has been analyzed for wide variations in its locations and safety factors associated with the most critical plane is determined.

1.8 Failure consideration of the Ore Body slope

Slope failures in surface operations involving hard rocks primarily depend on the characteristics of the rocks and the behavior of the geological features as well as the interaction between the geology and the rock characteristics. Soil or heavily fractured earth materials typically fail by circular failure whereas rock geometry fails by circular failures if there is any intrusion of weak layers incorporated into the rock mass or typically rock geometry fails by plane, wedge, or toppling modes. The stability of the slope is generally controlled by the shear strength parameters along with others. Stability analysis typically follows the limit equilibrium method. In limit equilibrium method, failure or sliding occurs when a limit equilibrium condition is reached i.e., when the resisting forces balance the driving forces such that any disturbances in the balance between them causes the slope to undergo failure. These design methods are widely accepted and are also commonly used and enable moderation of the slope performances with the variations in the parameters involved in slope design. The

primary idea behind the limit equilibrium approach is to determine a state of stress along the surface which is likely to fail such that the free body, along with the slip surface and the free ground surface remains in static equilibrium. The state of stress is then compared with the available strength, which is the stress required to cause failure along the slip surface.

Thus, the analysis involves determination of the factor of safety against sliding for an unstable block of rock mass. The analysis involves developing the model, assigning rock properties, specifying the boundary conditions followed by analyzing the whole of slope geometry to determine the location that would exhibit the lowest factor of safety.

1.8.1 Metal Mines Regulations, 1961 (reproduced verbatim)

Mine follows MMR-1961 as prescribed by the Directorate General of Mines Safety (DGMS) including the guidelines it received vide letter no 330234|SEZ|Chaibasa Region|Perm|2021|195681 date 31-01-2022.

2.0. OPENCAST WORKINGS:

(a) The height of the benches in alluvium and soft rock formation shall not be more than 3m and in overburden, ore or other hard rock formation shall not be more than the digging height of the machine used for digging, excavation or removal and in any case, it shall not be more than 9m.

(b) The width of any bench shall not be less than:

(i) The width of the widest machine plying on the bench plus two meters, or

(ii) If dumpers ply on the bench three times the width of the dumper, or

(iii) The height of the bench, whichever is more.

(c) If tippers or similar transport vehicles are deployed for transportation of ore, separate roads for such tipping trucks or similar vehicles shall be provided and safe loading practices shall be adopted avoiding plying of trucks on the same bench where men are to work, travel or rest.

(d) No manual workers shall be employed where HEMM is deployed in the mine.

4.0. SPOIL OVERBURDEN OR DEBRIS BANKS:

I (a) Spoils, overburden or debris shall be deposited at places belonging to the mine and duly approved by the manager in writing.

b) Spoils, overburden or debris shall not be deposited, beneath transmission, telephone, or power lines or near any public structure.

(c) The slope of a spoil bank face shall be determined by the natural angle of repose of the material being deposited but shall in no case exceed 37.5 degrees from the horizontal. The

spoil bank face shall not be retained by artificial means at an angle in excess of its natural angle of repose.

(d) Any spoil bank exceeding 30m in height shall be kept benched so that no such bench exceeds 30m in height and the general slope does not exceed 1 vertical to 1.5 horizontal. In no case, the height of any spoil bank shall be allowed to exceed 60m unless a scientific study on its stability has been done and separate permission is obtained from this Directorate.

(e) The spoil bank face shall not be retained by an artificial means at an angle above its natural angle of slope.

(f) The spoils overburden or debris shall not be deposited within 45m of a railway or other structures and it shall not be permitted to approach any of the above said structures closer than a distance equal to 1.5 times the vertical height of its face.

(g) The toe of a spoil-bank shall not be extended to any point within 100m of a mine opening, railway or other public works, public road or building or other permanent structure not belonging to the owner.

(h) A suitable fence shall be erected between any railways of public works or road or building or structures and the toe of an active spoil bank to prevent unauthorized persons from approaching the spoil bank.

(i) The backfilled area shall be kept benched and the distance of any active mine workings (faces) from the toe of the bottom-most backfilled face (bench) shall not be less than 100m.

II. No person shall or shall be permitted to approach the toe of an active spoil bank where he may be endangered from material rolling down the face. Suitable signs for warning the persons at conspicuous places shall also be displayed.

1.8.2 Safety Analysis of Slope Profiles

The geological transverse sections for mine provided by JSW Steel Ltd were considered and those slope profiles were analysed. Each material present have been assigned suitable strength characteristics as obtained from laboratory testing and field observations and the factor of critical safety value is computed. A number of such sections have been analysed that are represented below. Ground water table is present well below the slope forming materials and hence is assumed to have no effect on the stability of the slopes that have been considered for stability analysis.

For Rock samples, the cores were used to determine its representative UCS values and for the loose rock mass the samples, their cohesion and internal friction were calculated by direct shear test. However, these values are much higher and it’s not a reliable demonstration of the field condition. Therefore, the GSI value is incorporated in the determination of cohesion and

friction angle which is a much better representation of the field situation. Here, The GSI values were obtained from the on-site survey of the undisturbed exposed mineral outcrop. The m_i values were determined from the predefined values which best represents the rock strength. The Disturbance factor is considered 1 or 0.7 as per the mine practice.

The dump profile analyses were carried using the shear strength for overburden specimen. Limit equilibrium analysis involves density, cohesion and internal friction angle values. Intact ores were tested to determine the *c* and φ of those. The slope height considered was 10m. Intact values are always much higher than that available in the field. Mohr-Coulomb is a popular approach. So, its equivalent rock mass approach is adopted with suitable modifications (Sec. III). Accordingly, the slope profiles were analysed with parametric values (Table. 1-3). The following images show the safety factor analyses done for both dry and saturated conditions for respective sections (Figure 1 to 74).

Table 1: Geotechnical parameters of rock mass

ORE TYPE	GSI	UCS (MPa)	Intact Lab Test Results		MC Rock Mass Parameters		Average Density (g/cc
			Cohesion (MPa)	Friction Angle (Degree)	Cohesion (MPa)	Friction Angle (Degree)	
BHJ/BHQ	65	179	8.54	65	1.080	63	2.77
Lateritic Ore	52	32	4.93	56	0.095	51	1.75
Hard Laminated Ore	73	85	8.86	67	1.033	62	3.17

Table 2: Dry Rock Mass parameters

ORE TYPE	GSI	MC Rock Mass Parameters		Average Density (g/cc)
		Cohesion (MPa)	Friction Angle (Degree)	
Iron Ore 45 to 55 **%**	46	0.075	40	3.28
Laterite etc.	43	0.036	41	2.78
Iron Ore > 55 **%**	38	0.045	29	3.13
Shale	65	0.021	37	1.95
Overburden (Iron & Mn)	-	0.032	39	2.74

Table 3: Saturated Rock Mass parameters

ORE TYPE	GSI	MC Rock Mass Parameters		Average Density (g/cc)
		Cohesion (MPa)	Friction Angle (Degree)	
Iron Ore 45 to 55 **%**	46	0.071	39	2.98
Laterite etc.	43	0.033	40	2.55
Iron Ore > 55 **%**	38	0.043	28	2.82
Shale	65	0.016	34	1.74
Overburden (Iron & Mn)	-	0.027	32	2.47

PIT ANALYSIS

QUARRY 3 & 4

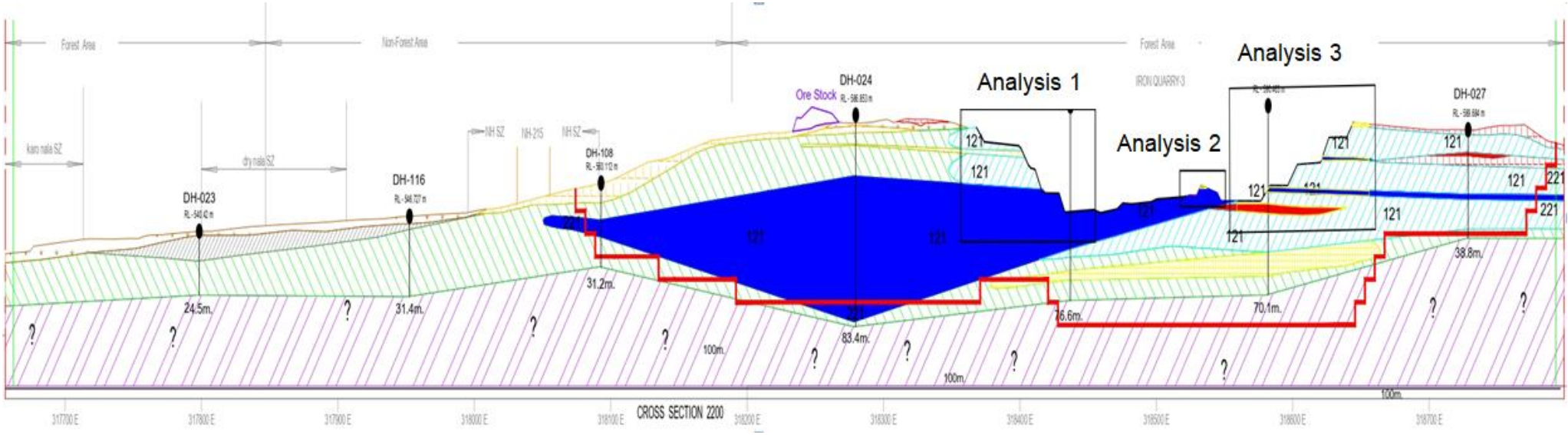


Figure 1: Narayanposhi section 2200N

HARD LAMINATED ORE	
IRON ORE +55%	
SHALE	
LIMONITE	
LATERITE	
LATERITIC IRON ORE	
GEOTHITE	
BHJ-BHQ	
IRON ORE 45-55%	

Analysis 1- 318400E (CROSS SECTION 2200)

1.1 Dry condition

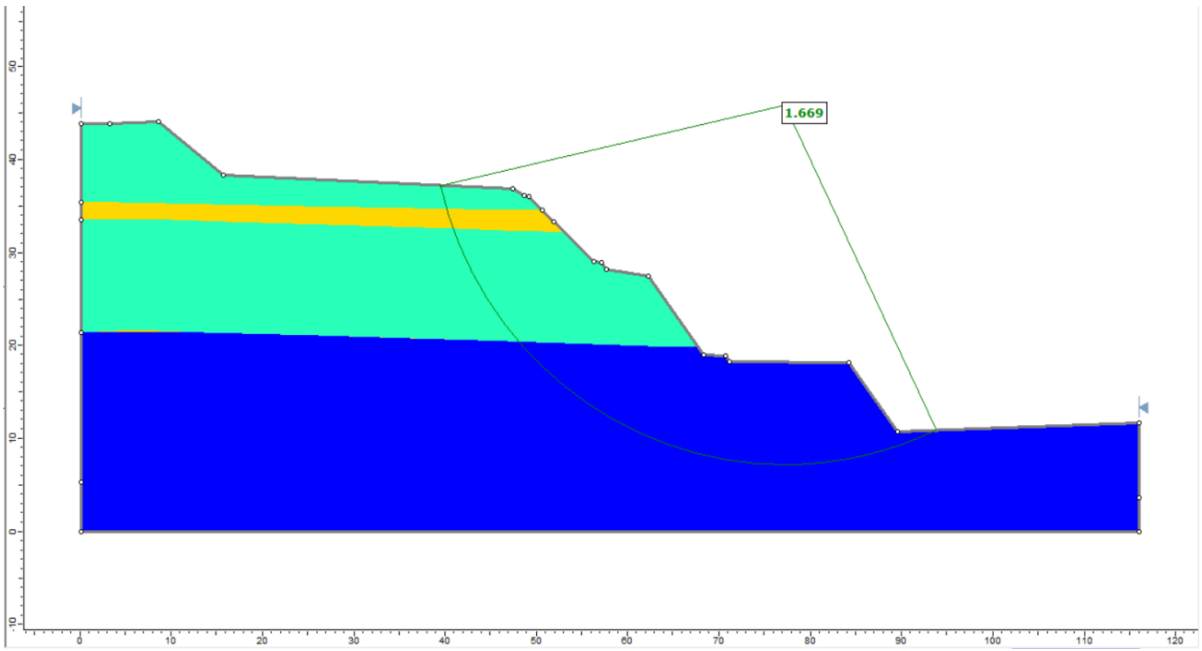


Figure 2: Slope stability analysis of a shale, laterite and Iron ore +55% slope with FOS of 1.669

1.2 Saturated condition

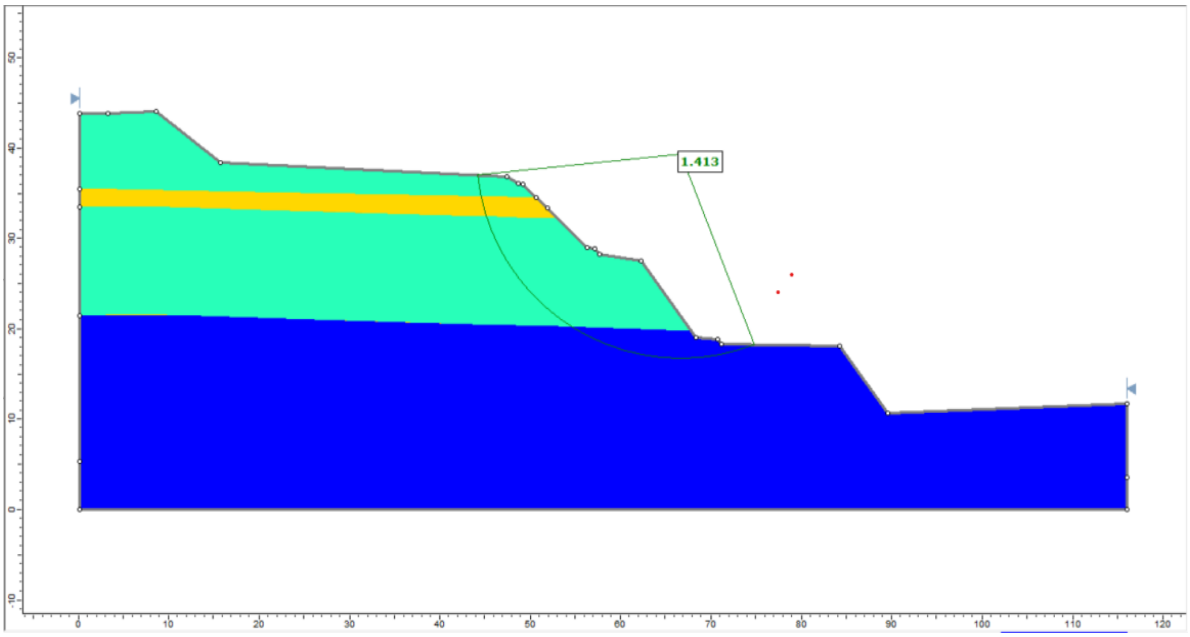


Figure 3: Slope Stability Analysis of shale, laterite and BHJ with FOS 1.413

Analysis 2- 318500E

2.1 Dry condition

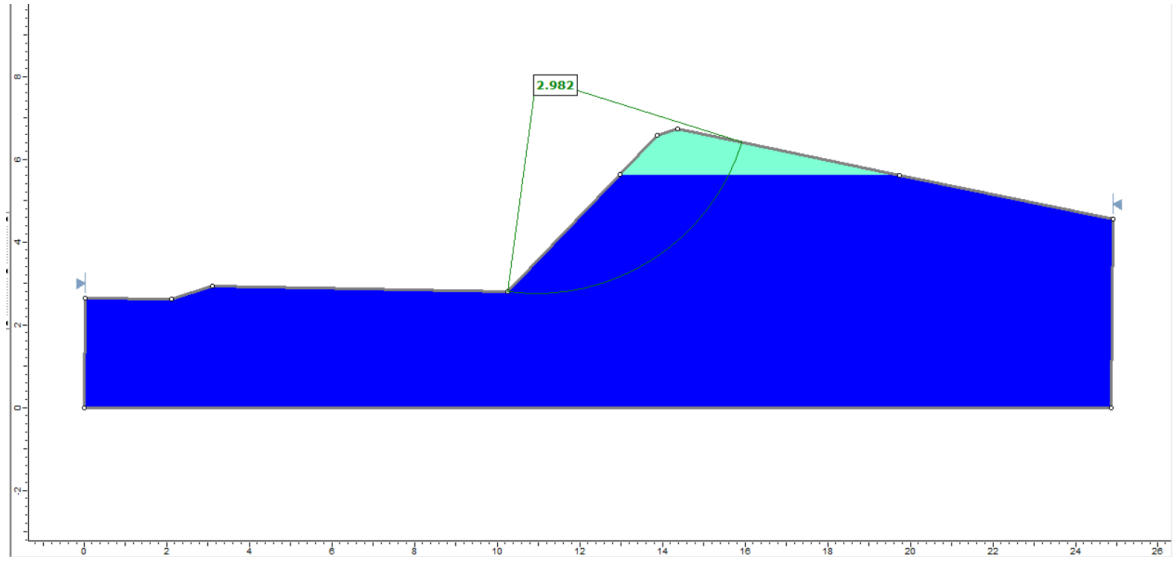


Figure 4: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS of 2.982

2.2 Saturated condition

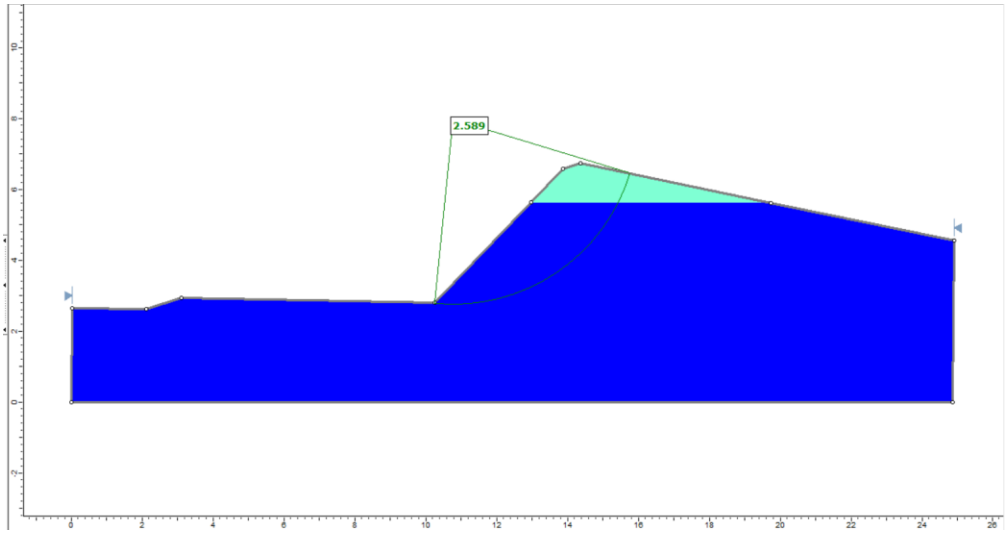


Figure 5: Slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS of 2.589

Analysis 3-318600E

3.1 Dry condition

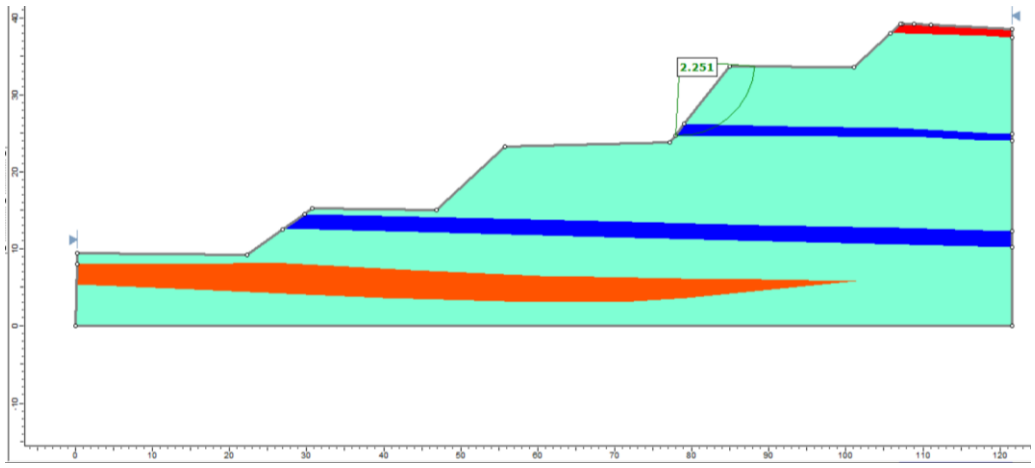


Figure 6: slope stability analysis of Iron ore 45-55% and Iron ore +55% Iron ore 45-55%pe with FOS of 2.251

3.2 Saturated condition

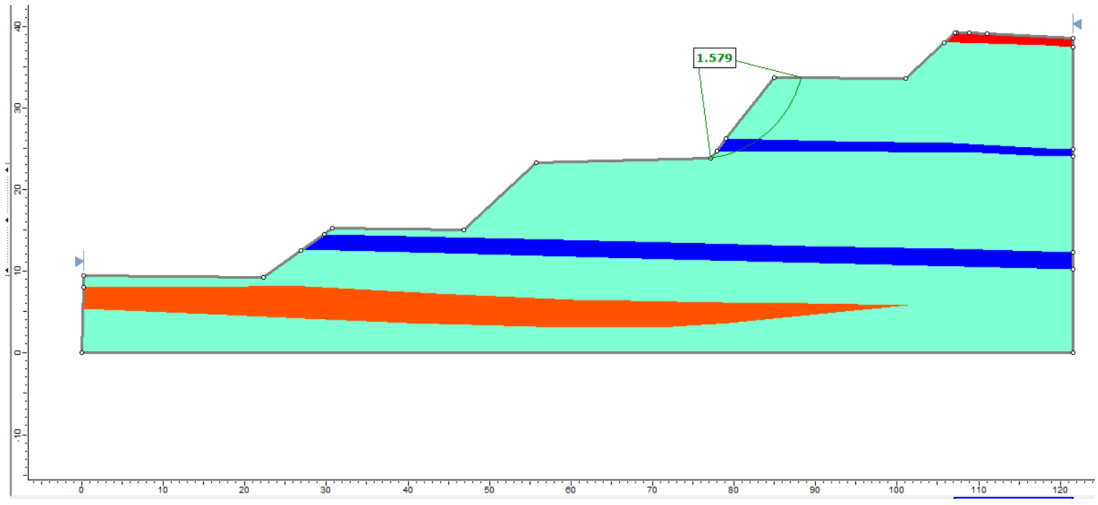


Figure 7: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS of 1.579

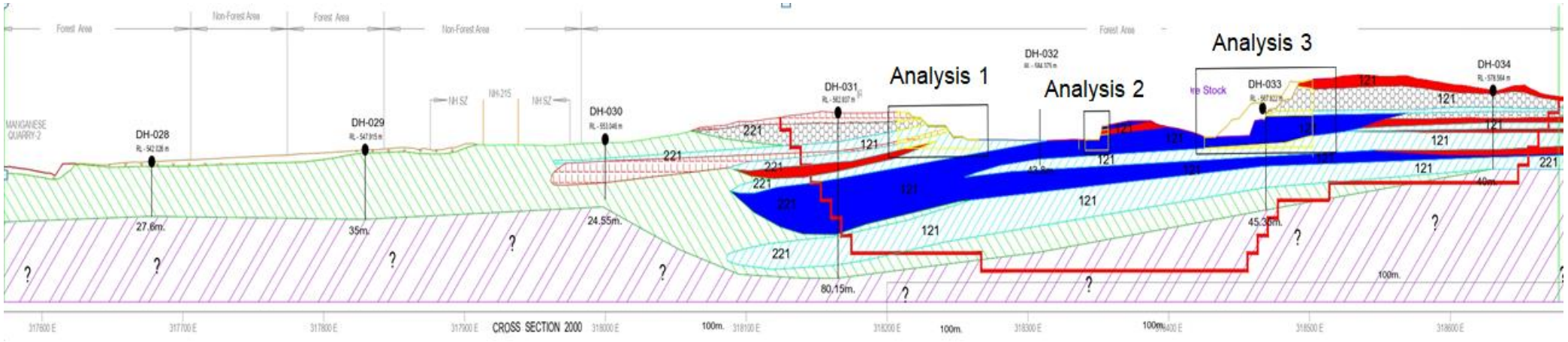


Figure 8: Narayanposhi section 2000N

HARD LAMINATED ORE	
IRON ORE +55%	
SHALE	
LIMONITE	
LATERITE	
LATERITIC IRON ORE	
GEOTHITE	
BHJ-BHQ	
IRON ORE 45-55%	

Analysis 1 - 318250E (CROSS SECTION 2000)

1.1 Dry conditions

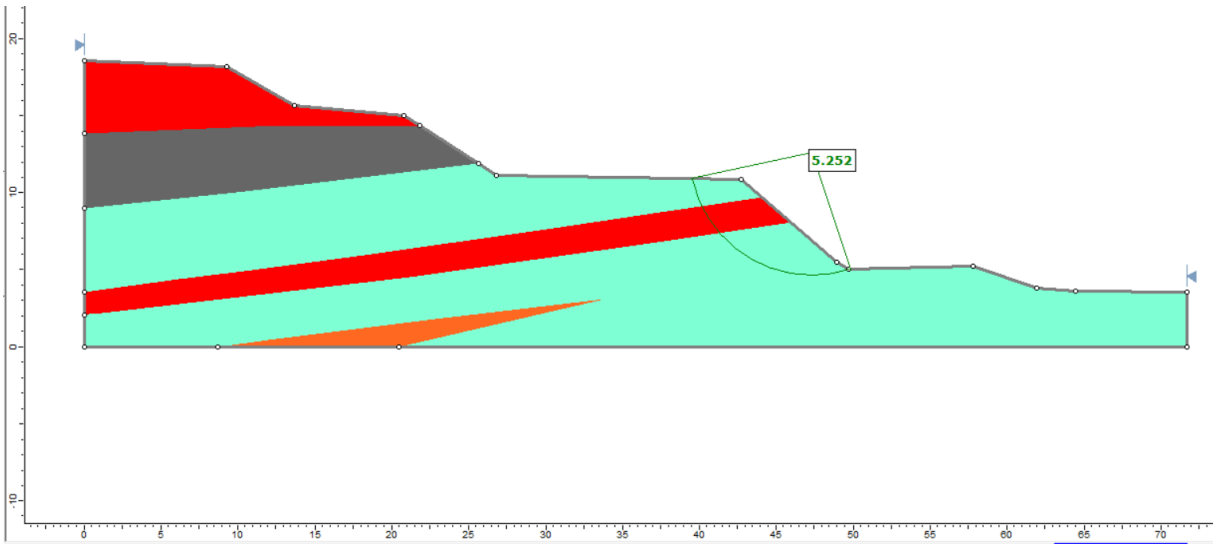


Figure 9: slope stability analysis of a SLO and lateritic ore slope with FOS of 5.252

1.2 Saturated condition

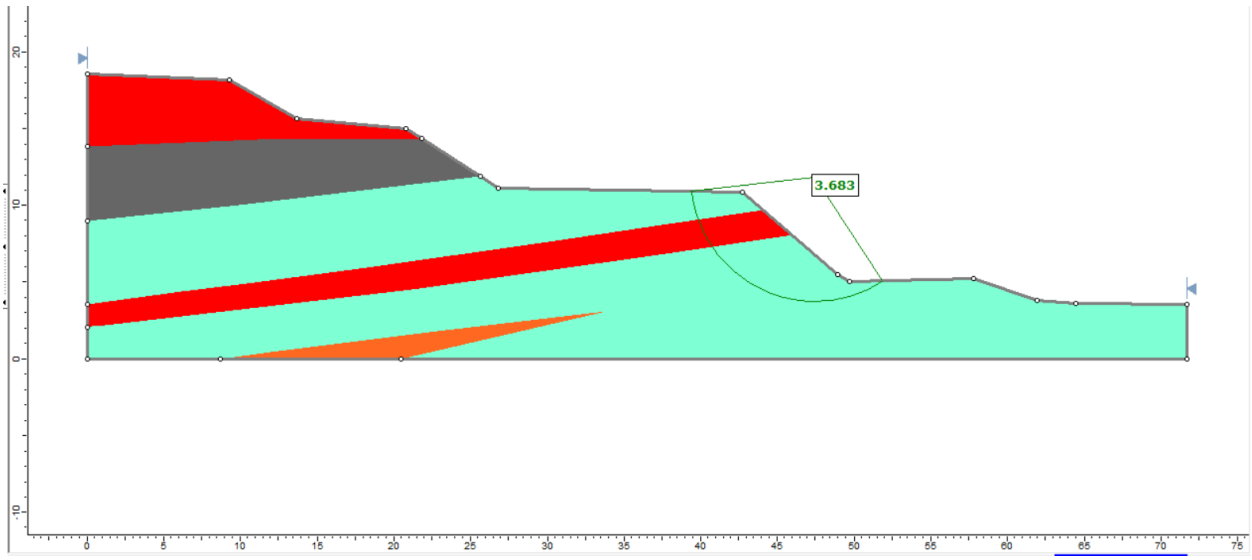


Figure 10: slope stability analysis of a Iron ore 45-55% and lateritic ore slope with FOS of 3.683

Analysis 2 - 318350E

2.1 Dry conditions

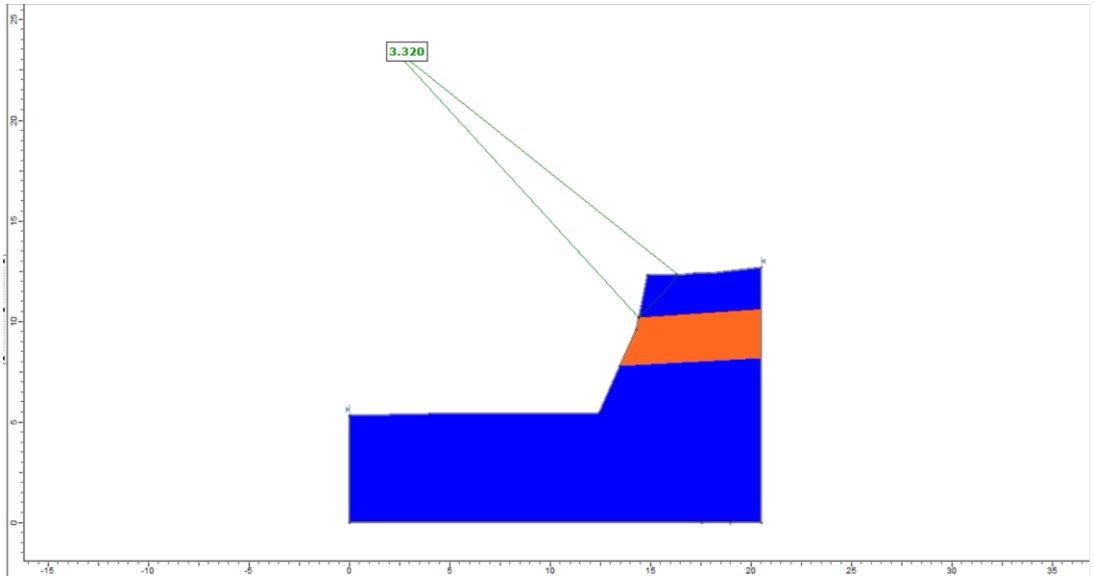


Figure 11: slope stability analysis of a Iron ore +55% slope with FOS of 3.320

2.2 Saturated conditions

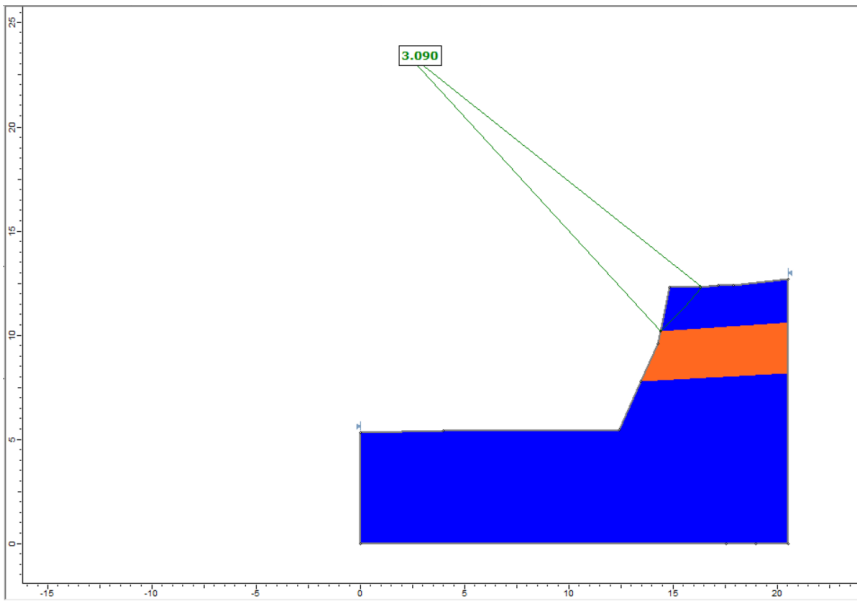


Figure 12: slope stability analysis of a Iron ore +55% slope with FOS of 3.090

Analysis 3 - 318500E

3.1 Dry conditions

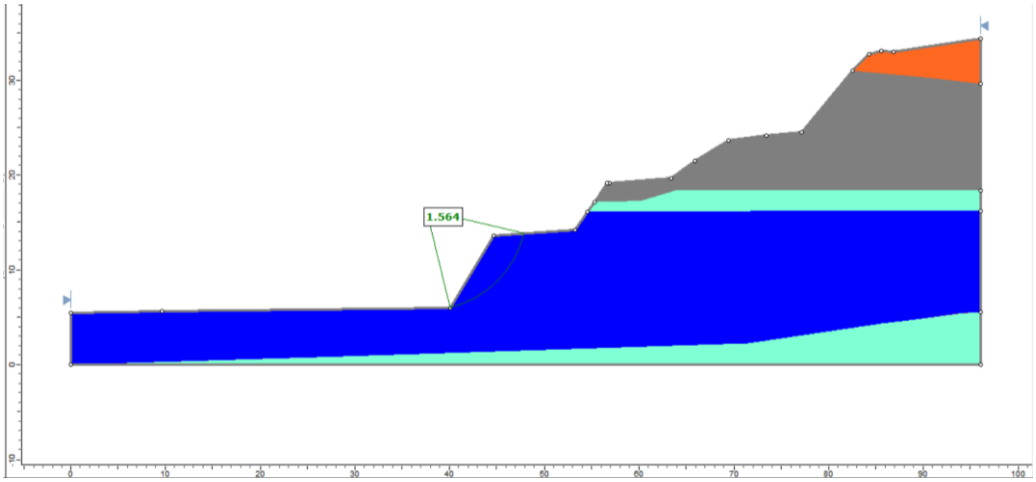


Figure 13: slope stability analysis of a Iron ore +55% slope with FOS of 1.564

3.2 Saturated conditions

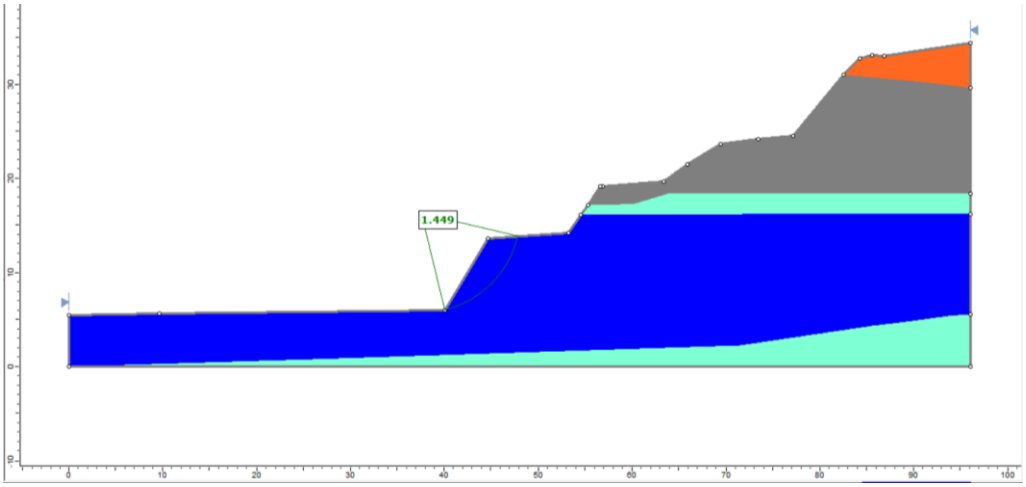


Figure 14: slope stability analysis of a Iron ore +55% slope with FOS of 1.449

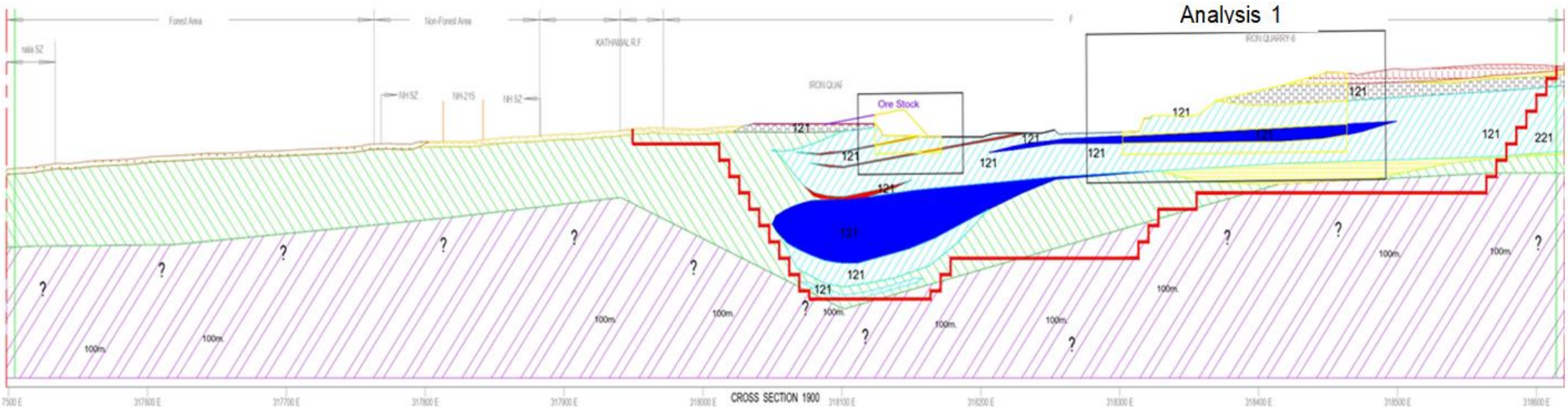


Figure 15: Narayanposhi section 1900N

HARD LAMINATED ORE
IRON ORE +55%
SHALE
LIMONITE
LATERITE
LATERITIC IRON ORE
GEOTHITE
BHJ-BHQ
IRON ORE 45-55%

Analysis 1 - 318400E (CROSS SECTION 1900)

1.1 Dry condition

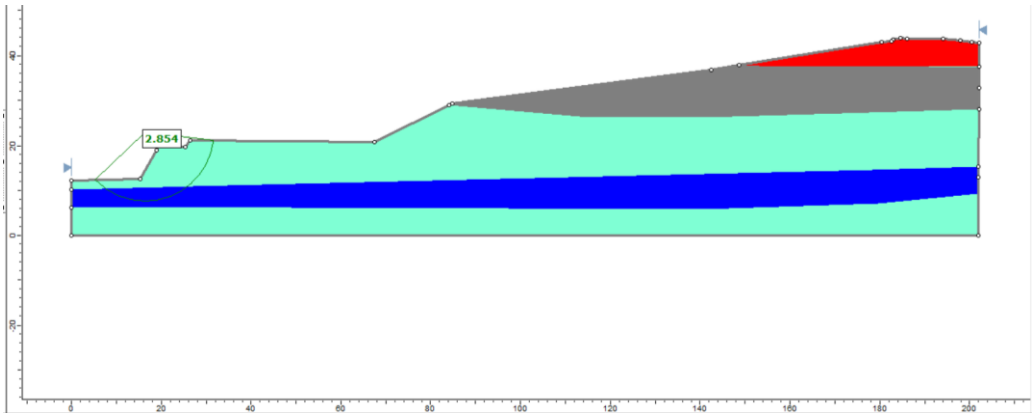


Figure 16: slope stability analysis of a Iron ore 45-55% slope with FOS of 2.854

1.2 Saturated condition

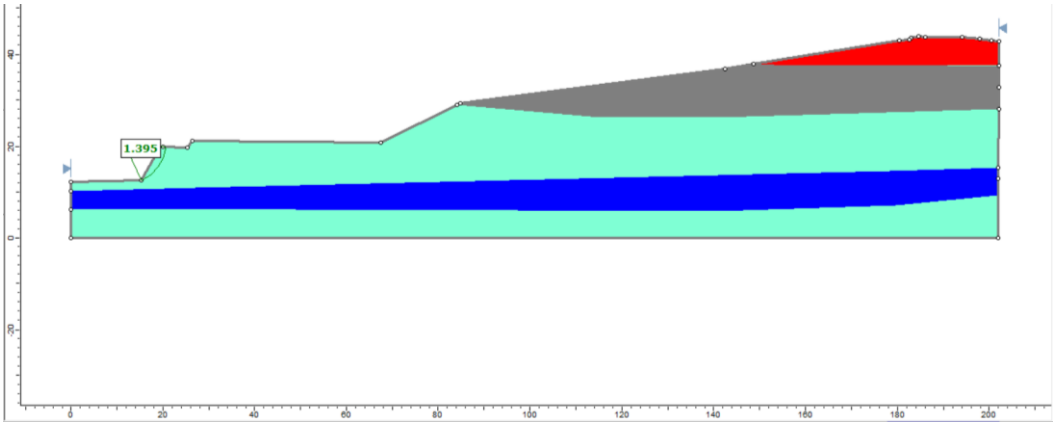


Figure 17: slope stability analysis of a Iron ore 45-55% slope with FOS of 1.395

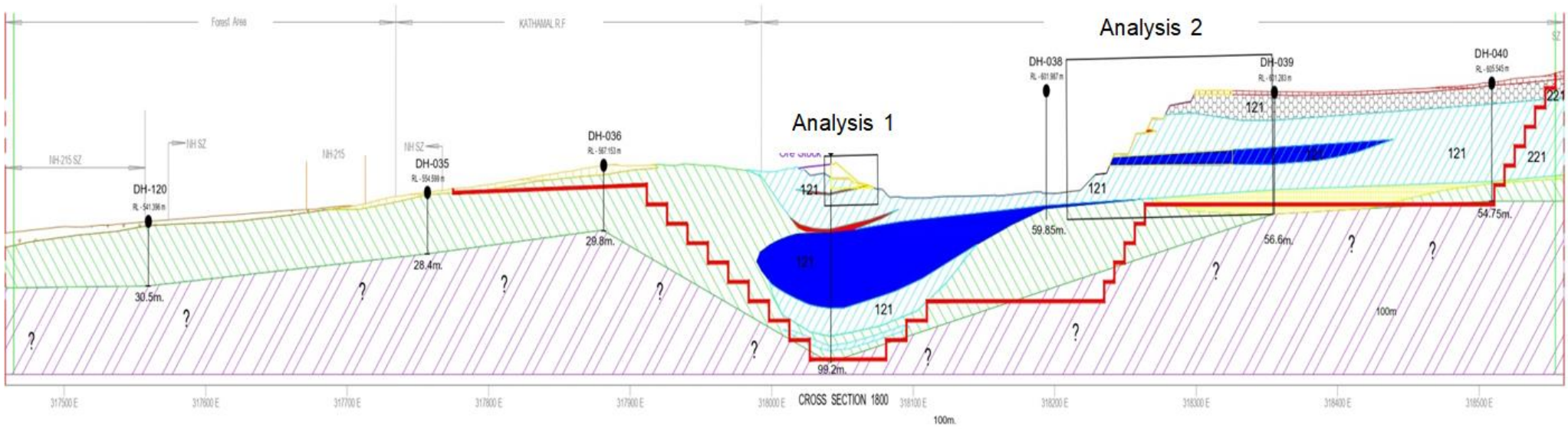


Figure 18: Narayanposhi section 1800N

HARD LAMINATED ORE
IRON ORE +55%
SHALE
LIMONITE
LATERITE
LATERITIC IRON ORE
GEOTHITE
BHJ-BHQ
IRON ORE 45-55%

Analysis 1 - 318050(CROSS SECTION 1800)

1.1 Dry condition

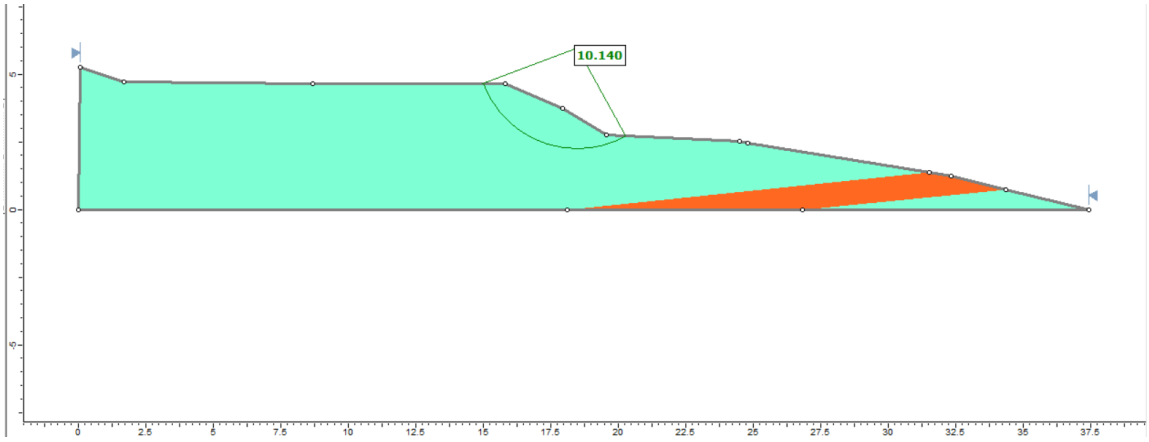


Figure 19 slope stability analysis of Iron ore 45-55% slope with FOS 10.140

1.2 Saturated condition

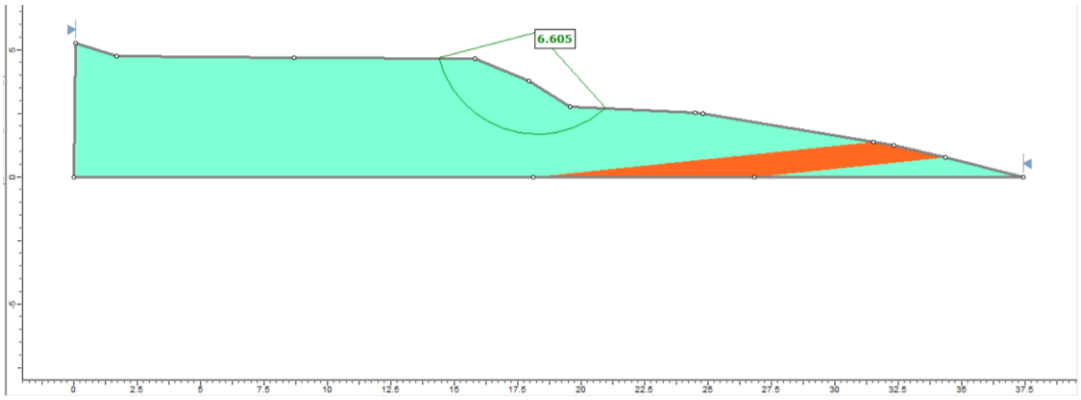


Figure 20: slope stability analysis of a Iron ore 45-55% slope with FOS 6.605

Analysis 2- 318300E

2.1 Dry conditions

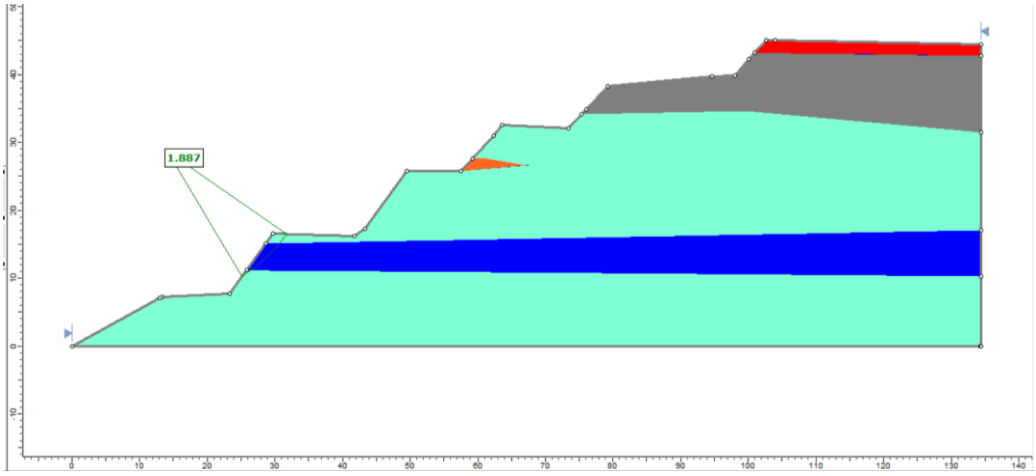


Figure 21: slope stability analysis of a Iron ore +55% and Iron ore 45-55% slope with FOS 1.887

2.2 saturated conditions

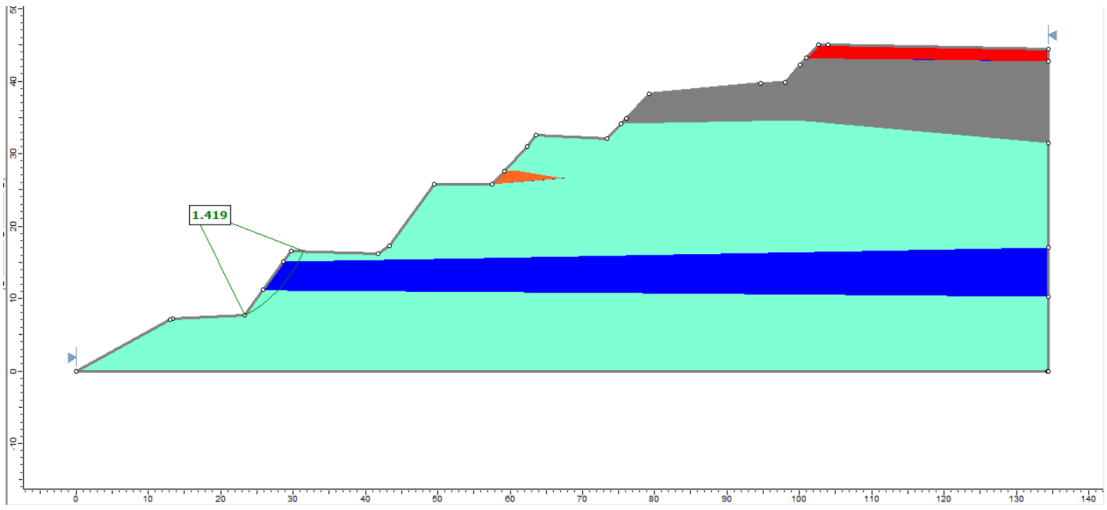


Figure 22: slope stability analysis of a Iron ore +55% and Iron ore 45-55% slope with FOS 1.419

QUARRY RF

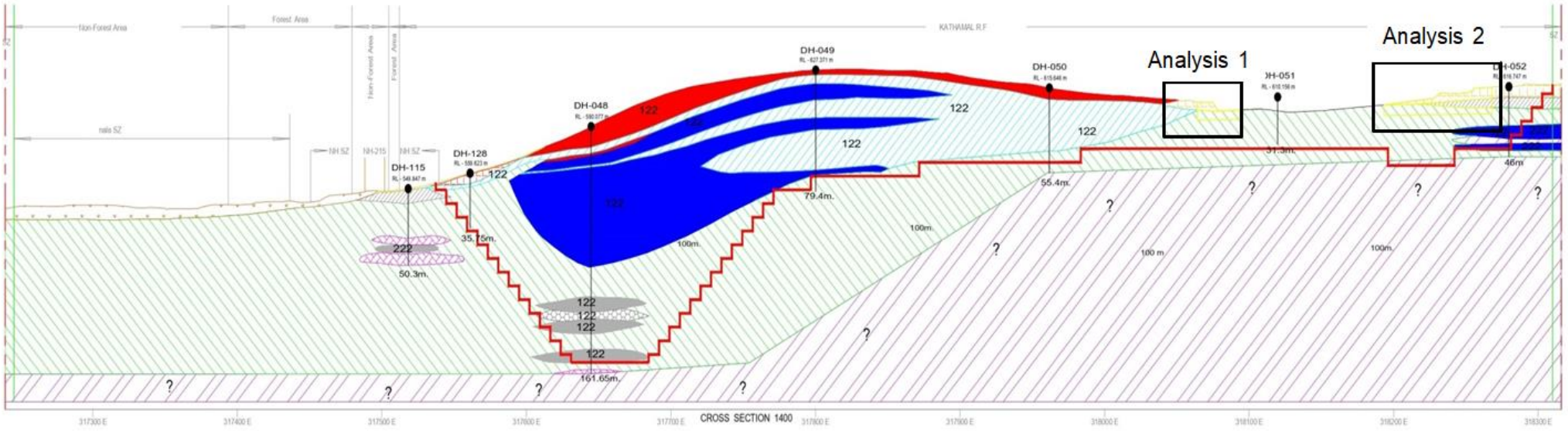


Figure 23: Narayanposhi section 1400N

HARD LAMINATED ORE
IRON ORE +55%
SHALE
LIMONITE
LATERITE
LATERITIC IRON ORE
GEOTHITE
BHJ-BHQ
IRON ORE 45-55%

Analysis 1 - 318100E (CROSS SECTION 1400)

1.1 Dry conditions

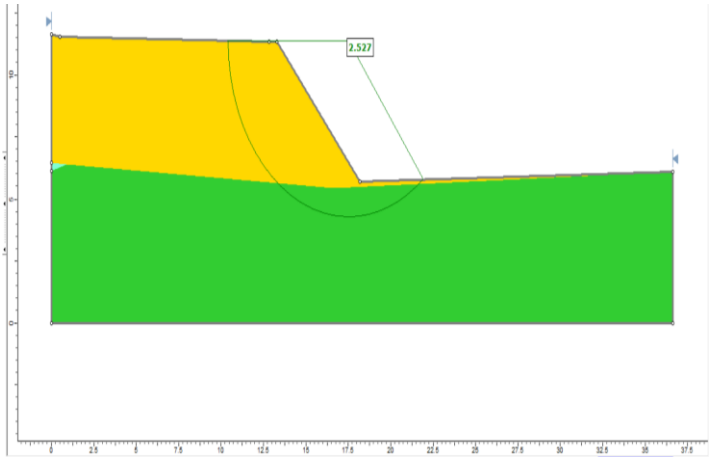


Figure 24: slope stability analysis of a laterite and shale slope with FOS of 2.527

1.2 Saturated conditions

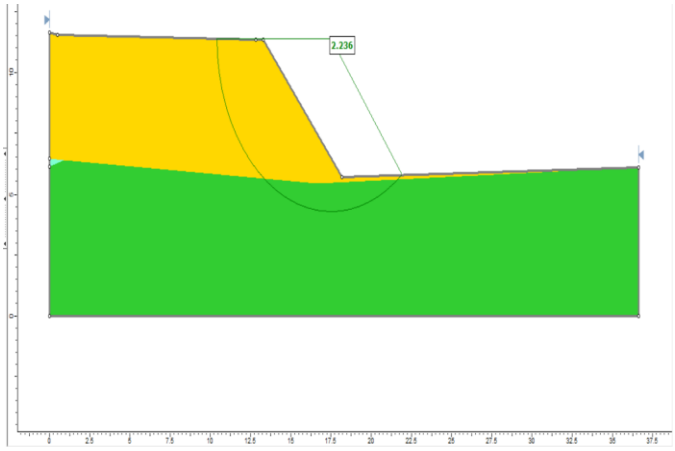


Figure 25: slope stability analysis of a laterite and shale slope with FOS of 2.236

Analysis 2 - 318250E

2.1 Dry conditions

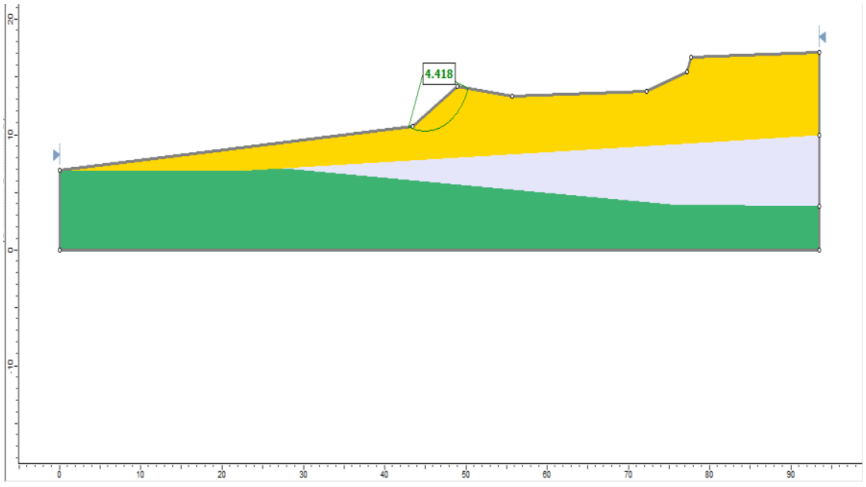


Figure 26: slope stability analysis of a laterite slope with FOS of 4.418

2.2 Saturated conditions

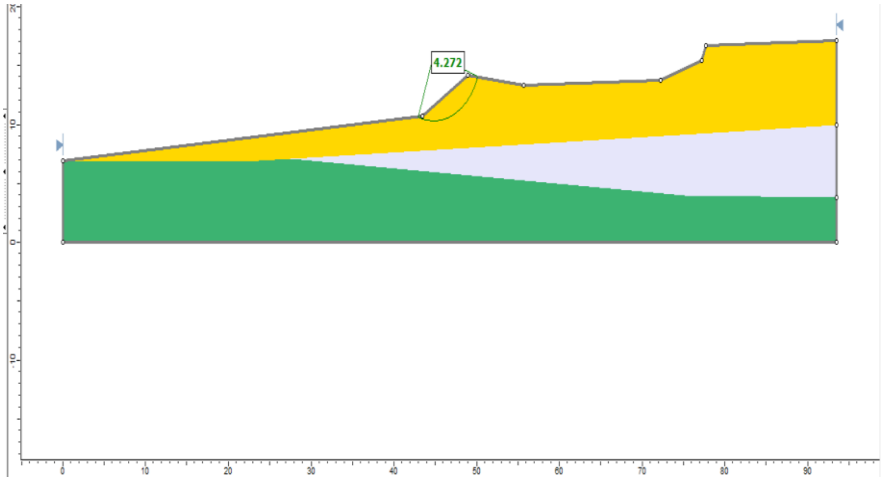


Figure 27: slope stability analysis of a laterite slope with FOS of 4.272

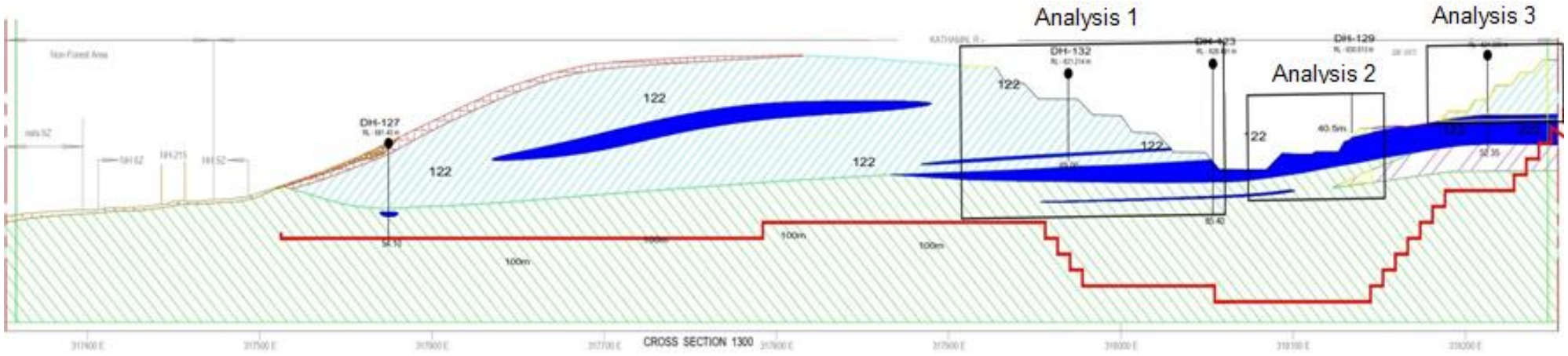


Figure 28: Narayanposhi section 1300N

HARD LAMINATED ORE
IRON ORE +55%
SHALE
LIMONITE
LATERITE
LATERITIC IRON ORE
GEOTHITE
BHJ-BHQ
IRON ORE 45-55%

Analysis 1 - 318000E CROSS SECTION 1300

1.1 Dry condition

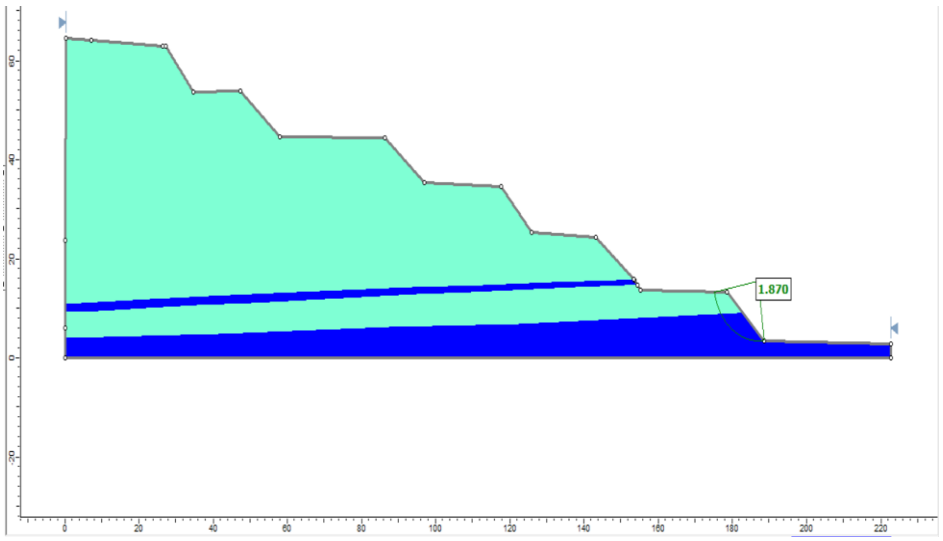


Figure 29: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS of 1.870

1.2 Saturated condition

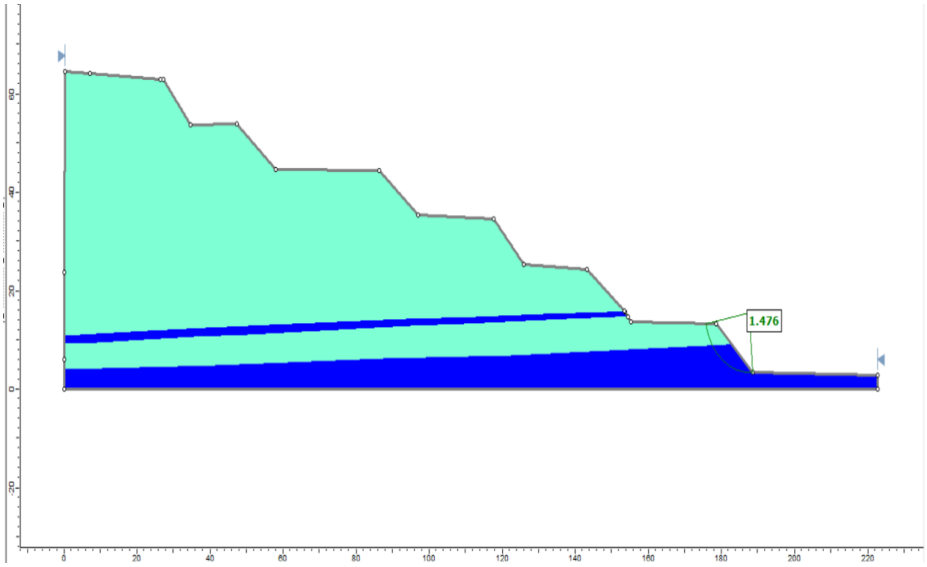


Figure 30: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS of 1.476

Analysis 2 - 318100E

2.1 Dry condition

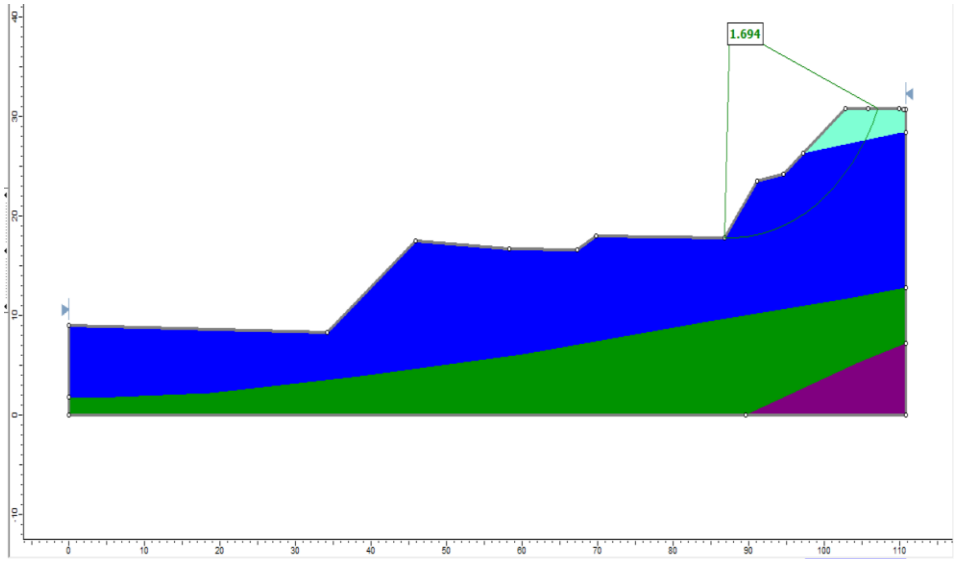


Figure 31: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS 1.694

2.2 Saturated condition

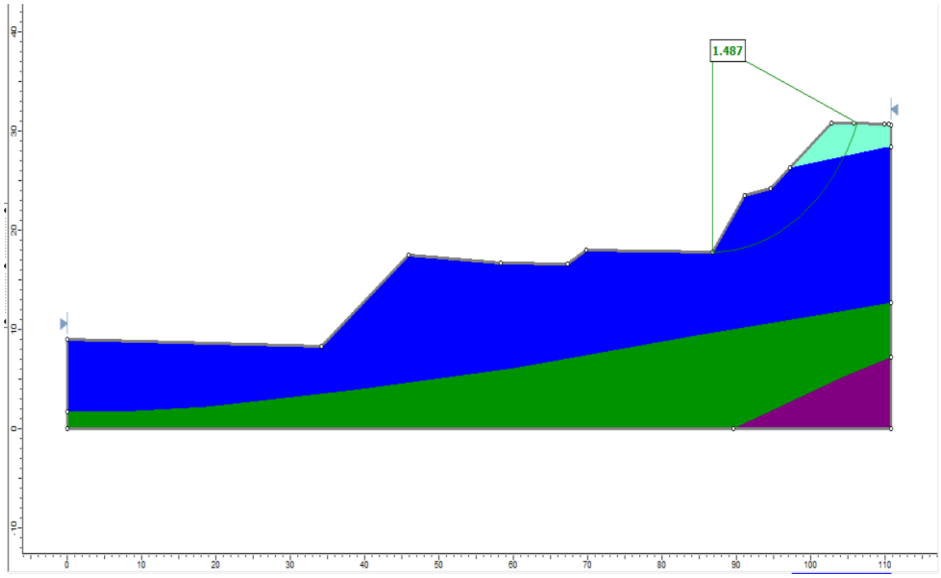


Figure 32: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS 1.487

Analysis 3 - 318200E

3.1 Dry condition

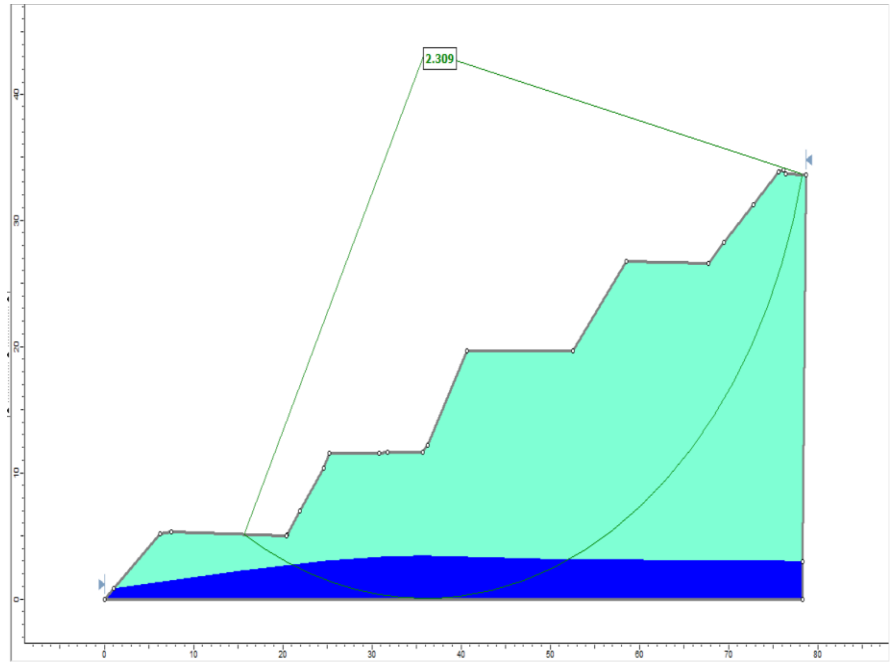


Figure 33: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS of 2.309

3.2 Saturated condition

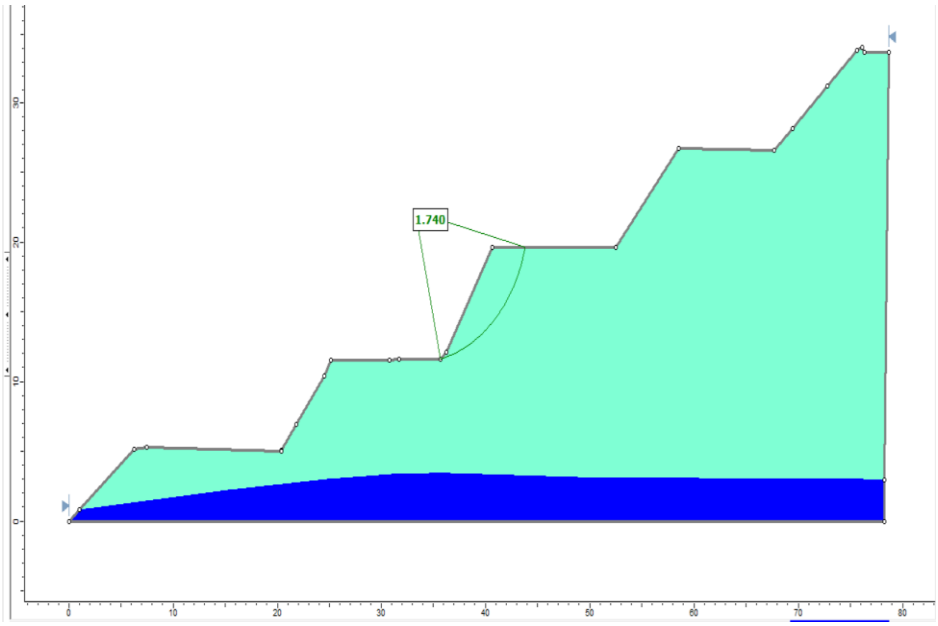


Figure 34: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS 1.740

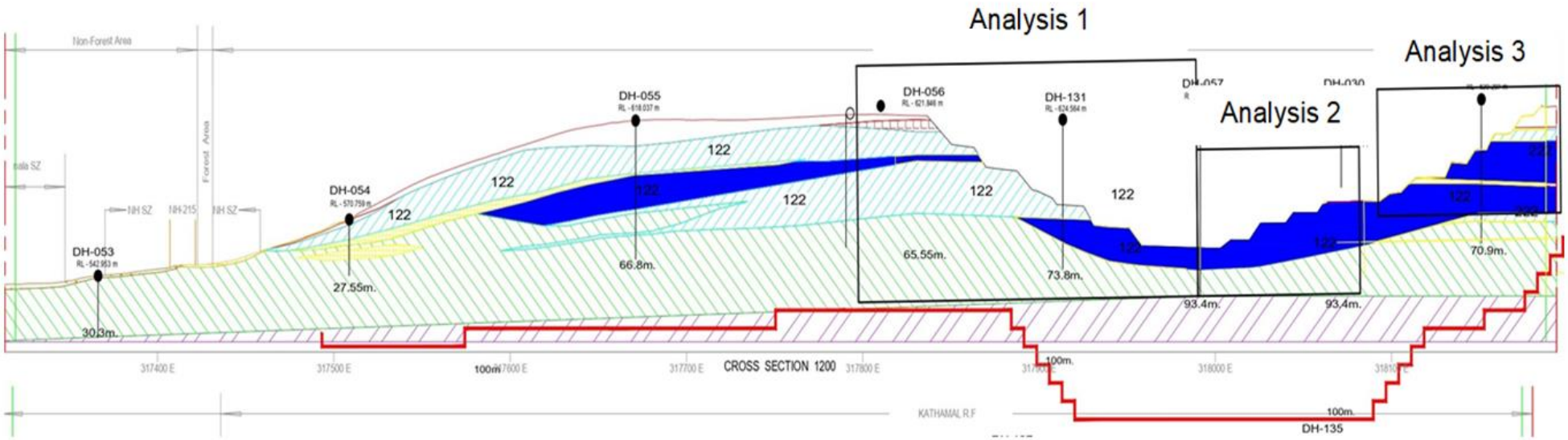


Figure 35: Narayanposhi section 1200N

HARD LAMINATED ORE	
IRON ORE +55%	
SHALE	
LIMONITE	
LATERITE	
LATERITIC IRON ORE	
GEOTHITE	
BHJ-BHQ	
IRON ORE 45-55%	

Analysis 1- 317900E CROSS SECTION 1200

1.1 Dry condition

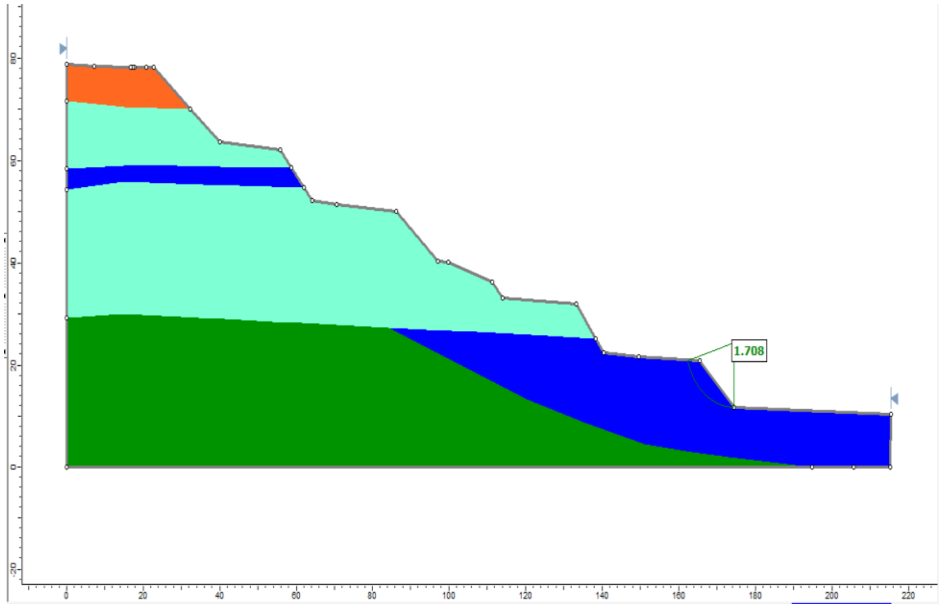


Figure 36: slope stability analysis of a Iron ore +55% slope with FOS of 1.708

1.2 Saturated condition

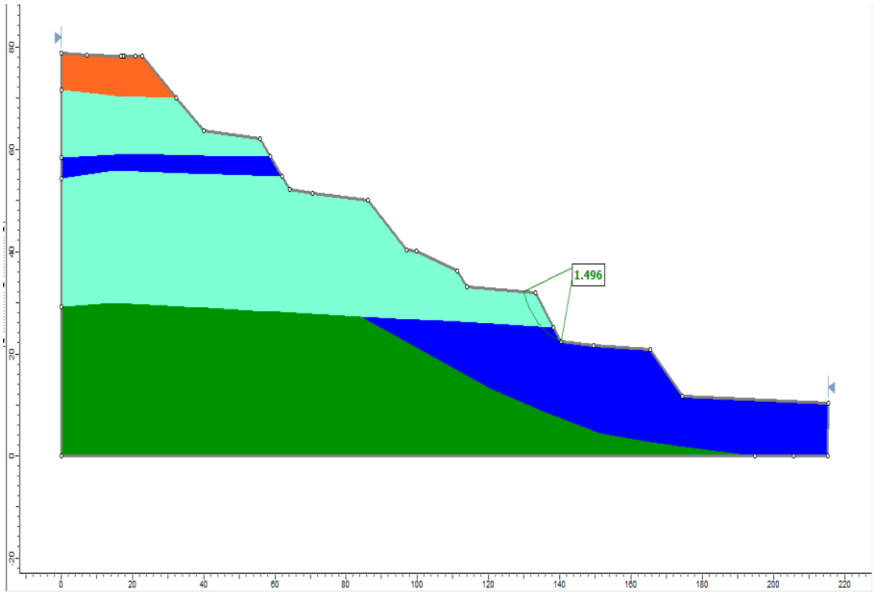


Figure 37: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS 1.496

Analysis 2 - 318000E

2.1 Dry condition

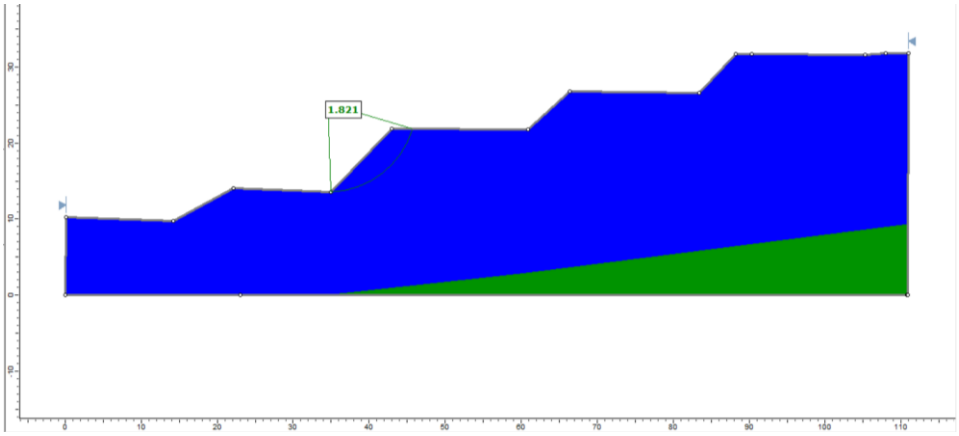


Figure 38: slope stability analysis of a Iron ore +55% slope with FOS of 1.821

2.2 Saturated condition

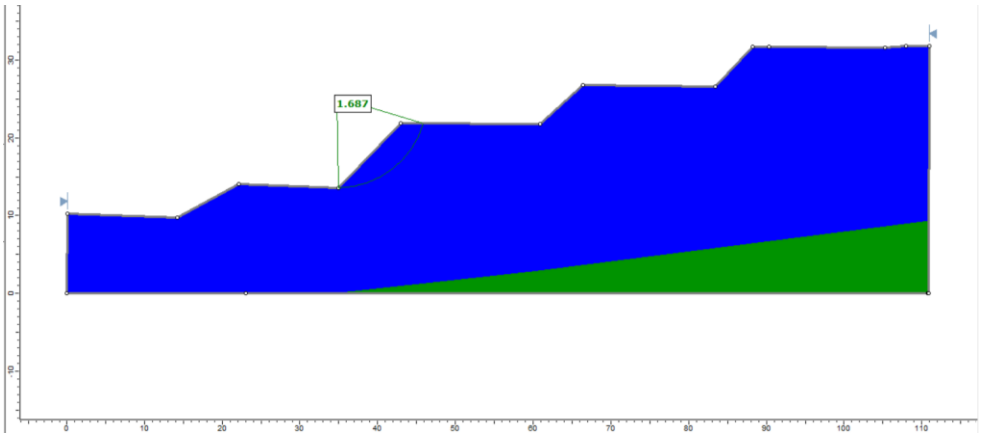


Figure 39: slope stability analysis of a Iron ore +55% slope with FOS of 1.687

Analysis 3 - 318100E

3.1 Dry condition

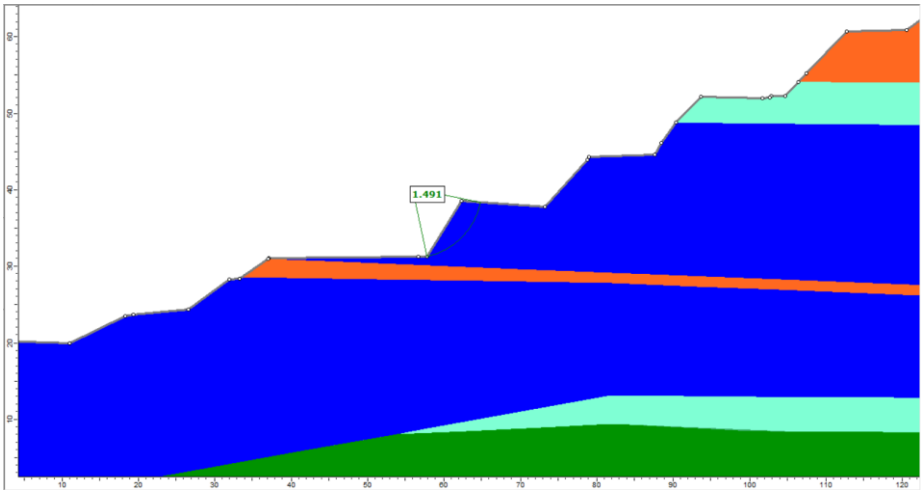


Figure 40: slope stability analysis of a Iron ore +55% slope with FOS of 1.491

1.2 Saturated condition

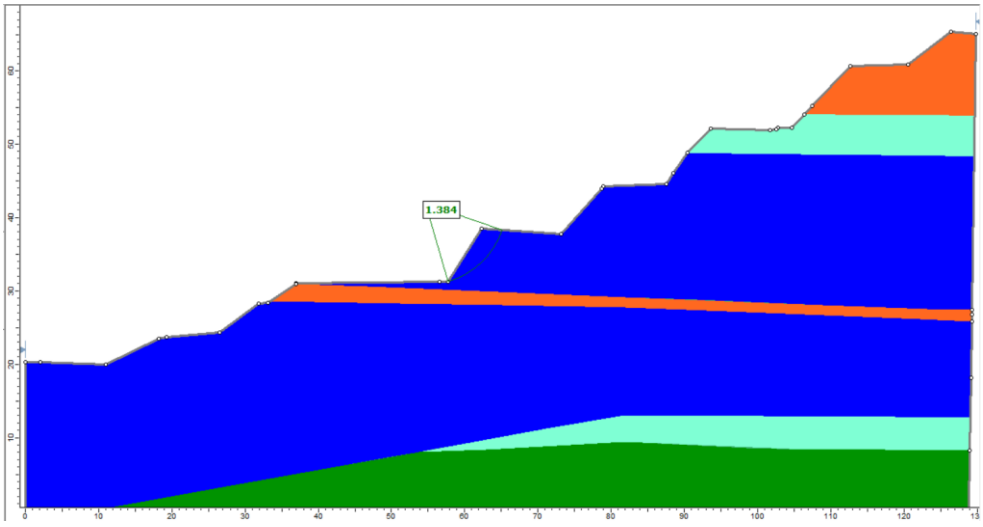


Figure 41: slope stability analysis of a Iron ore +55% slope with FOS of 1.384

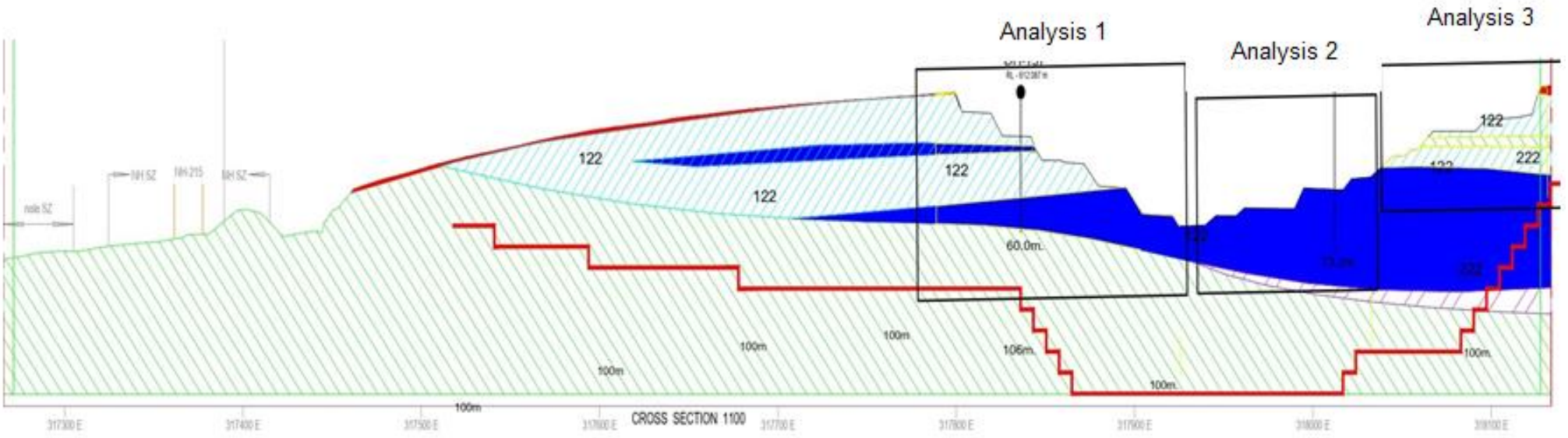


Figure 42: Narayanposhi section 1100N

HARD LAMINATED ORE
IRON ORE +55%
SHALE
LIMONITE
LATERITE
LATERITIC IRON ORE
GEOTHITE
BHJ-BHQ
IRON ORE 45-55%

Analysis 1 - 317850E CROSS SECTION 1100

1.1 Dry condition

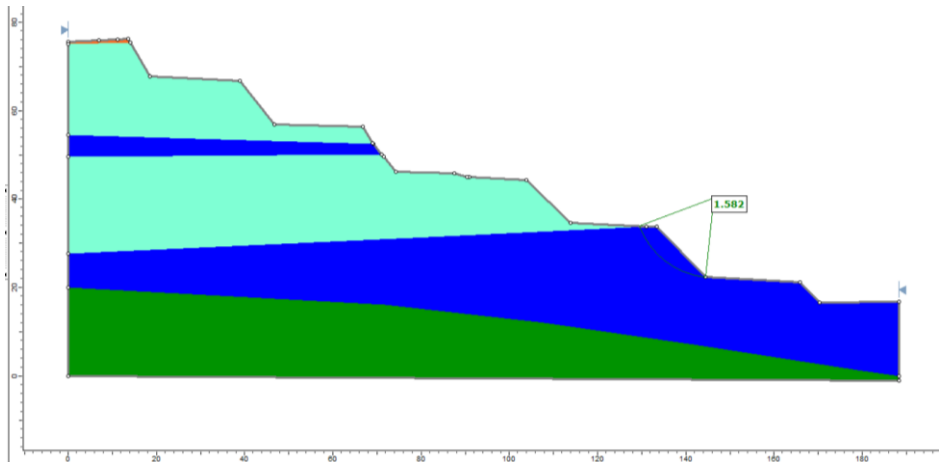


Figure 43: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS of 1.582

1.2 Saturated condition

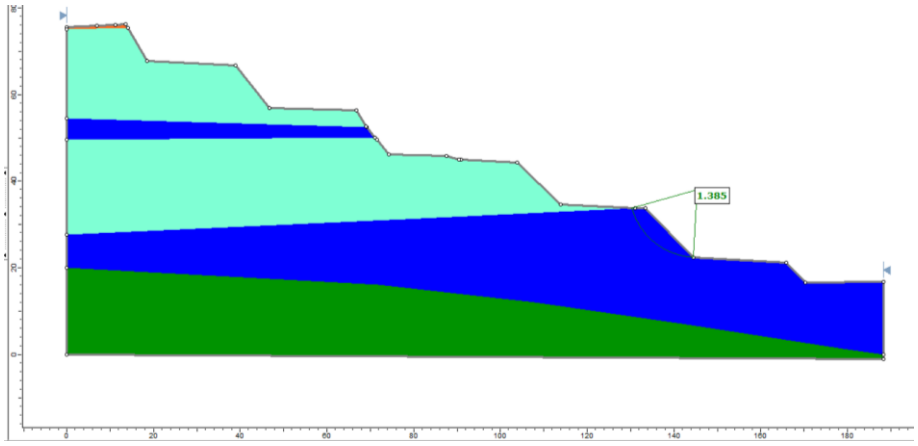


Figure 44: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS of 1.385

Analysis 2- 318000E

2.1 Dry condition

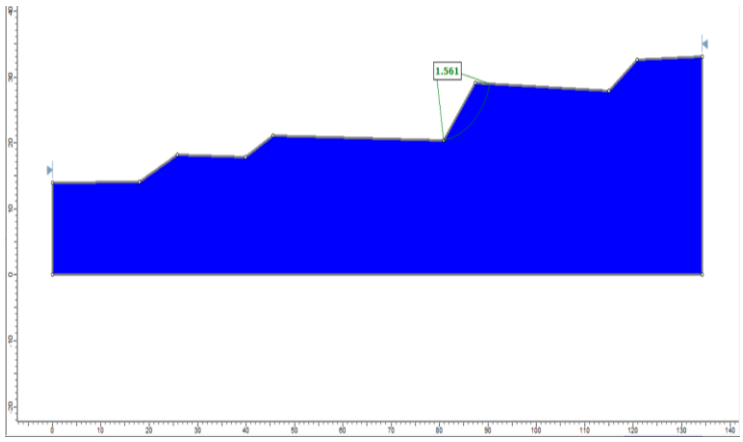


Figure 45: slope stability analysis of a Iron ore +55% slope with FOS of 1.561

2.2 Saturated condition

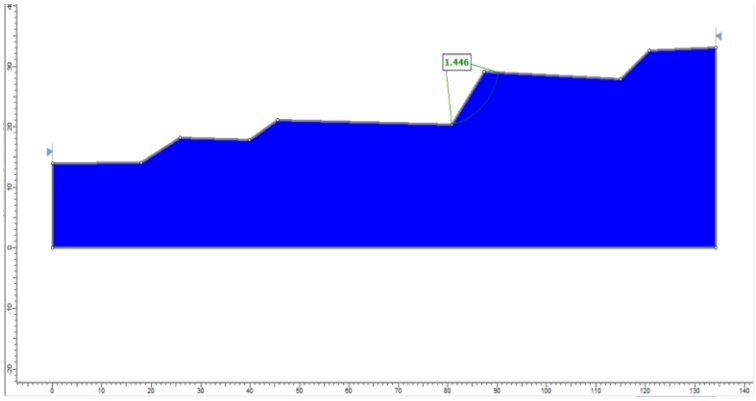


Figure 46: slope stability analysis of a Iron ore +55% slope with FOS of 1.446

Analysis 3 - 318100E

3.1 Dry condition

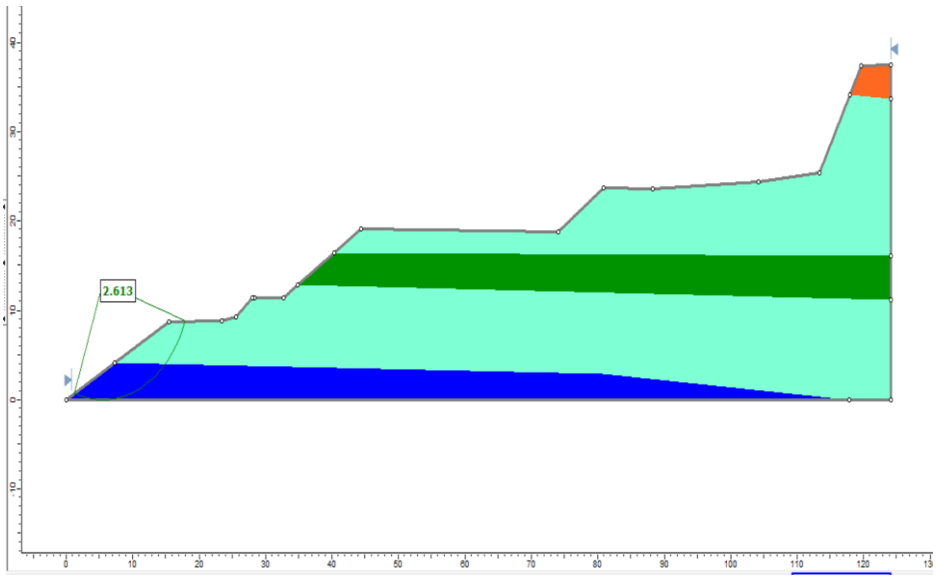


Figure 47: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS 2.613

3.2 Saturated condition

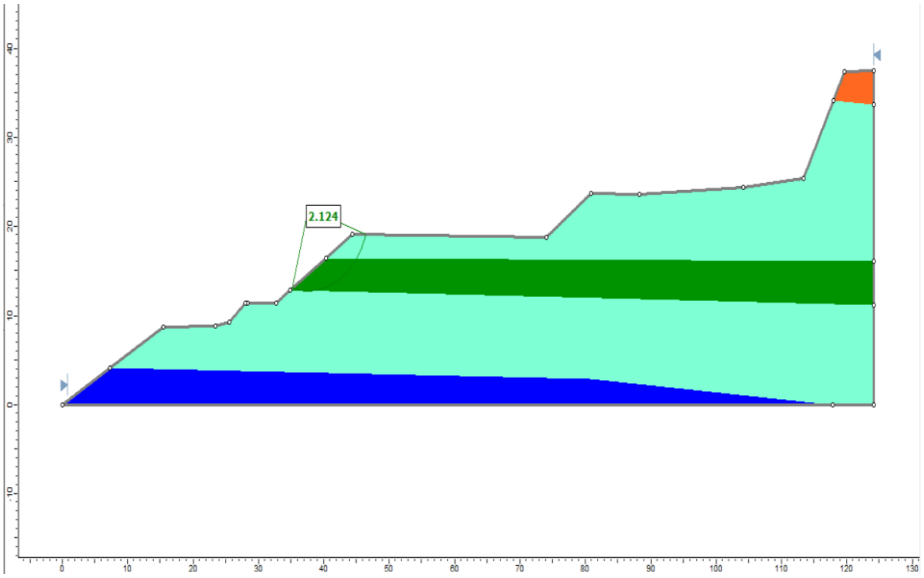


Figure 48: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS 2.124

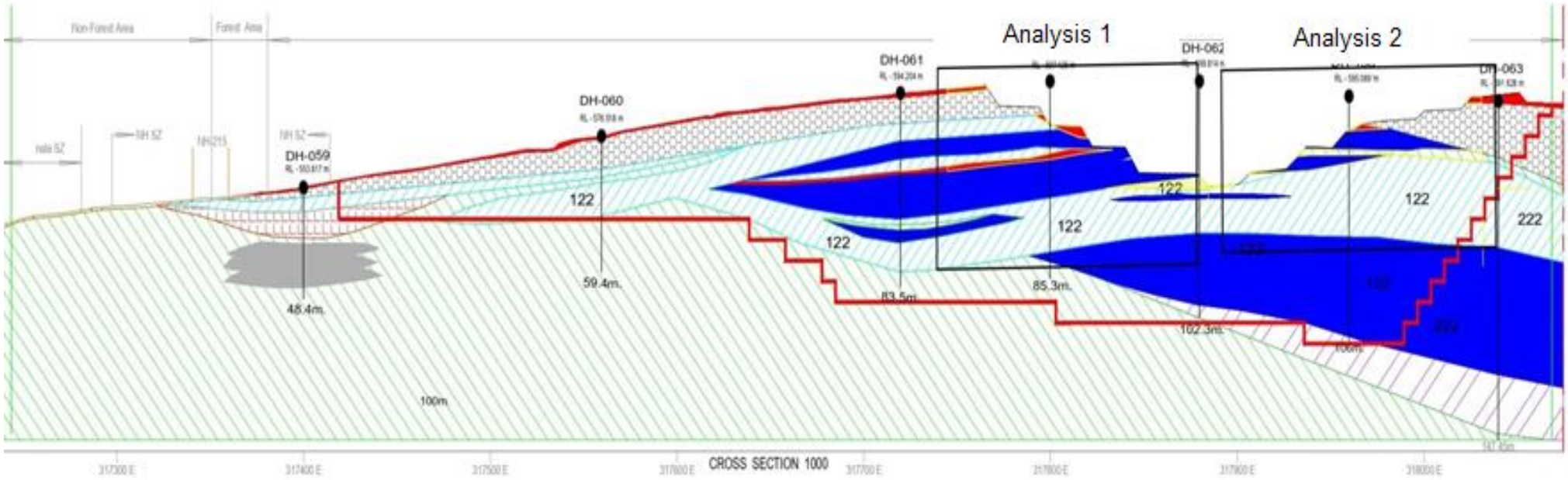


Figure 49: Narayanposhi section 1000N

HARD LAMINATED ORE
IRON ORE +55%
SHALE
LIMONITE
LATERITE
LATERITIC IRON ORE
GEOTHITE
BHJ-BHQ
IRON ORE 45-55%

Analysis 1 - 317800E CROSS SECTION 1000

1.1 Dry condition

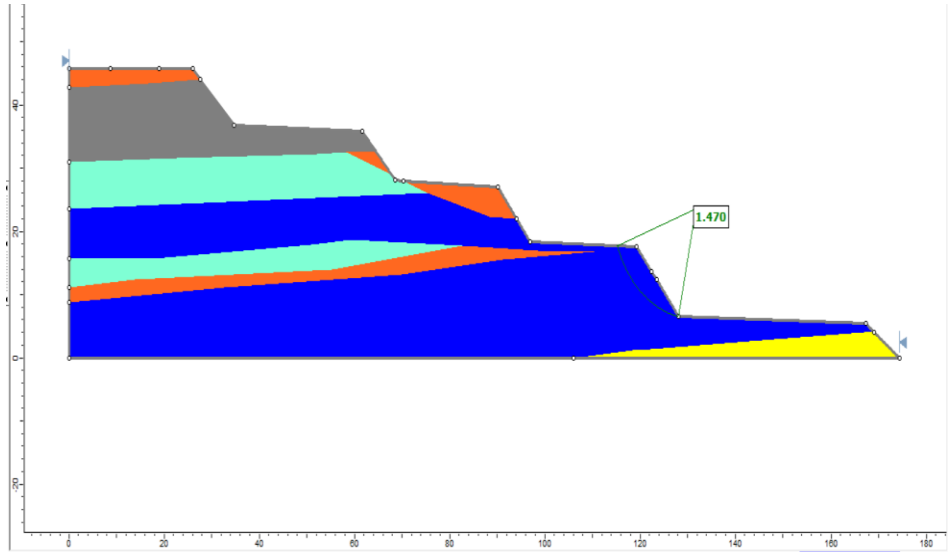


Figure 50: slope stability analysis of Iron ore +55% slope with FOS of 1.470

1.2 Saturated condition

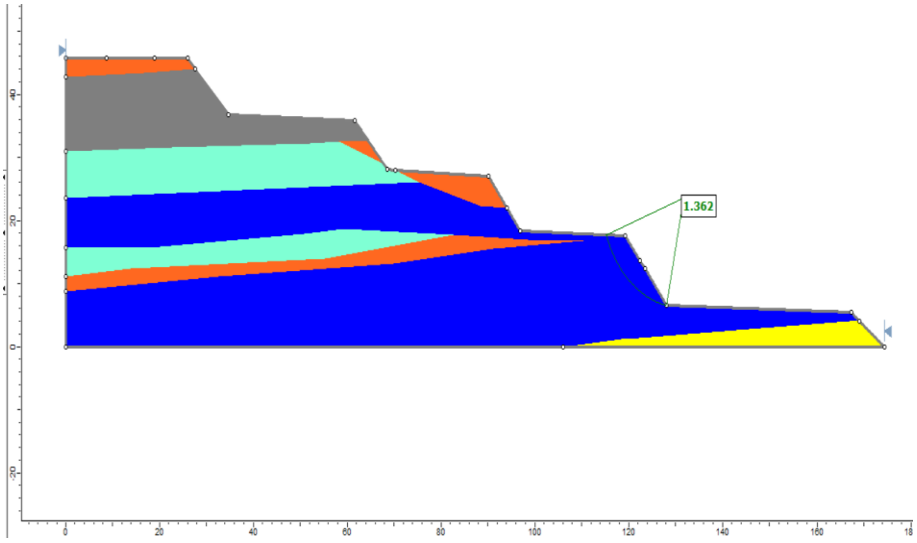


Figure 51: slope stability analysis of Iron ore +55% slope with FOS 1.362

Analysis 2-318000E CROSS SECTION 1000

2.1 Dry condition

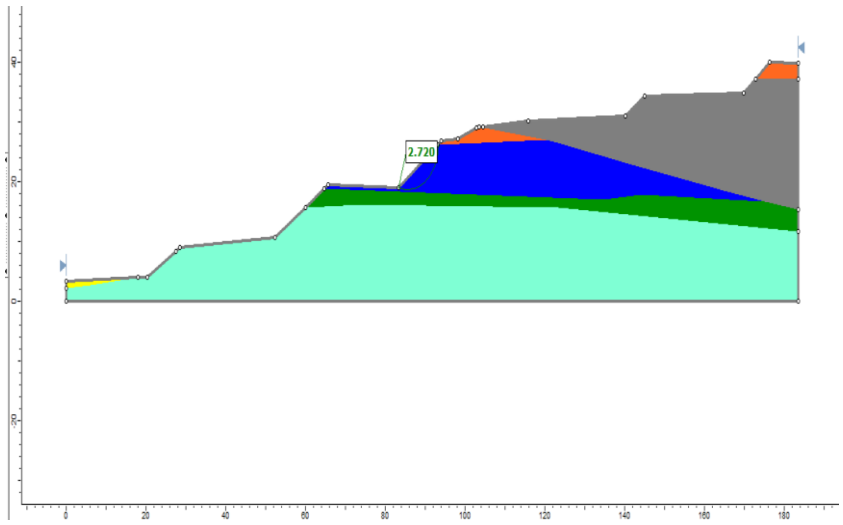


Figure 52: slope stability analysis of a Shale and Iron ore +55% slope with FOS of 2.720

2.2 Saturated condition

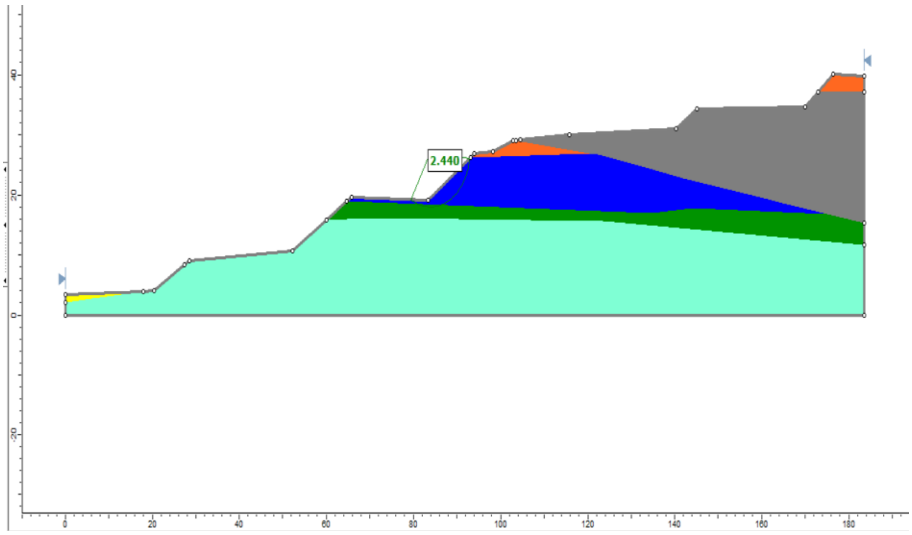


Figure 53: slope stability analysis of a Shale and Iron ore +55% slope with FOS of 2.440

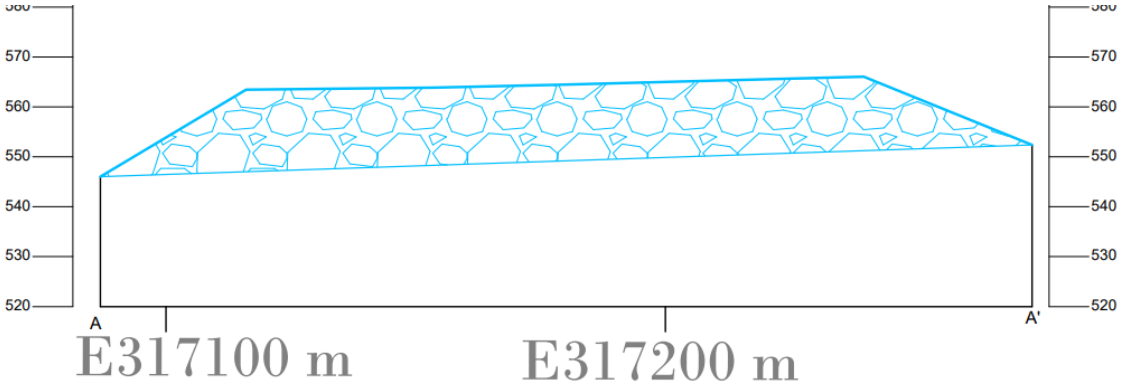


Figure 54: Manganese quarry dump section along A-A'

1.1 ANALYSIS 1

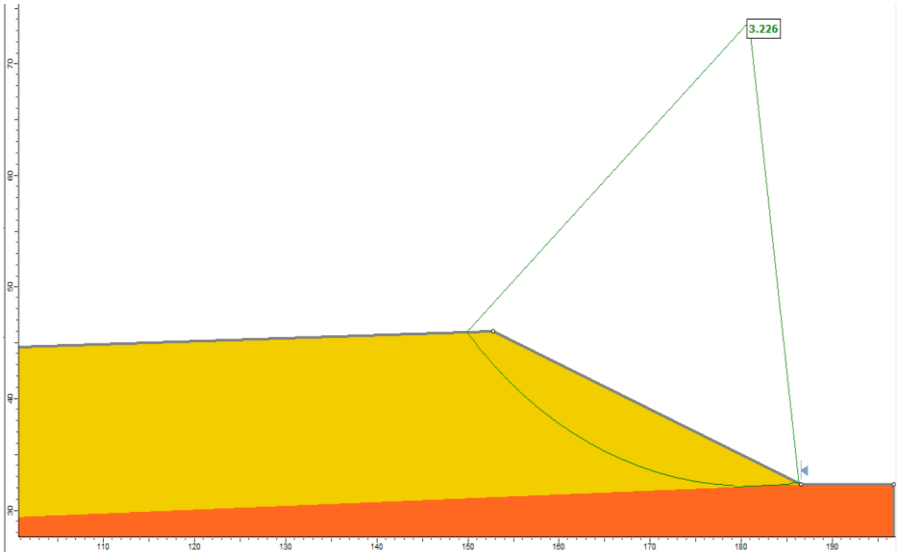


Figure 55: Slope stability analysis with FOS 3.226

1.2 ANALYSIS 2

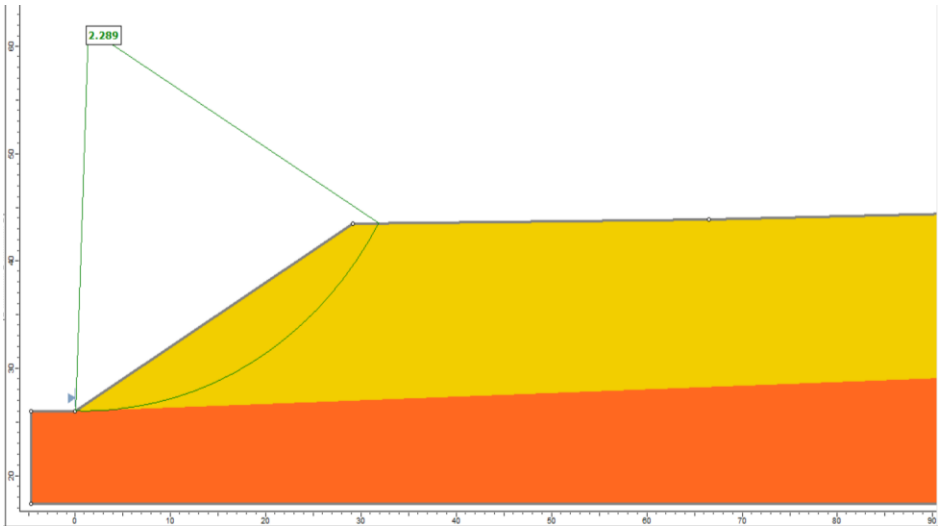


Figure 56: Slope stability analysis of the dump with FOS of 2.289

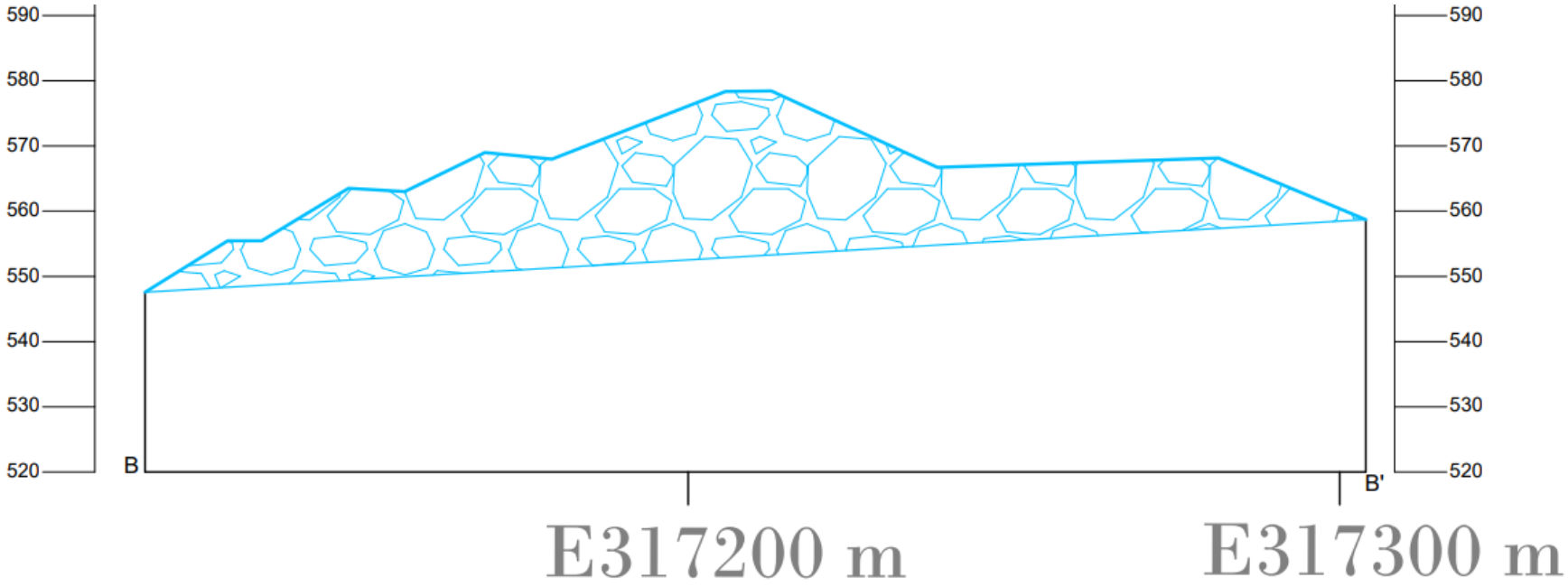


Figure 57: Manganese quarry dump section along B-B'

1.1 ANALYSIS 1

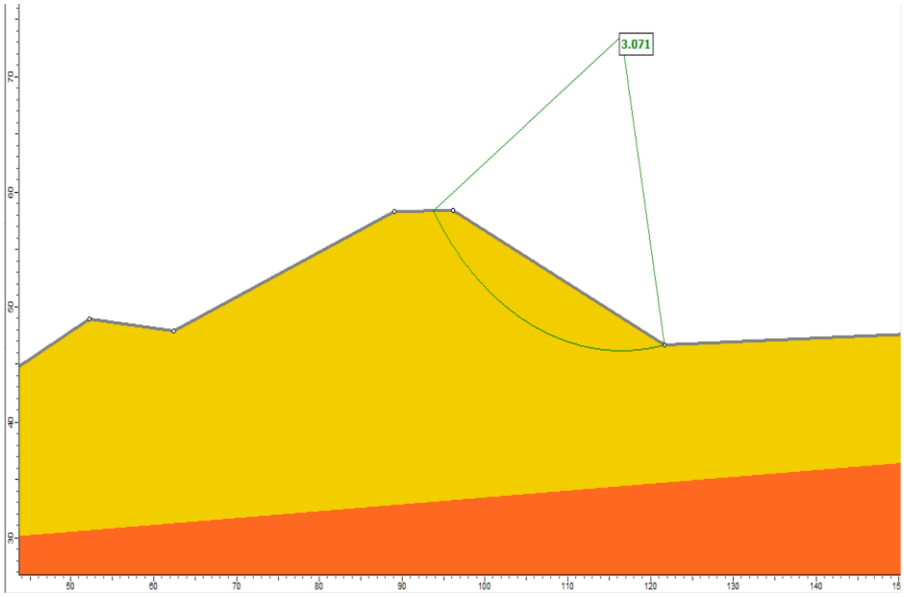


Figure 58: Slope stability analysis of the dump with FOS of 3.071

1.2 ANALYSIS 2

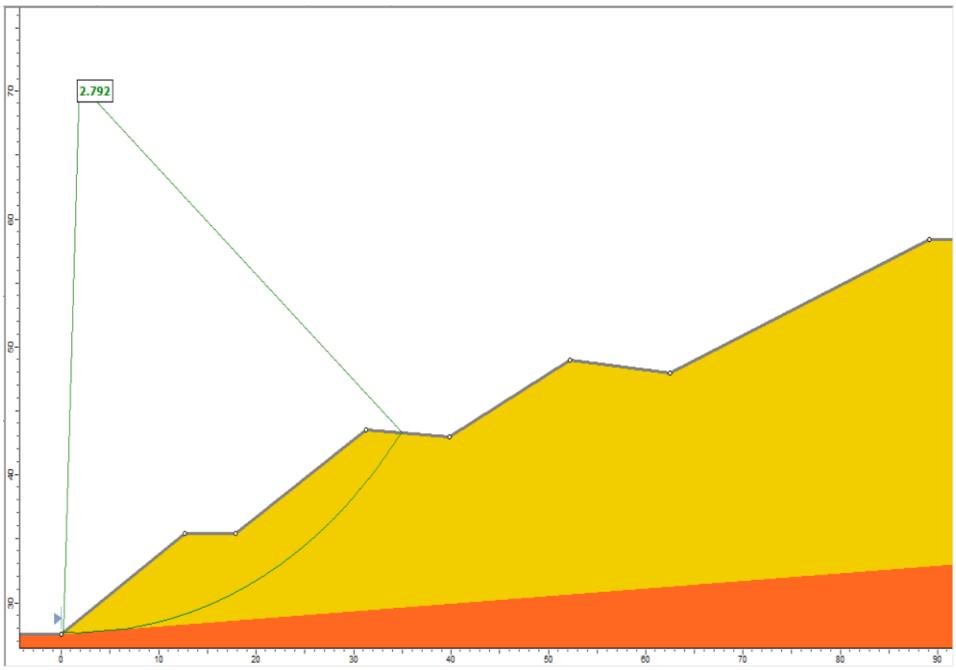


Figure 59: Slope stability analysis of the dump with FOS of 2.792

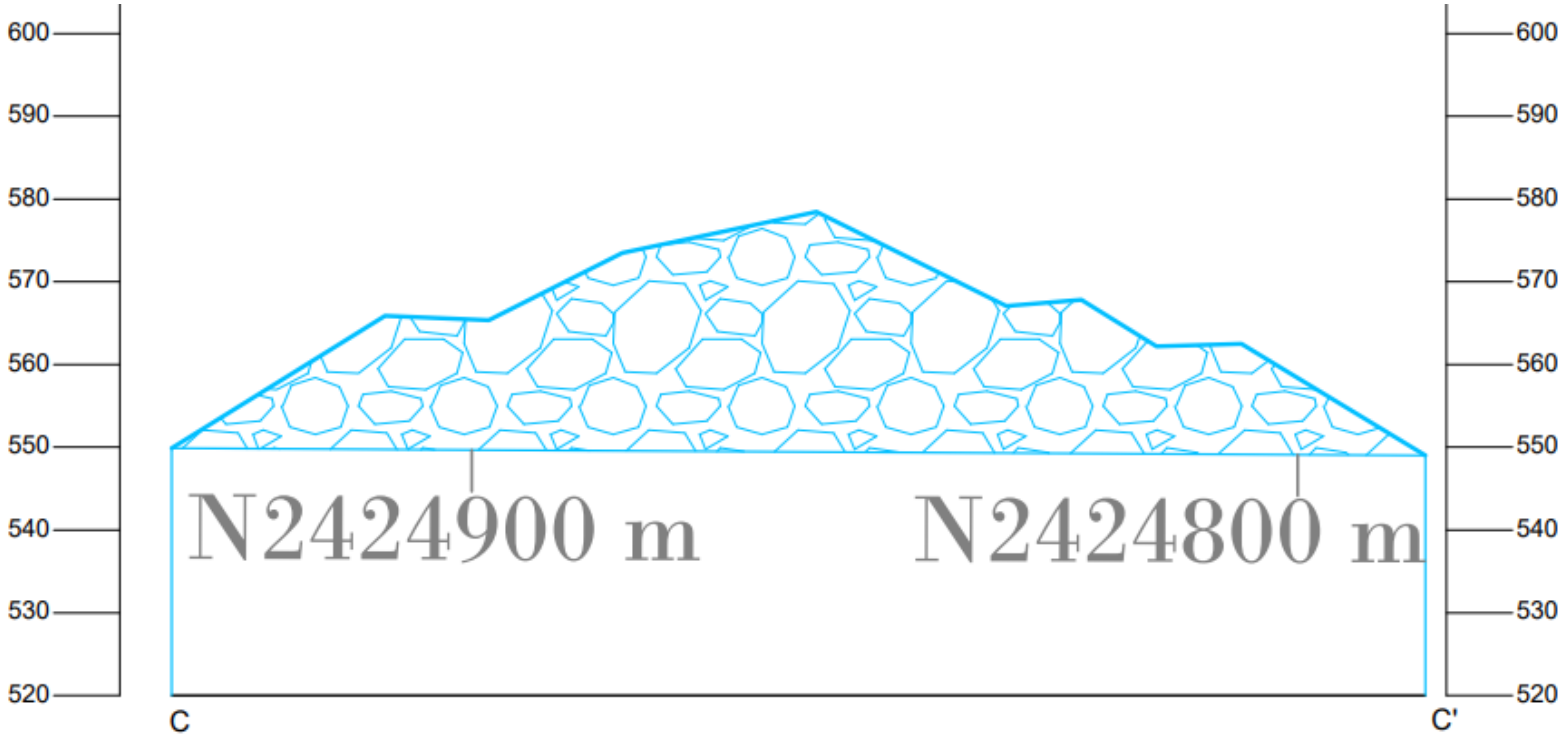


Figure 60: Manganese quarry dump section along C-C'

1.1 ANALYSIS 1

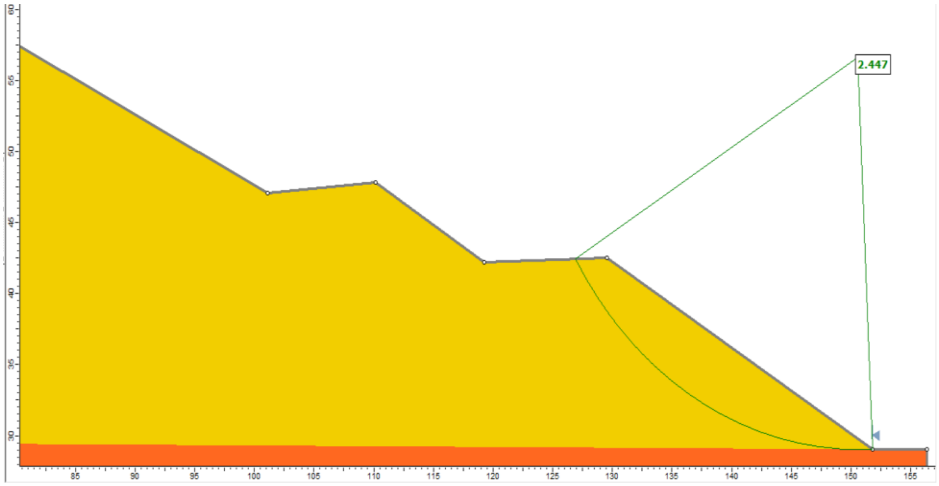


Figure 61: Slope stability analysis of the dump with FOS of 2.447

1.2 ANALYSIS 2

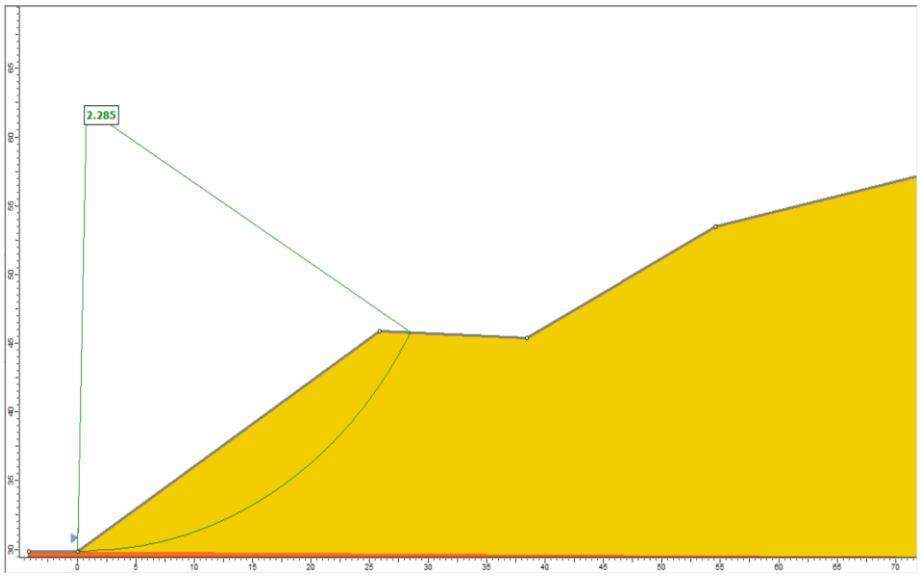


Figure 62: Slope stability analysis of the dump with FOS of 2.285

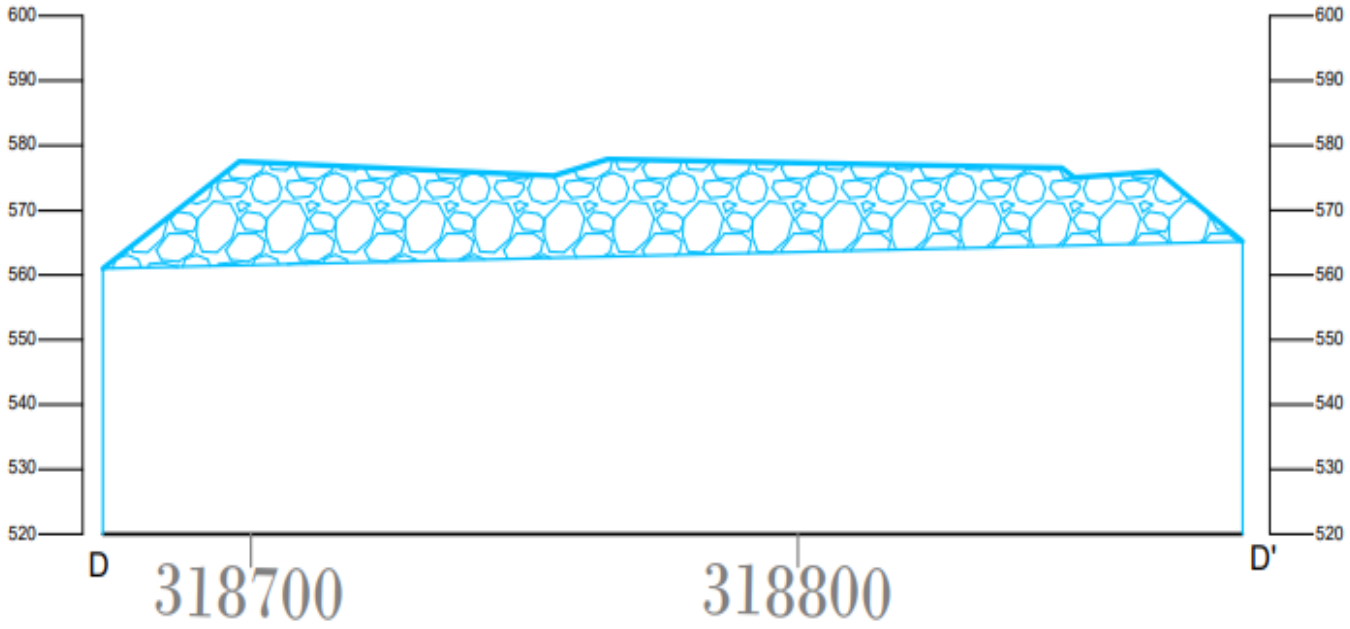


Figure 63: Quarry 3 dump section along D-D'

1.1 ANALYSIS 1

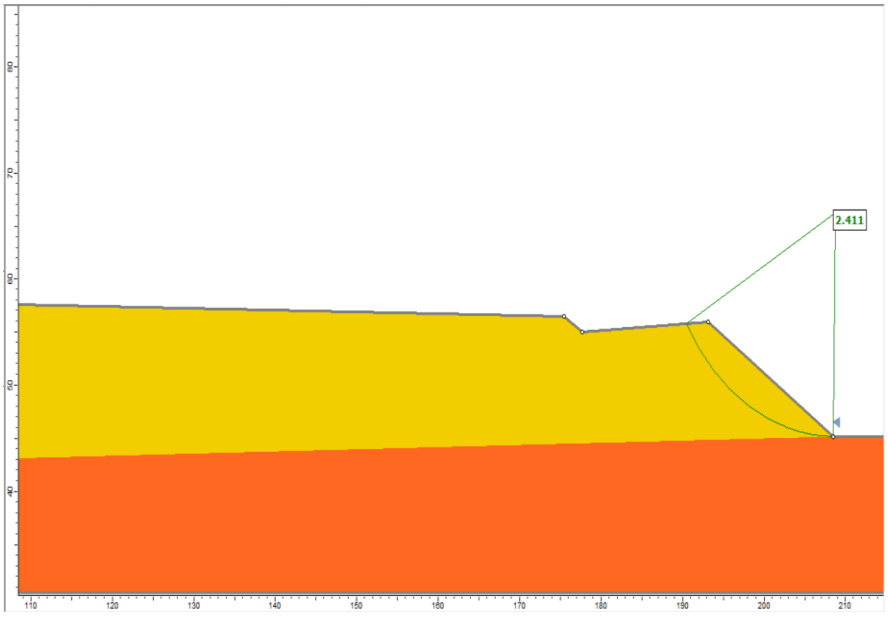


Figure 64: Slope stability analysis of the dump with FOS of 2.411

1.2 ANALYSIS 2

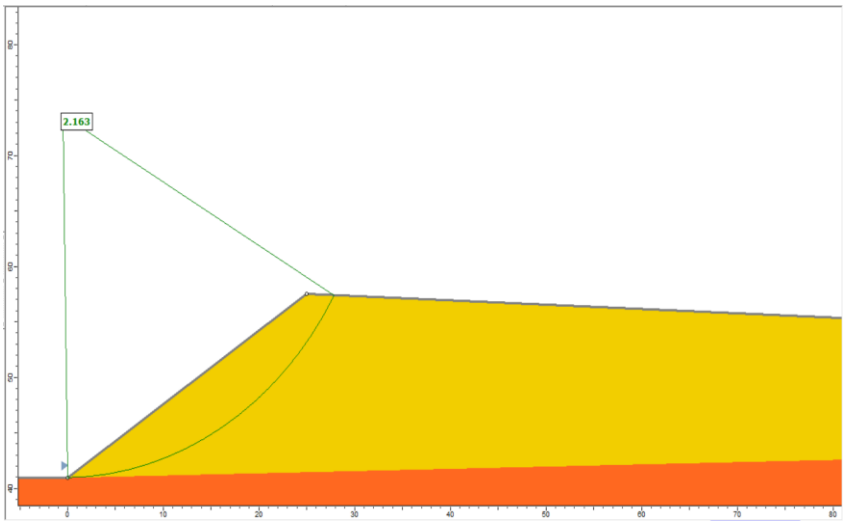


Figure 65: Slope stability analysis of the dump with FOS of 2.168

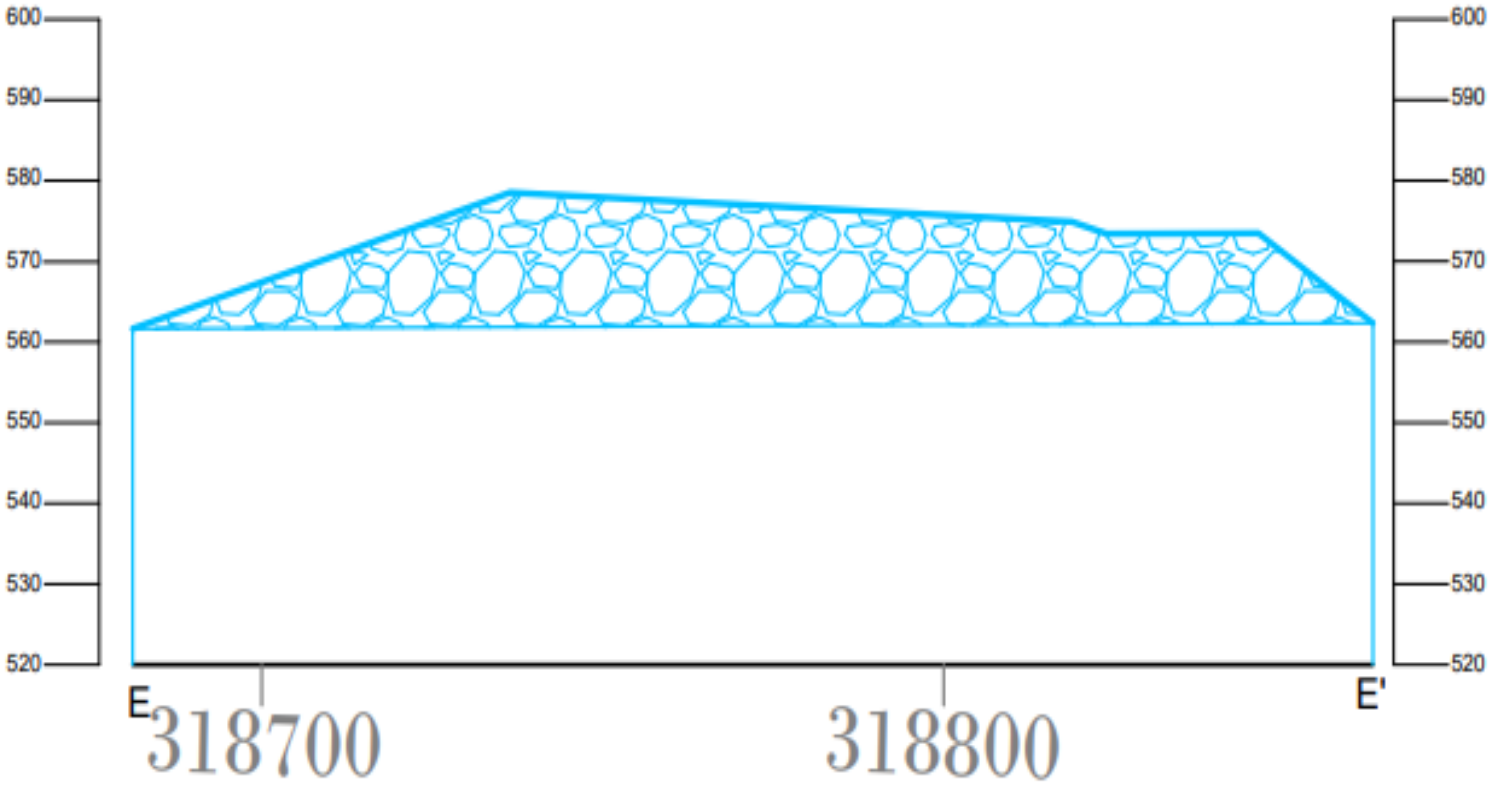


Figure 66: Quarry 3 dump section along E-E'

1.1 ANALYSIS 1

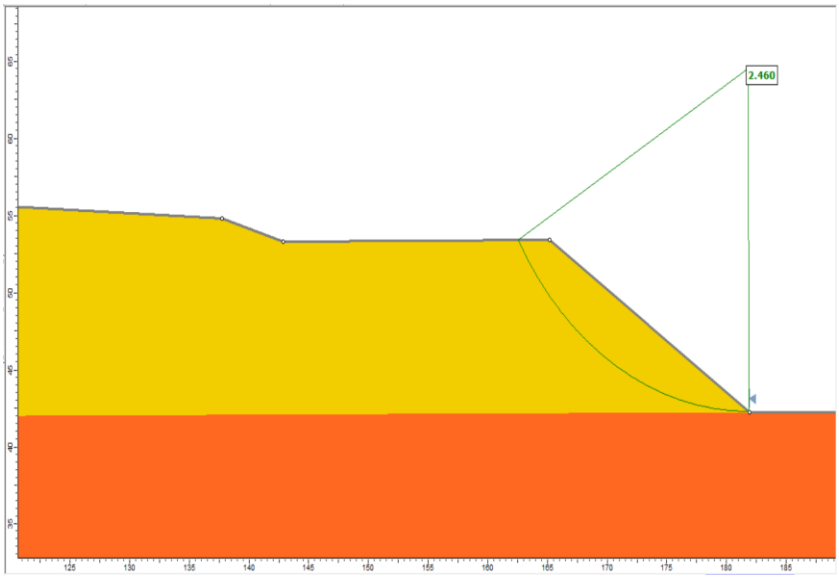


Figure 67: Slope stability analysis of the dump with FOS 2.460

1.2 ANALYSIS 2

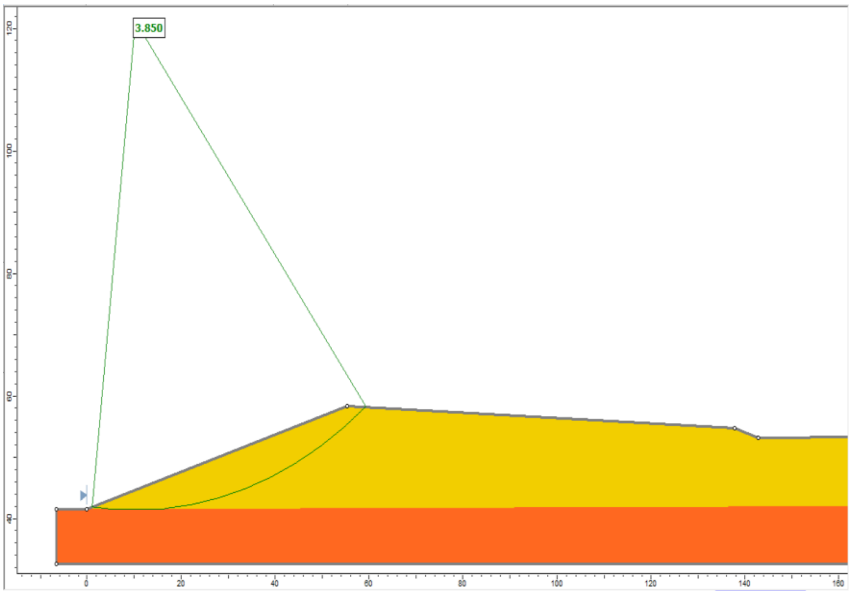


Figure 68: Slope stability analysis of the dump with FOS of 3.850

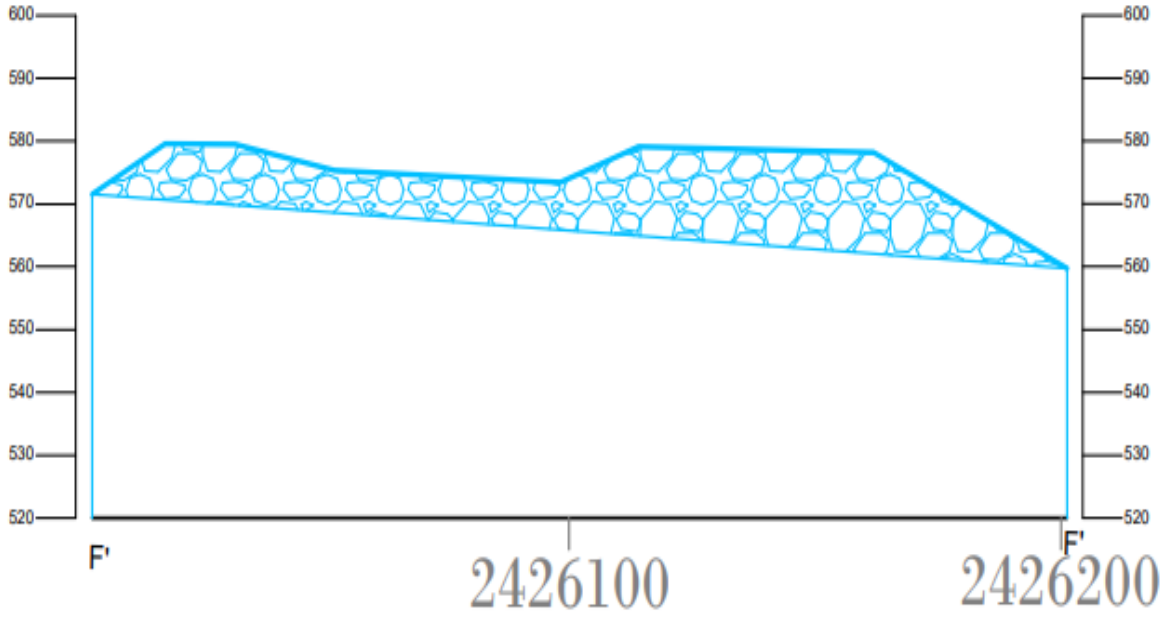


Figure 69: Quarry 3 dump section along F-F'

1.1 ANALYSIS 1

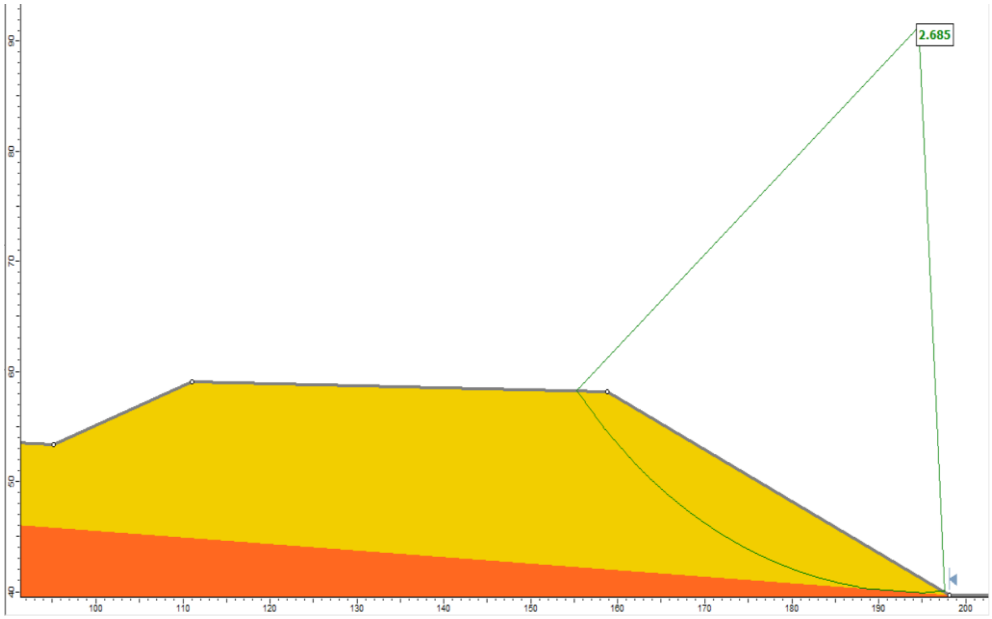


Figure 70: Slope stability analysis of the dump with FOS of 2.685

1.2 ANALYSIS 2

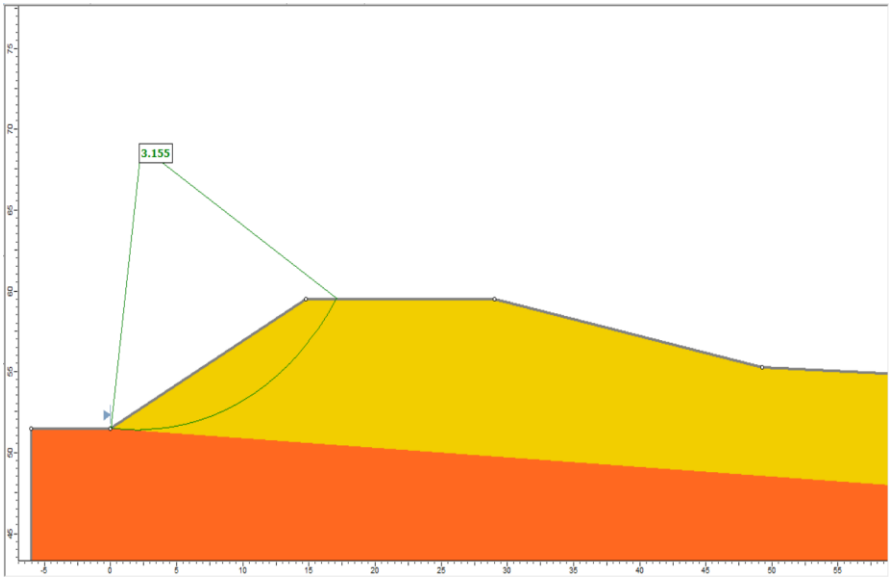


Figure 71: Slope stability analysis of the dump with FOS of 3.155

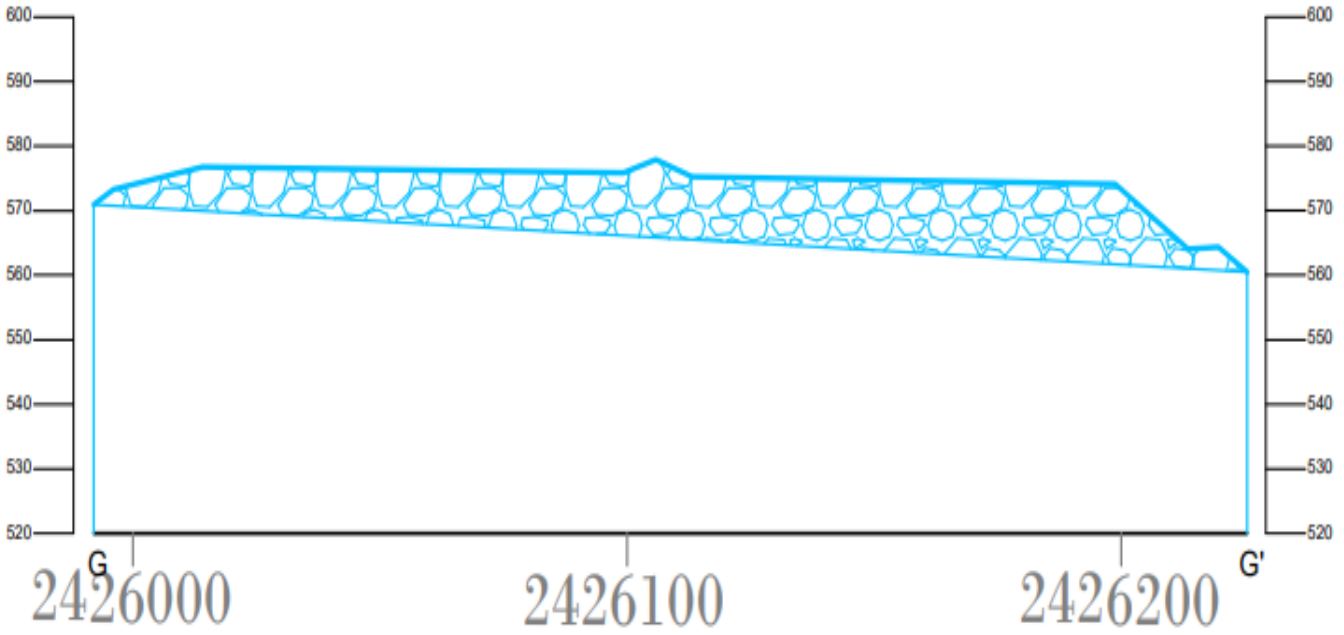


Figure 72: Quarry 3 dump section along G-G'

1.1 ANALYSIS 1

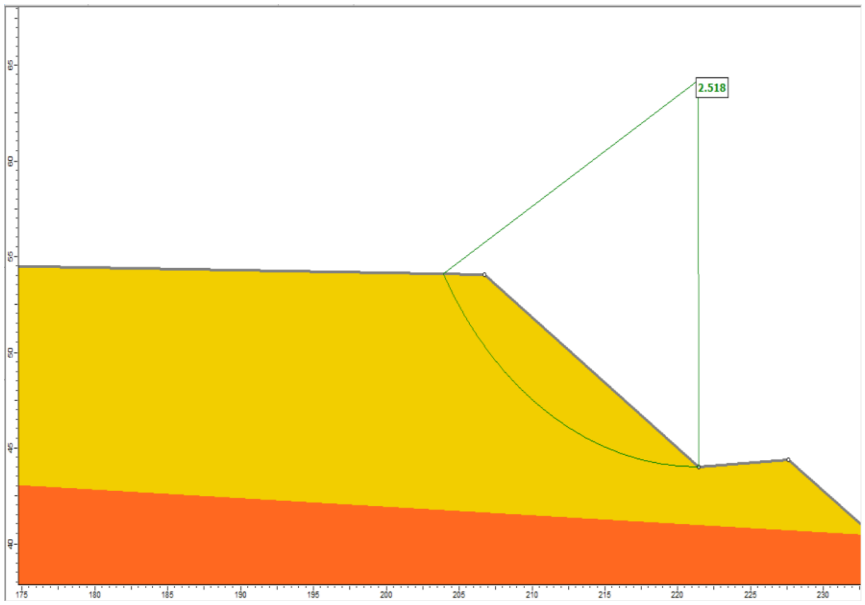


Figure 73: Slope stability analysis of the dump with FOS of 2.518

1.2 ANALYSIS 2

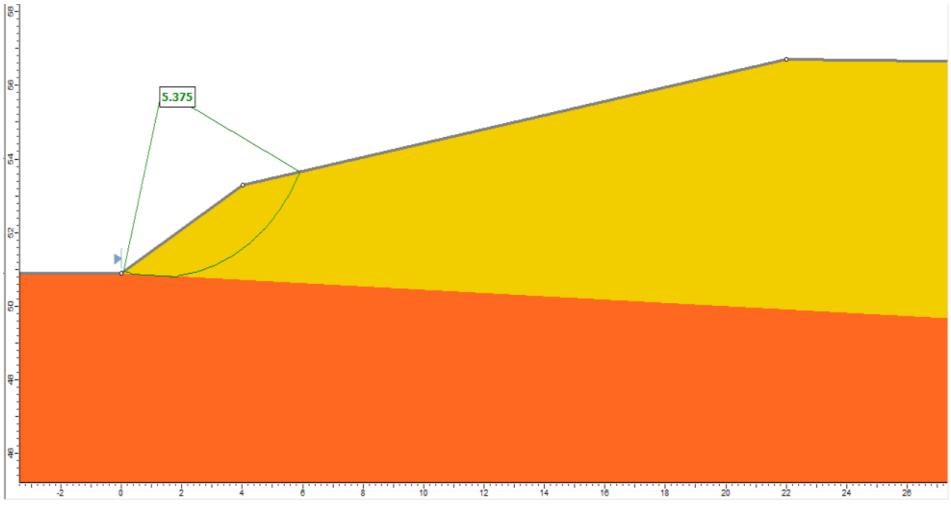


Figure 74: Slope stability analysis of the dump with FOS of 5.375

PIT ANALYSIS FOS TABLE

Section		FOS			
Northing	Easting	dry	figure	saturated	figure
2200	318400	1.669	2	1.413	3
	318500	2.982	4	2.589	5
	318600	2.251	6	1.579	7
2000	318250	5.252	9	3.683	10
	318350	3.320	11	3.090	12
	318500	1.564	13	1.449	14
1900	318400	2.854	16	1.395	17
1800	318050	10.140	19	6.605	20
	318300	1.887	21	1.419	22
RF quarry					
1400	318100	2.527	24	2.236	25
	318250	4.418	26	4.272	27
1300	318000	1.870	29	1.476	30
	318100	1.694	31	1.487	32
	318200	2.309	33	1.740	34
1200	317900	1.708	36	1.496	37
	318000	1.821	38	1.687	39
	318100	1.491	40	1.384	41
1100	317850	1.582	43	1.385	44
	318000	1.561	45	1.446	46
	318100	2.613	47	2.124	48
1000	317800	1.470	50	1.362	51
	318000	2.720	52	2.440	53

DUMP ANALYSIS FOS TABLE

Dump sections were analysed for both dry and saturated conditions. As observed in dump, safety factor in dry condition is more than that in saturated condition. Hence, for the dump the images of analysis with dry condition are not shown.

DUMP ANALYSIS				
Section	Analysis	Profile	FOS	Figure
MANGANESE QUARRY A-A'	1.1	Profile close to 317200	3.226	55
	1.2	Profile close to 317100	2.289	56
MANGANESE QUARRY B-B'	1.1	Profile close to 317300	3.071	58
	1.2	Profile close to 317200	2.792	59
MANGANESE QUARRY C-C'	1.1	Profile close to 2424800	2.447	61
	1.2	Profile close to 2424900	2.285	62
QUARRY 3 DUMP D-D'	1.1	Profile close to 318800	2.411	64
	1.2	Profile close to 318700	2.168	65
QUARRY 3 DUMP E-E'	1.1	Profile close to 318800	2.460	67
	1.2	Profile close to 318700	3.850	68
QUARRY 3 DUMP F-F'	1.1	Profile close to 2426200	2.685	70
	1.2	Profile close to 2426100	3.155	71
QUARRY 3 DUMP G-G'	1.1	Profile close to 2426200	2.518	73
	1.2	Profile close to 2426000	5.375	74

2.0 CONCLUSIONS AND RECOMMENDATIONS

A few analyses were carried out for singular strata type of soft material such as laterite, Iron ore +55% (Blue Dust), shale and Iron ore 45-55% (SLO) to estimate the bench height and bench slope for safety factor 1.3. The graphs show respective bench slopes at the corresponding bench heights. Analyses show all the quarry benches as well as dumps have safety factor more than 1.3 and hence are considered stable. The dump benches have slope angle less than the recommended angle of 37.5^0.

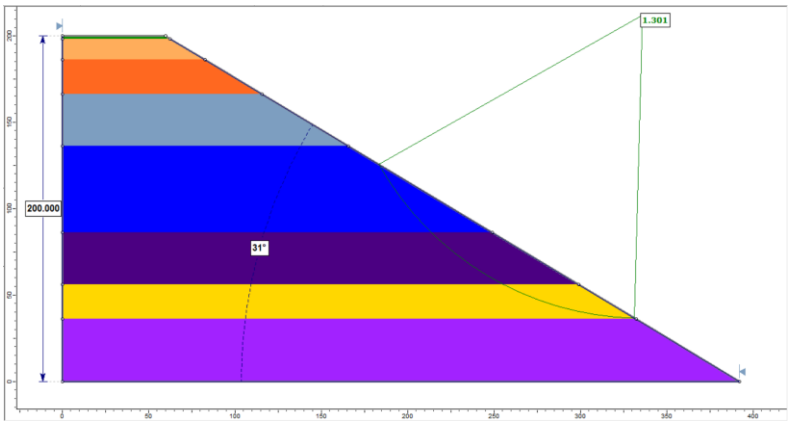
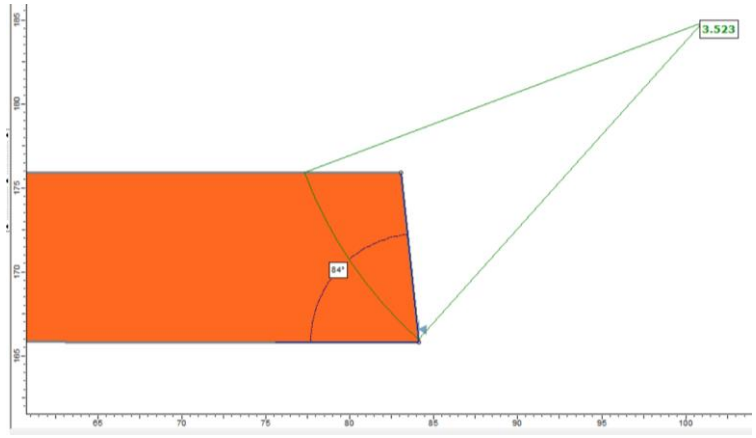
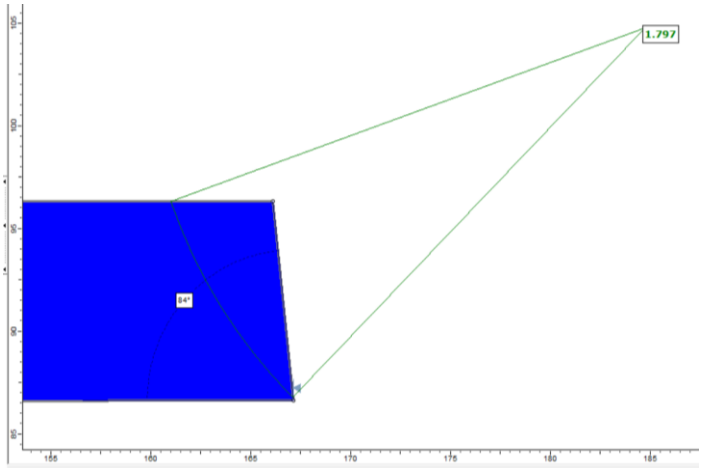


Figure: Overall Pit slope angle of 31^0 with FoS 1.301

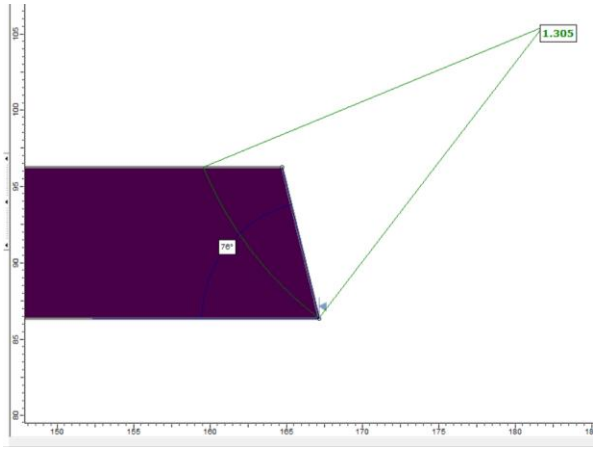
LATERITE



SLO



Blue dust



Shale

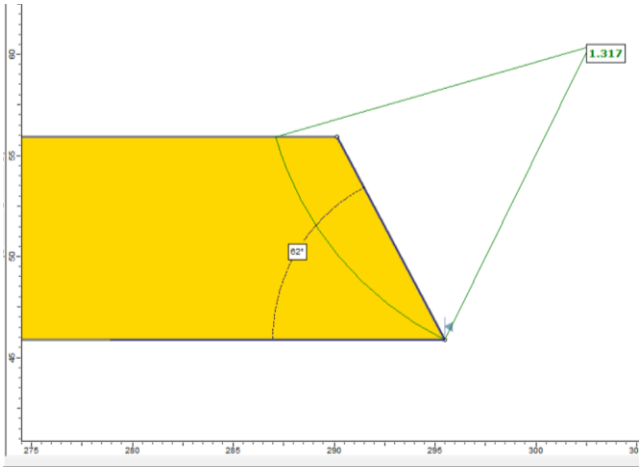


Table: Slope Angles for different heights and materials

Sl. No.	*Material Type*	*10 meters*	*9 meters*	*8 meters*
1	Laterite	84^0	$>84^0$	$>84^0$
2	SLO	84^0	$>84^0$	$>84^0$
3	Blue Dust	76^0	$>80^0$	$>80^0$
4	Shale	62^0	64^0	68^0
5	BHQ	$>80^0$	$>80^0$	$>80^0$
6	Lateritic Ore	$>80^0$	$>80^0$	$>80^0$
7	Hard Laminated Ore	$>80^0$	$>80^0$	$>80^0$

Analysis for Overburden Dump

The geotechnical parameters for dump materials for both the iron and manganese pits were very close and hence the average values were taken to predict the FoS of the overall layout and individual bench layout. DGMS guideline restricts the maximum over all height to 90m with maximum slope angle 37.5^0. The analysis shows that the FOS is 1.347. the corresponding FOS for 30m single bench is 1.371 (figures below).

90m Overall OB Section

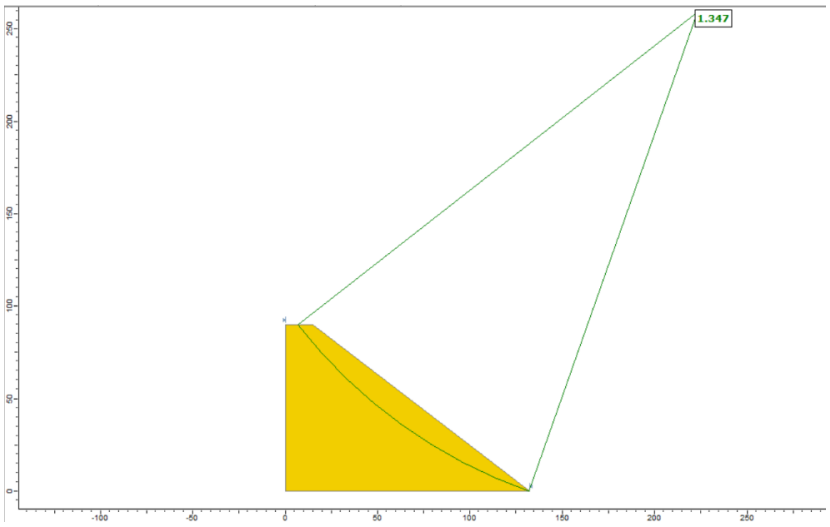


Figure 75: Total height 90m OB for angle 37.5^0 with FOS 1.347.

Single bench

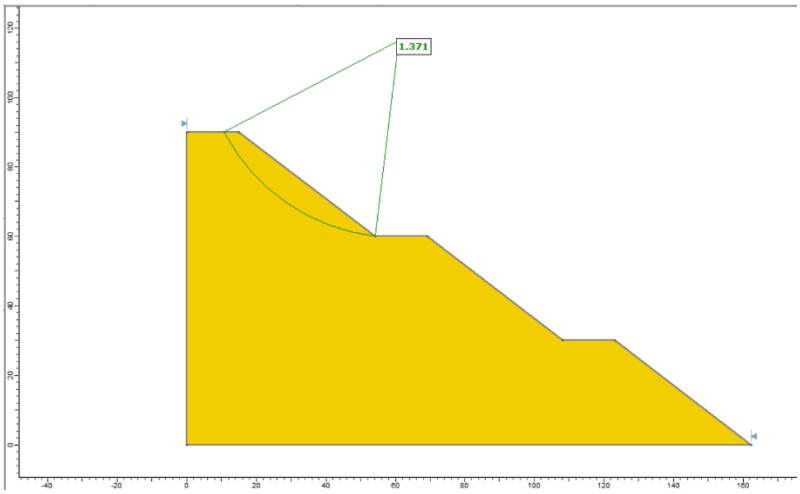


Figure 76: OB slope with 30m bench at angle 37.5^0 with FOS 1.371.

Precautionary Measures

Unanticipated movement on the ground can pose hazardous condition that may harm lives, equipment and properties. There are several ways to reduce chances of surface ground failure as (a) safe geotechnical design, (b) secondary support or rock fall catchment system, and (c) maintaining devices for advance warning of impending failure. Proper bench design can minimize rock fall hazards. Certain support system may enhance overall rock mass strength. The analysis shows that no large-scale failure is possible though localised bench failure cannot be ruled out. Those should be arrested by lower benches and hence access of machineries should be maintained.

Drainage and Water Management

Rainwater plays a adverse role in mine slope stability. So, care should be made to avoid entry of rainwater in the slope. So, suitable drainage facility should be made in and around the mine and waste dump. Drains should be properly maintained. Drain channels should be inspected regularly to keep the path free from debruises. Effectiveness of drainage may be maintained by piezometers and other instruments to check the functioning.

Rainwater should not be allowed to accumulate or left unattended. Effective garland drain should be provided around pit and waste dumps. Maintaining a proper gradient should help in quick run off of water. Surface run off and sub surface water adds to instability. Grasses have very high binding capacity and help in long term stabilisation. It also helps in reducing the water pressure due to evapo-transmission.

Water management

Rainwater of the adjacent areas should not be allowed to enter the mine pit. It would cause erosion and deep gullies. So, rainwater catchment area should be channelled away to other areas. The upper surface of the mine and dump should be adequately graded to divert he run off of rainwater away. Therefore, proper levelling and grading of surface should be carried out. Regular and continuous maintaining should be done to check the flow path of rainwater and to

take immediate remedial measures. Rainwater in the dump should be channel down effectively through effective toe drain arrangement. Subsurface drainage system or sub drains should remove subsurface water directly from an unstable slope, to redirect adjacent ground water sources away and to reduce hydrostatic pressure.

Stability of Benches

Pit walls often experience vibration due to poor blasting operations. Uncontrolled blasting results in over brakes, widening of existing cracks/joints, creation of fresh cracks etc. Those become critical to the stability of pit slopes. Therefore, a properly designed and controlled blasting should be carried out. Controlled blasting with closely spaced or carefully designed drill holes, properly selected explosives, and sequential detonation should be adopted. The control blasting can be achieved by broadly by (i) using an explosive with a relatively low detonation velocity, and (ii) maintaining air gap between the explosive and the wall of drill hole. The mine authority is recommended to go for scientific study for this.

Slope Monitoring

Three general principles of slope geo-mechanics that govern slope stability are (Kliché, 1999)

a. Slope failures do not occur spontaneously.
b. Most slope failures tend towards equilibrium.
c. A slope failure does not occur without warning.

The slope should be regularly monitored to observe any instability in advance to avoid any damage to men and machineries. The instability if detected at early stage can be addressed by adopting suitable remedial measure. In general, slope stabilisation involves continuous monitoring of the slopes to detect any movement. The guidelines given in the gazette of Indian extraordinary part –II, section 3, Subsection-1, New Delhi Feb 21, 2020 for mine workings should be followed. There should be a team of dedicated skilled persons with proper training for slope

monitoring exercises. Slope stabilisation schemes as grading, serrating, benching, arresting rock falls, and other measures should be adopted. Slope monitoring mechanism varies widely from a simple visual observation of signs of instability to use of state of art instrumentation. Regular surveying of other benches and their movement both horizontal and vertical can be carried out to determine potential instability. Determination of simple displacement by tension cracks mapping, extensometers and survey points are some of the cost-effective monitoring methods. Typically, all these methods should be adopted as no single method represent the whole behaviour accurately. Systematic mapping of tension cracks shows geometry of the failure more effectively. All cracks should be mapped regardless of apparent cause. The end of the cracks should be flagged or marked so that new cracks or extensions of existing cracks can be identified. Portable wire extensometers provide monitoring in areas of active instability across tension cracks. The extensometers should be positioned on stable ground behind the last visible tension crack and the wire should extend to the unstable area. Anyone working in the area can check on slope movement by inspecting the instruments. The monitoring of prism targets with the total station provides detailed movement history for displacement and rates in the unstable areas.

Monitoring Schedule

A well designed and developed monitoring schedule should be established. Frequency of monitoring depends on precision, rate of movement and how critical the area is. If there is heavy rain or a large blast in the area, additional measurement should be made. Mines should attempt to establish measurement of surface movement through survey network. The network should consist of target areas/locations/sections (e.g. prism shape) placed on and around area of anticipated instability on slopes and one or more non-moving contact points for survey stations. The angles and distances from the survey stations to the locations/areas/sections should be measured on regular basis to establish history of movement on slope. The permanent control points for the survey stations should be placed on stable ground.

Tension Cracks

The formation of cracks at the top of a slope, specifically on dump sections exhibits the sign of instability. The measurement and monitoring of the changes to crack width and its direction of propagation establish the extent of the unstable area. Existing cracks may be identified with clear identification so that new cracks can be easily identified.

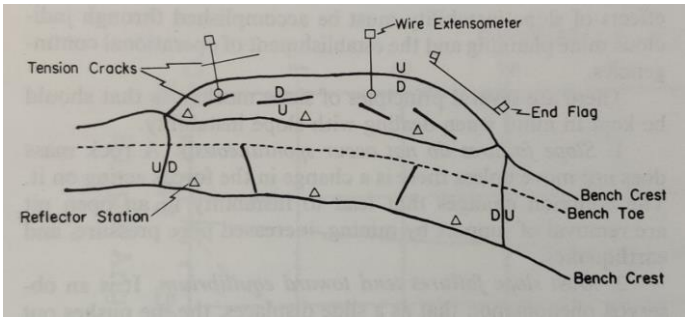


Figure 75: Methodology to measure tension crack (after Call, 1982)

Measurements of tension cracks can be carried out simply by driving two stakes or either side of it and measuring its separation over time. Portable wireline extensometer is another method of monitoring tension crack behaviour.

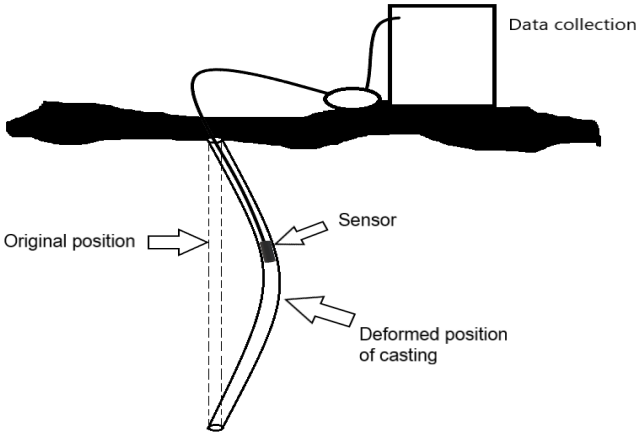


Figure 76: Cross-sectional schematic of typical traverse-probe inclinometer system

Inclinometer is another equipment to monitor ground movement specifically in horizontal direction (fig 16, pp). The end of the casing is fixed to a stable part. The groves has sensing units and the deflection of casing reflects the movement of rock mass. Inclinometers provide information on

- Location of shear zones
- Natures of shear along the zone plan rotational.

- Measurement along shear zones and predict its rate i.e. constant, accelerating or decelerating

Borehole extensometer is another technique to monitor slope movement. It consists of tensioned rods anchored at varying points in the borehole (Fig 18). Changes in the distance between the anchor and the rod head give the movement information for rock mass.

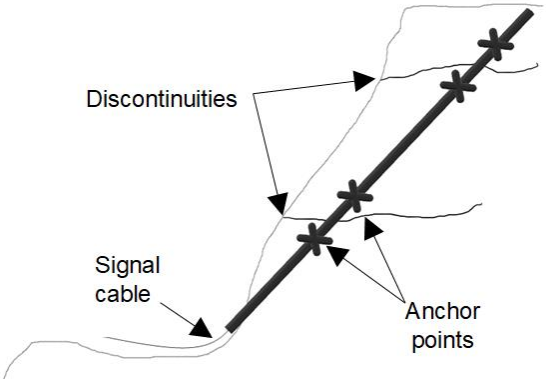


Figure 77: Multi-point borehole extensometer

TDR (Time Domain Reflectometry) is a recent approach that uses electronic pulses through coaxial cable. Signal at the deformation or break in cable position gives information on the subsurface rock mass behaviour.

Piezometers

The effectiveness of mine dewatering schemes and the effects of seasonal variations can be determined by piezometers. Excessive pore pressure, water infiltration in particular at geological boundaries cause slope failures. So, data on water pressure development should be maintained regularly. Highwalls and other potential faces should be examined regularly for new seeps or changes in water flow rate.

Stress, gravity loading, rock mass strength, geology, pore pressure as well as many other factors contribute to slope failure. Complete attention to monitor each and every potential failure block is neither feasible not economical and often not attainable with conventional point displacement monitoring techniques. As mining activities progress, it becomes important to monitor different

sections of the pit walls. So, frequent relocation of survey devices can be challenging. A recent advancement that is being experimented with success is synthetic aperture radar (SAR). It can generate high quality digital elevation maps (DEMs) and detect disturbances of earth's surfaces. There are a few variations of the same that are being developed that can take continuous images in almost all weather and time conditions. Those may be explored by the mine management.

3.0 Additional Recommendations

The following additional recommendations are made with reference to the slope stability investigation carried for Narayanposhi iron and manganese ore mine.

1. There is no challenge due to ground water at the mine. However, steps are recommended to have an effective garland drain/bund all around to collect/divert run off rainwater of the catchment area before it reaches the mine slopes. The drains should be kept clear of silt and debris.

2. There should be regular mapping of the weak zones, faults, and bedding planes of the pit by geologist and data should be used for further analysis of slope stability for different geo-mining condition. It will facilitate to detect any unfavorable conditions at different stages of mining.

3. Mining and excavation activities change the physical dimension of the system. So regular scientific study should be carried out for safety factor analysis of the pit as well as dump sections, say every 5 to 6 years or if significant alteration of system happens, or change in geological structural features is observed.

4. Mine management should make a dedicated team of trained and competent persons for slope monitoring with clearly defined duties and responsibilities. The monitoring should be done periodically at least once a month and the results of the monitoring should be recorded. The monitoring data should be regularly analyzed to predict the slope movement or instability well in advance. In case of need, help/advice may be sought from expert agencies in the field of slope stability and slope monitoring.

5. During rainy season, an officer should be deputed for regular visual observation in and around the mine and dump to see that rain water is not accumulating at any point except sump. The

effectiveness of drains should also be visually ascertained. If any blockage is observed, immediately steps should be taken to make it effective. If any tension crack is detected in the pit/dump, the entry of water inside the crack should be checked.

6. Mine management should explore construction of a dedicated barricades of adequate strength and dimensions between the lease boundary and nearby settlements so that the debris or rolling fragments are arrested by the barricades.

References

1. Hoek, E and Brown, E.T., 1997, Practical Estimate of Rock Mass Strength, Int. Journal of Rock Mechanics and Mining Sciences, Vol 34, No 2, pp 203-215
2. Hoek, E., Carranza-Torres, C.T., and Corkum, B., 2002, Hoek-brown Failure Criterion-2002 Edition, Proceedings, 5th North American Rock Mechanics Symposium, Toronto, Canada, Vol 1, pp 267-273
3. Shivakugan, N, S K Shukla and B M Das; 2013; "Rock Mechanics: An Introduction", Taylor and Francis Group, CRC Press, ISBN 978-0-415-80923-8; pp 115-241
4. Hoek, E. and J.W. Bray, 1977, Rock Slope Engineering, Institution of Mining and Metallurgy, London, pp 309
5. The Metalliferous Mines Regulations [MMR] 2019, vide The Gazette of India, CG-DL-E-27022020-216432, Extraordinary, PART II—Section 3—Sub-section (i), pp 180-184
6. Indian Standard Method for Determination of Tensile Strength by Indirect Tests on Rock Specimen, IS 10082-1981, pp 12
7. Indian Standard Method of Test for laboratory Determination of Water Content, Porosity, Density and related properties of Rock Material, IS 13030-1991
8. Indian Standard Method of Test for the determination of Unconfined Compressive Strength of Rock Material, IS 9143-1979
9. Indian Standard Method of Test for the determination of Strength of Rock Materials in Triaxial Compression, IS 13047-1991
10. Call, R.D., 1982, "Monitoring Pit Slope behaviour", Proceedings 3rd International Conference on Stability in Surface Mining, SME-AIME, New York, pp 229-248
11. Kliche, C. A., 1999, Rock Slope Stability, Publ: SMME Inc., CO, USA, pp 252
12. Wyllie, D. C., and Mah, C. W., (2004). Rock Slope Engineering. Spon Press, London and New York

Ref No 3: As per the aforementioned recommended FOS criteria (p192)

where F_r is the total force available to resist the sliding of the rock block and F_i is the total force tending to induce sliding. For a slope on the point of failure, a condition of limiting equilibrium exists in which $F_r = F_i$, and thus FS = 1. For stable slopes, $F_r > F_i$, and therefore FS > 1. In practice, rock slopes with FS = 1.3 to 1.5 are considered to be stable; the lower value is taken for temporary slopes such as mine slopes, whereas the higher value is considered for permanent slopes such as slopes adjacent to road pavements and railway tracks.

6.3.2 Plane failure

Figure 6.3 shows a rock slope of height H inclined to the horizontal at an angle i. The sliding rock block $A_1A_2A_3$ is separated by the joint/bedding/failure plane A_2A_3, which is inclined to the horizontal at an angle θ. A_1A_3 $(= B)$ is the top width of the sliding rock block, and W is its weight. The stability of the rock block $A_1A_2A_3$ is analysed as a two-dimensional limit equilibrium problem, considering a slice of unit thickness through the slope. Only the force equilibrium is considered, neglecting any resistance to sliding at the lateral boundaries of the sliding block. The joint/bedding plane material is assumed to be a c–ϕ soil material, with c and ϕ as cohesion and angle of internal friction (also called angle of shearing resistance), respectively, obeying the Mohr–Coulomb failure criterion.

The total force available to resist the sliding block is

$$F_r = sA \tag{6.2}$$

where s is the shear strength of the sliding failure plane, and A is the area of the base A_2A_3 of the sliding rock block. It is given as

$$A = \frac{H}{\sin\theta} \tag{6.3}$$

The top width B is calculated as

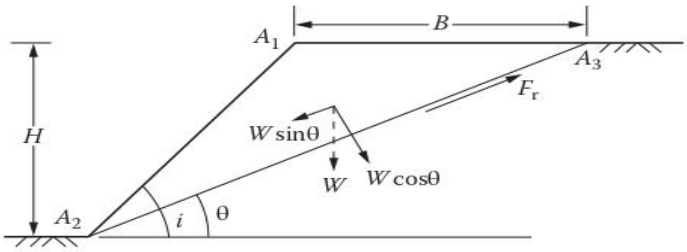


Figure 6.3 A rock slope in plane failure.

ANNEXURE XXVII

JSW Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

No. JSW/S/CO/2025/292 Date:30/06/2025

To,
The Member Secretary,
State Pollution Control Board, Odisha
Paribesh Bhawan, A/118, Nilakantha Nagar,
Unit-8, Bhubaneswar, Odisha-751012.

Sub: - Submission of Hazardous Waste Annual Return (Form 4) in respect of Narayanposhi Iron & Manganese Ore Mine **of M/s JSW Steel Ltd for the period** April 2024 to March 2025.

Dear Sir,

We have obtained the Hazardous Waste Authorization vide letter number **IND-IV-HW-1349/11182** dated 23.07.2024 and valid upto 31.03.2026.

We are submitting herewith annual return of Hazardous Waste in Form 4 for Narayanposhi Iron & Manganese Ore Mine, M/s JSW Steel Ltd. for the period of April 2024 to March 2025.

Seeking your co-operation as always.

Thanking you, Yours

Faithfully
For JSW Steel Ltd

Vijay Kumar 30/06/2025

Vijay Kumar
(Authorized Signatory)

Copy to: The Regional Officer, Regional Office, Rourkela Office of the State Pollution Control Board, At- Near Panposh Hockey Chowk, AT/PO. - Panposh, Rourkela – 769 004, Dist – Sundargarh, Odisha.

FORM 4

[See rules 6(5), 13(8), 16(6) and 20(2)]

FORM FOR FILING ANNUAL RETURNS

[To be submitted to State Pollution Control Board by 30th day of June of every year for the preceding period April-2024 to March-2025]

1. Name and address of facility : M/s JSW Steel Ltd
Narayanposhi Iron and Manganese Ore Mine in villages Harischandrapur, Koira, Kashira, Kusumdihi and Kathamala RF villages under Koira tehsil of Sundergarh district, Odisha state

Authorization No. and Date of issue : HWA No L.No. **IND-IV-HW- 1349/11182** dated 23.07.2024 and valid upto 31.03.2026.

2. Name of the authorised person and full address
With telephone, fax number and e-mail : Mr. Vijay Kumar
HOD - EHS
JSW Steel Ltd,
Tehsil-Barbil,
District - Keonjhar (Odisha) Pin: 758035
Email: vijay.kumar6@jsw.in
Mobile: +91 9177633349

Production during the year (product wise), Wherever applicable : **4557768** Mt Iron Ore (ROM) & Mn Production 553.902 Mt

Part A. To be filled by hazardous waste generators

1. Total quantity of waste generated category wise : **As per Annexure - I**

2. Quantity dispatched
(i) to disposal facility :
(ii) to recycler or co-processors or pre-processor : **As per Annexure - I**

(iii) others :

3. Quantity utilised in-house, if any - : Nil

4. Quantity in storage at the end of the year – : **As per Annexure - I**

Part B. To be filled by Treatment, storage and disposal facility operators

1. Total quantity received - : **Not Applicable**

2. Quantity in stock at the beginning of the year -

3. Quantity treated –

4. Quantity disposed in landfills as such and after treatment –

5. Quantity incinerated (if applicable) – **Not Applicable**

6. Quantity processed other than specified above - **Not Applicable**

7. Quantity in storage at the end of the year –

Part C. To be filled by recyclers or co-processors or other users

1. Quantity of waste received during the year – **Not Applicable**
(i) domestic sources
(ii) imported (if applicable)- **Not Applicable**

2. Quantity in stock at the beginning of the year -

3. Quantity recycled or co-processed or used –

4. Quantity of products dispatched (wherever applicable) – **Not Applicable**

5. Quantity of waste generated - **Not Applicable**

6. Quantity of waste disposed - **Not Applicable**

7. Quantity re-exported (wherever applicable)- **Not Applicable**

8. Quantity in storage at the end of the year – **Not Applicable**

Date: 30.06.2025

Place: Narayanposhi Iron and Manganese Ore Mine

Part A. To be filled by hazardous waste generators

Annexure-1

S.N.	Type of Hazardous Waste	Category		Unit	Approved Quantity as per CCA *	Total Qty. of generated category wise in FY 24-25	Quantity dispatched			Quantity utilized in house	Quantity in storage at the end of year	Description of treatment
		Sch	Code				To disposal facility	To recyclers / co-processors or pre-processor	Other			
1	Used or spent oil*	I	5.1	T/A	50	50.9	0	25.1	0	0	25.8	Sold to registered recycler
2	Wastes or residues containing oil	I	5.2	T/A	20	1.05	0	1	0	0	0.05	Sold to registered recycler
3	Empty barrels/contain ers/liners contaminated with hazardous chemicals /wastes	I	33.1	T/A	20	5.107	0	0	0	0	5.107	Stored

*As per Hazardous Waste Authorization

ANNEXURE XXVIII

6F
03.8.23

JSW ted
Regd.Office:JSWCentreB
andraKurlaComplex,
Bandra(East),Mumbai-400051
CIN :L27102MH1994PLC152925
Phone :+912242861000
Fax :+912242863000
Website:

No.JSW/S/CO/2023/457

Date: 03/08/2023

OFFICE OF THE DIVISIONAL FOREST OFFICER BONAI DIVISION
Receipt No. 7840
Dtd. 03.08.23

To,
TheDivisionalForestOfficer,
Bonai Division, Dept. of Forest &
Environment.At. /P.O.Bonai,
Dist.Sundargarh,Odisha.

Sub:-Requestforfinancial details of compensatory afforestation &progress so far in respect of NarayanposhiIron& Manganese OreMines ofM/s.JSW SteelLimited(erstwhile lesseeM/s. AMTCPvt. Ltd.),At Narayanposhi,Koira, Dist.Sundargarh.

Ref: - Approved Environment Clearance vide letter no J-11015/288/2008-IA.II(M) by MoEF&CC, (GoI), dated 18th June 2019 to M/S AMTC Pvt Ltd.

DearSir,

With reference to aforesaid subject, it is to request for obtaining all financial expenditure details with respect to compensatory afforestation &progress till time for**Narayanposhi Iron & ManganeseOre Mines of M/s. JSW Steel Limited** (erstwhile lessee M/s. AMTC(P) Ltd.), At Narayanposhi,VillageKasira,Koira, Dist. Sundargarh. Odisha.

Financial outlay for activities in project area given Rs.27,43,000 for Compensatory afforestation (Rs. 20,84,000 through DDNo 095664 Dtd 14.06.2006 &Rs. 6,59,000 DDNo239093 Dtd 13.06.2007and Rs.16,82,000 as Penal Compensatory afforestation (Rs. 15,84,000 DD No 004561 Dtd 31.03.2001 &Rs. 98,000 DDNo 121818 Dtd 16.06.2001.

Expenditure detail and implementation certificate is requested to fulfill the compliance of given specific condition number 22 of Environmental clearance as referred, for which weshallremaingrateful toyou.

Yourssincerely,

For**JSWSteelLimited**

Mrutyunjaya Mahapatro

MrutyunjayaMahapatro
(AuthorizedSignatory)

ANNEXURE XXIX

JSW Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

No. JSW/SSWCP/2023/333 Date: 14/06/2023

To,
The Divisional Forest Officer,
Bonai Division, Dept. of Forest & Environment.
At./P.O. Bonai, Dist. Sundargarh, Odisha.

Sub: - Request for the issuance of implementation certificate of approved Site-specific wildlife conservation plan (SSWCP) for Narayanposhi Iron & Manganese Ore Mines of M/s. JSW Steel Limited (erstwhile lessee M/s. AMTC Pvt. Ltd.), At Narayanposhi, Koira, Dist. Sundargarh.

Ref: - Approval of Site-Specific Wildlife Conservation Plan vide letter no: 1WL-C-SSP-260/2010 / Memo no 6257, dated 04.09.2010 by PCCF(Wildlife) and Chief Wild Life Warden, Odisha.

Dear Sir,

With reference to aforesaid subject, it is to request for the issuance of implementation certificate of approved Site-specific wildlife conservation plan (SSWCP) for **Narayanposhi Iron & Manganese Ore Mines of M/s. JSW Steel Limited** (erstwhile lessee M/s. AMTC(P) Ltd.), At Narayanposhi, Village Kasira, Koira, Dist. Sundargarh.

Financial outlay for activities in project area given Rs. 92.0 lakhs and for activities in project impact area given Rs. 196.0 lakh; in total it was laid for Rs. 288.0 lakhs were submitted. The amount was deposited vide DD No. 045122 (by HDFC BANK), dated 10th Sept 2010 at office of DFO, Bonai through MS-CAMPA account to undertake activities both inside the project area & project impact area.

Implementation certificate is requested to fulfill the compliance of given EC condition, for which we shall remain grateful to you.

Thanking you
Yours sincerely,

For JSW Steel Limited

Mrutyunjaya Mahapatro

Mrutyunjaya Mahapatro

(Authorized Signatory)

Annexure: XII-A

ANNEXURE XXX

VETIVER GRASS PLANTATION





ANNEXURE XXXI

Seeking information regarding implementation status of approved SSWLCP for Narayanposhi Iron & Manganese Mines

1 message

Rajgopal Patra <rajgopal.patra@jsw.in> Thu, 29 Feb, 2024 at 10:21 am
To: dfo.bonai@odisha.gov.in
Bcc: Suresh Mohapatra <suresh.mohapatra@jsw.in>

Dear Sir,

In continuation to our earlier mail dated 15th June 2023, with our letter no JSW/SSWLCP/2023/333 which is enclosed here with , we would like to bring to your kind attention that it is required to submit the Implementation Status of SSWLCP as approved vide letter no 1WL-C-SSP-260/2010/ Memo no 6257 dated 04/09/2010 by PCCF (Wildlife) and Chief Wildlife warden , Orissa for Narayanposhi Iron & Manganese Mine against which an amount of Rs 288 Lakh was remitted to CAMPA against the demand raised by your good office.

In this regard once again we seek information
regarding status of SSWLCP for onward submission to MoEF & CC as part of compliance of Environment clearance condition.

Your early reply will be highly appreciated.

Regards.
RG Patra

On Thu, 15 Jun, 2023, 3:13 pm Rajgopal Patra, <rajgopal.patra@jsw.in> wrote:

> Sir,
> Please find attachettached request for issuance of implementation certificate of approved Site-specific wildlife conservation plan (SSWCP) for Gonua Iron & Manganese Ore Mines & Narayanposhi Mines
>
> Regards
> Raj Gopal Patra

ANNEXURE XXXII

6F

SITE SPECIFIC CONSERVATION PLAN FOR NARAYANPOSI IRON & MANGANESE ORE MINES OF SUNDARGARH DISTRICT OF ORISSA

OF

M/s. ARYAN MINING AND TRADING CORPORATION (P) LIMITED

By

Sri S.K. Mishra, IFS (Retd.)

&

Sri S.K. Mohanty, OFS (Retd.)

App. copy

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EXECUTIVE SUMMARY

0.1.1. Narayanposi Manganese and Iron Ore Mines held by M/s. AMTC (Pvt.) Limited since 1945 is located in Koira and Kasira villages in Sundargarh district and lies 2 km NW of Koira.

0.1.2. The lease area of 349.263 Ha includes forest area of 259.191 Ha with Kathmala R.F. over 92.113 Ha, Kathmala PRF over 96.977 Ha and Khesra forests of 70.101 Ha.

0.1.3. Final forest diversion over 244.327 Ha (including virgin forest land over 184.591 Ha) has been approved by MoEF under Sec.2 of F.C. Act, 1980 vide their F.No. 884/2000-FC (Vol.I) dt.15.11.2007.

0.1.4. The mine is in 3rd renewal stage from 03.02.2005 to 02.02.2025.

0.1.5. Mining plan for 7 years (2003-04 to 2009-10) has been approved by IBM vide their No. BBS/SG/Fe & Mn/MP-193 dt.20.05.2004 and progressive mine closure plan approved on 26.05.2005.

0.1.6. Environmental Clearance has been issued vide MoEF No. J-11015/388/2005-IA.II(M) dt.28.03.2007 for production of iron ore & manganese ore upto 0.6 mtpa and 0.0078 mtpa respectively.

0.1.7. A modified mining plan has been prepared from 2008-09 to 2009-10 for enhanced production of iron and manganese ore from 0.6 to 3 mtpa and 0.0078 to 0.36 mtpa respectively.

0.1.8. As per the revised plan as on 29.04.2010, mineable reserve of iron & Manganese ore are 67,776,800t and 254,592t respectively. The corresponding mine life is 23 and 8 years respectively.

0.1.9. Environmental Clearance for the enhanced production has been applied for.

0.2.1 The terrain is undulating from 545-640m from MSL. Two small dry nalas originate from the area.

0.2.2 The entire mining operation is open cast, semi mechanized with wet crushers at site.

0.2.3 There are 16 small iron ore quarries and 11 small trial pits for Mn Ore. Active quarries are Q1 (top), Q3, 3A, Q6, 6A, 6B, 6C for iron ore and Q5 (Mn Ore). The latter is under temporary suspension. All

pits will merge with each other as the mining proceeds. There are 11 dumps but only 1 active now.

0.2.4 Iron & Mn Ore raised from the mine is supplied to various iron & steel plants, sponge iron units and also exported.

0.3.1 The mine area does not form a part of any P.A. or any declared conservation unit nor there any such unit within the BZ. There is no recognized elephant corridor between viable populations within the BZ.

0.3.2 The vegetation of core zone is scattered trees and patchy forests of sapling/pole crop of dry peninsular sal. Fauna is represented by squirrel, rat, mongoose and crow.

0.3.3 The vegetation of BZ is mostly moist peninsular high level sal with Shorea-Xylia-Terminalia-Schleichera association. Bambusa bambos is found in valley bottoms & nala banks. Faunal components include langur, macaque, spotted deer, barking deer, hyena, jackal and Schedule-I fauna like Elephant, Sloth bear, Python and Pea fowl. The status of Schedule I fauna is not known precisely.

0.4.1 The perceived impacts of mining are habitat loss, dust pollution, noise, light & water pollution, soil erosion, accidental fall of animals, dearth of water, ground fire, garbage generation in core area.

0.4.2 The perceived impacts in buffer zone are loss of habitat quality, fragmentation, loss of biodiversity, depredation of wild animals, forest fire, disturbance and accidents due to road traffic, poaching, unauthorized mining, conflict over forest resources etc.

0.5.1 In order to minimize the impacts stated above, plantation of species qualifying elephant habitat on O.B. dumps, reclaimed area, protection of plantations by engaging Van Sahayaks, fixing coir geo textile, grass seeding, pollution control measures, HDPE tanks (2) for small animals & birds, solar powered fencing, fire prevention incentive, garbage disposal and promotion of awareness among mine workers & transporters have been suggested for M.L. area.

0.5.2 For the BZ, assisted natural regeneration, game tanks, check dams of random rubble on upper catchments of nalas for soil and

moisture conservation, salt licks, baseline studies and monitoring of biodiversity, engagement of trackers to collect data on elephant movement and as part of anti-depredation squad, equipments, corpus fund, fire line maintenance, fire prevention incentive to VSS, check gates and remuneration to watchers, provision of alternative livelihood to 200 beneficiaries after due training, awareness promotion amongst school students & villagers and digited maps and cover assessment of buffer zone has been provided for.

0.5.3 The plan is for 10 years from 2010-11 to 2019-20. The implementation will be planned and monitored by a committee under the chairmanship of DFO Bonai Division with representative of mine owner, 2 VSS Presidents, a NGO, R.O. Koira, a mine worker as members.

0.6.1 The cost of the plan is Rs.302.00 lakhs; Rs.138.00 lakhs for the M.L. area and Rs.144.00 lakhs for the buffer zone. In addition, the lease will provide a vehicle, wages of a driver and 100 litres HSD per month, which comes to Rs.20.00 lakhs.

CHAPTER-I
INTRODUCTION

1.0.1 **Lease Grant Order:** The lease for Narayanposi Manganese ore mines in Village Koira & Kairs of Bonai tahasil in Sundergarh District was originally granted by the Ex-State Rulers of Bonai in favour of M/s. AMTC (P) Limited for a period of 20 years with effect from 03.02.1945 to 02.02.1965for 839.24 acres or 349.263 Ha. The first renewal was granted by the Govt. of Orissa, Mining & Geology Dept. for a period of 20 years from 03.02.1965 to 02.02.1985. However, Govt. in Mining & Geology Department vide their letter No.III(B)-MG_AA/77-4824 Dt.19.05.1978 conveyed their approval to the inclusion of Iron ore in the renewal of Mining lease for Manganese ore over 349.263 Ha. In villages Koira and Kasira in Bonai Tahasil to be co-terminus with the existing lease for Manganese ore already held by the lessee. The 2nd RML of this lease was granted for another 20 years w.e.f. 03.02.1985 to 02.02.2005 vide Mining & Geology Dept. letter No. 12413/III(B)MG/12/85/MG dt.16.11.1985 and the lease deed was executed on 15.0 1.1986. So, this lease has been granted over 349.263 ha of area out of which 259.191 ha is forest land.

1.0.2 **Lease area:** The total lease area is 349.263 ha which includes 259.191 ha of forest area and 90.072 ha of non-forest land.

1.0.3 **Details of forest land:** The forest land of 259.191 ha comprises of 92.113 ha of Kathmal R.F., 96.977 ha in Kathmal P.R.F. and 70.101 ha of Khasra Forest.

1.0.4 **Diversion of forest land:** Out of the total lease area, the lessee vide his application Dt.09.091997 had applied for diversion of 244.327 ha (59.736 ha of broken forest land and 184.591 ha of virgin forest land) leaving aside 14.864 ha as Safety Zone. The Govt. of India, MoEF in their letter No.8-34/2000-FC-12324(F) Dt.29.06.2001 approved for diversion of 59.736 ha broken forest land only leaving 1.604 ha of Safety Zone and 0.416 ha for

public purpose. The MoEF in their above approval order stipulated that, the User Agency will get the virgin forest land of 184.591 ha fenced and protected at the Project Cost under the supervision of the Forest Dept. and this area will not be leased out to any one else for mining till expiry of this lease. The User Agency has already applied for 3rd RML of this mining lease for 20 years w.e.f. 03.02.2005 to 02.02.2025 to the State Govt. of Orissa, Steel & Mines Dept. MoEF considering the proposal during 3rd RML has granted diversion of 244.327 ha vide their letter No.8-34/2000-FC (Vol.1) Dt.15.11.2007.

1.0.5 **Area allowed for mining:** MoEF vide their letter No. 8-34/2000-FC (Vol.1) Dt.15.11.2007 has granted diversion of 244.327 Ha of forest land for mining and allied purposes.

1.0.6 **Mining Plan:** The current Mining Plan duly approved by IBM is valid upto 2009-10.

1.0.7 According to the approved Mining Plan the potential mineable reserve of 26.28 million ton of Iron Ore and 0.17 million ton off Manganese ore. The annual rate of production is projected as 06.00 million ton of Iron Ore and 7,800 M.T. of Manganese ore. The life of the mine has been estimated to be 48 years for Iron ore and 22 years for Manganese ore years. Further exploration of the area by the lessee up to mineralized depth may further increase the life of the mine.

Divisional Forest Officer
& Wildlife Warden
BONAI DIVISION

24.08.2010
Conservator of Forests,
Rourkela Circle

For Aryan Mining & Trading Corporation (P) Ltd.
Dy. Manager,(Survey)
for A.M.T.C(P) Ltd.

CHAPTER – II
ESSENCE OF THE LEASE AREA

2.0.0 **Location of the mine:** The mine is located in villages Koira, Kasira and in Kathmal R.F. as well as in Kathmal P.R.F. of Bonai Tahasil of Sundergarh Dist. of Orissa, forming a part of the Survey of India Topo Sheet No.73 G/1 and G/5. The lease area is bounded by latitude 21^0 54' 00" to 22^0 57' 00" north and longitude of 85^0 13' 00" to 85^0 16' 00" east.

2.1.0 **Communication:** This area is located at a distance of 05 Kms from koira town in Bonai Tahasil. The nearest railhead is Barsuan on South Eastern Railway which is located at a distance of 33 Kms. Other nearest railheads at Barbil and Badjamda.

2.2.0 **Topography:** The landscape of the area along with the ZOI (10 K.Ms.) are undulating hills with altitudes varying from 545 mtr to 640 mtrs above MSL. General slope of the area is towards north. The three peak points are at 640 mtr, 620 mtr and 595 mtr within the lease area.

2.3.0 **Drainage:** Drainage in this area is dendritic type. The peak-points mentioned in the foregoing para 2.2.0 are connected with each other in different trends with intervening valley from where seasonal nallas have emerged. The prominent ones are flowing due north which divide the M.L. area into three parts. River Karo flowing due north close to the western boundary outside the lease area, constitutes the principal drainage system and collects surface run-off water through the seasonal nalls.

2.4.0 **Climate:** The area experiences tropical climate. The highest temperature is 45^0 in the valley zone during May/June and lowest 6.3^0 in January. The average annual rainfall is 2146.4 mm. About 75% of annual rain is distributed between June to September, being the period when south west monsoon is

active. Relative humidity is 87.3% in September and 37% in March.

2.5.0 **Geology:** The rocks in the lease area are shale and phyllites and laterites of various compositions. A vast reserve of Iron ore occurs along the hill top and ridges.

2.1.1 **Forest and Forest type:** Sundergarh District has a forest cover of 4.047 Sq.Km. out of which moderately dense forest constitute 2,787 Sq.Km. (Canopy density 0.40 and above) and open forest cover of 1,260 Sq.Km. (Canopy density 0.10 to 0.40). This is as per information in State of India's Forest Report, 2005 prepared by Forest Survey of India, Dehradun. Bonai Forest Division is in Sundergarh District. The total forest land of Bonai Forest Division is 1493.93 Sq.Km. This figure is as per Working Plan of Bonai Division which is valid from 1997-98 to 2016-17. Champian & Seth has classified the forests of this Division in the eastern part of the division into two types and sub-types.

1. Sub-group 3C-Northern Indian Tropical Moist Deciduous Forests.
2. Sub group 5B- Northern Tropical Dry Deciduous Forests
3. Sub group 2B-Northern Tropical semi evergreen Forests & *Terminalia tomentosa* Forests 3/1 E.

However, Kathmal R.F. has been included in Forest type – 3c/C2e (i) Moist Peninsular High Level Sal and 3C/C2 (ii) Dry Peninsular Sal forests. This sub-type is confined to the upper slopes, ridges and flat tops of the forest blocks like Kathmal, Khajurdihi, Mandhamaruni, Sarkunda, Toada and Rakshi R.Fs. Here quality II Sal finds its occurrence in the valleys and low lying areas having deep loamy soil while hill slopes are mostly covered with Q.III. In these areas, the patches of mixed forests with predominance of Anogesissus latifolia are also found within the Sal belts. Regeneration of Sal is fairly well but there is risk of annual repeated fire. The area is however free from frost. The common associates of Sal available in the top canopy are

Terminalia alata (Asan), Anogeissus latifolia (Dhaura), Syzygium cuminii (Jamun), Lagerstroemia parviflora (Patuli), Pterocarpus marsupium (Bija). The middle storey contains Careya arborea (Kumbhi), Bauhinia purpurea (Kanchan), Bridelia retusa (Kasi), Ougeinia oogeinensis (Bandhan) and Wedlandia excreta. Helectoris isora Modaphal) and Indigofera pulchela are commonly found as undergrowth. The common species of climbers available are Bauhinia vahlii (Siali) and Smylax macrophylla (Muturi). Themida and Imperata are the common grasses. Bamboo species like Dendrocalamus strictus (Salia) does not occur in this sub-type.

The total area of Khandadhar R.F. is 927.56 ha and has been allotted to Protection Working Circle whereas the total area of Khandadhar P.R.F. is 1570.375 ha and allotted to Rehabilitation Working Circle.

2.1.1 **Working Plan prescription**

Kathmal R.F. has been included in Selection Working Circle in the current Working Plan. Mostly Sal Conversion and Coppice system which had been adopted in the last plan and prior to that could not achieve the set target. On account of these reasons and as per the prescribed guidelines, forest areas worked under these systems have been incorporated in this working circle so as to improve the crop status by taking suitable silvicultural operation as narrated below:-

a. To improve the density and composition of forest crop and to encourage the natural regeneration and establishment of principal species by taking suitable silvicultural operation with due emphasis on soil and water conservation. To restock to artificial regeneration wherever necessary.

b. inconsistence with primary objective, removal of mature and siviculturally available trees before they become un-sound on sustained yield basis.

c. Removal of un-sound and defective trees under improvement felling so as to improve and increase the stocking of principal species.

2.1.3 Flora and Fauna

The common species noticed in the lease area and in the impact area of 10 Kms is furnished below. This is as per field observation and as per list authenticated by D.F.O., Bonai Division **(Annexure-VI).**

Core Zone

Local Name	Botanical Name	Family
TREES		
Asan	*Terminalia alata*	Combretaceae
Bahada	*Terminalia belerica*	Combretaceae
Char	*Buchnania lanzan*	Anacardiaceae
Dhaura	*Anogeissus latifolia*	Combretaceae
Harida	*Terminalia belerica*	Combretaceae
Kusum	*Schleichera oleosa*	Sapindaceae
Kurum	*Adina cordifolica*	Rubiaceae
Mahul	*Madhuca indica*	Sapotaceae
GRASSES		
Phulabandhuni	*Thysanolaena maxima*	Gramineae
SHRUBS / HERBS		
Basanga	*Adhatoda vasica*	Acanthaceae
Dhatki	*Woodfordia fruticosa*	Lythraceae
Kurei	*Holarrhena antidysenterica*	Apcynaceae
CLIMBERS		
Atundi	*Combretum decandrum*	Combretaceae
Mututri	*Smylax macrophylla*	Liliaceae
Siali	*Bauhinia vali*	Papilonaceae
Satabari	*Asparagus racemosus*	Liliaceae

2.1.4 Fauna

The lease area and its Zone of Influence do not form part of any National park, Wildlife Sanctuary, Biosphere Reserve, Tiger Reserve, Elephant Reserve or Ramsar site. The wild animals occurring in the lease area and its surrounding (buffer) are listed below:

Local Name	English Name	Zoological Name	Schedule
MAMMALS			
Squirrel	Indian Palm Squirrel	*Funambulus pennanti*	II
Cat	Jungle Cat	*Felis chaus*	II
Musa	Rat	*Rattus rattus*	V
Thekua	Rabbit	*Lepus nigricolis*	IV
BIRDS			
Baya	Weaver bird	*Ploccus phillipinus*	IV
Koili	Cuckoo	*Eudynamis Scolopaceus*	IV
Kau	Crow	*Corvus splendens*	V
Sua	Parrot	*Psittacula krameri*	IV
Para	Pigeon	*Columba livia*	IV
Ghar Chatia	Sparrow	*Passer domesticus*	IV
REPTILES			
Dhamana	Rat snake	*Ptyas mucosus*	II
Godhi	Yellow monitor	*Varanus monitor*	II
Naga	Cobra	*Naja naja naja*	II
Chiti	Krait	*Bungarus caeruleus*	II
Cahndan Boda	Russell's viper	*Vipera ruseelli*	II

Flora of Buffer Zone

Local Name	Botanical Name	Family
TREES		
Bel	*Aegle marmelos*	Rutaceae
Bahada	*Terminalia belerica*	Combretaceae
Bana Bhalia	*Semicarpus anacardium*	Anacardiaceae
Dhaura	*Anogeissus latifolia*	Combretaceae
Dimiri	*Ficus glomerata*	Moraceae
Haldu	*Adina cordifolia*	Rubaceae
Harida	*Terminalia chebula*	Combretaceae
Jamun	*Syzygium cuminii*	Myrtaceae
Jack fruit	*Artocarpus heterophyllus*	Moraceae
Kendu	*Diospyrus melanoxylon*	Ebenaceae
Kusum	*Schleichera oleosa*	Sapindaceae
Kasi	Bridelia retusa	Euphorbiaceae
Tamarind	*Tamarindus indicus*	Ceasalpiniaceae
GRASSES		
Khara grass	*Imperata cylindrical*	Gramineae
Phulabandhuni	*Thysanolaena maxima*	Gramineae
SHRUBS / HERBS		
Anantamula	*Hemidesmus indicus*	Asclepidaceae
Arakha	*Calotropis gigantia*	Asclepidaceae

Local Name	Botanical Name	Family
Basanga	*Adhatoda vasica*	Acanthaceae
Dhatki	*Woodfordia fruticosa*	Lythraceae
Kurei	*Holarrhena antidysenterica*	Apcynaceae
CLIMBERS		
Atundi	*Combretum decandrum*	Combretaceae
Baidanka	*Mucuna monosperma*	Papilonaceae
Bichhuati	*Urtica dioica*	Euphorbiaceae
Mututri	*Smylax macrophylla*	Liliaceae
Siali	*Bauhinia vali*	Papilonaceae
Satabari	*Asparagus racemosus*	Liliaceae

2.1.5 Fauna of Buffer Zone

Local Name	English Name	Zoological Name	Schedule
MAMMALS			
Bilua	Jackal	*Canis aureus*	II
Harina	Chital	*Axix axis*	III
Kutura	Barking deer	*Muntiacus muntijack*	III
Neula	Mongoose	*Herpestes eduardsii*	II
Cat	Jungle Cat	*Felis chaus*	II
Musa	Rat	*Rattus rattus*	V
Thekua	Rabbit	*Lepus nigricolis*	IV
Hanu	Languor	*Presbytes entellus*	II
Monkey	Rhesus monkey	*Macaca mulatta*	II
BIRDS			
Baya	Weaver bird	*Ploccus phillipinus*	IV
Koili	Cuckoo	*Eudynamis Scolopaceus*	IV
Kau	Crow	*Corvus splendens*	V
Sua	Parrot	*Psittacula krameri*	IV
Para	Pigeon	*Columba livia*	IV
Ghar Chatia	Sparrow	*Passer domesticus*	IV
Bana Kukuda	Red Jungle fowl	*Gallus gallus*	IV
Bhadbhadalia	Blue Jay	*Coracias benghalensis*	IV
REPTILES			
Ajagar	Python	*Python molurus*	I
Naga	Cobra	*Naja naja naja*	II
Chiti	Krait	*Bungarus caeruleus*	I
Chandan Boda	Russels viper	*Vipera ruseelli*	II

Land use pattern of the lease area:

2.1.6 The land use pattern of this lease area as has been furnished in the recent forest diversion proposal is as follows:

Purpose	Forest Land (Ha)
Mining including Mobile Crusher & Screening Plant	136.505
Storing of minerals	9.244
Ore Dressing and Staking	33.239
Dumping of O.B.	41.201
Storing of tools and machineries	Nil
Const. of building, weigh bridge, Magazine etc.	3.861
Construction of roads/ railway siding	2.950
Sub Total	***227.000***
Safety Zone	84.256
Area covered under Afforestation	10.920
Area for public use and Nala	18.156
Grand Total	**340.332**

24.06.2010
Conservator of Forests,
Rourkela Circle

Divisional Forest Officer
& Wildlife Warden
BONAI DIVISION

For Aryan Mining & Trading Corporation (P) Ltd.
Dy. Manager, (Survey)
for A.M.T.C (P) Ltd.

CHAPTER – III
PROCESS OF MINING

3.0.0 **Salient features of Mining:** This is an opencast semi-mechanized mechanized mine. Sizing of Iron ore will be done by crushing. Natural fines will be screened for separating large size boulders. This mine is being worked on single shift basis.

3.1.0 **Size of benches:** Average height of benches is 5.0 m and 10.0 m wide for safe working. The individual benches will be kept nearly vertical (70^0 to 80^0) and overall slope angle of quarry will be kept at less than 27^0. Mining will progress laterally as well as depth wise.

3.2.0 **Development of quarries:** Manganese ore is proposed to be mined out by the formation of 3m high and 5m wide benches. Overall pit slope angle will be maintained at less than 31^0 with the horizontal.

3.3.0 **Surface and rain water management:** All preventive measures would be adopted for prevention and regulation of wash offs from the excavated area during rains. Retaining walls and garland drains around the ultimate pit limits of all working quarries and ore stacks shall be built in a phased manner and a series of check dams as well as settling tanks would be provided at the end of each garland drain so as to allow the clean water to escape out of the lease area. This will also help in recharging the ground water.

3.4.0 **Extent of mechanization:** Presently the following machinery for construction, leveling, compaction, drilling, blasting, loading and transporting operations is deployed in this mine.

Sl. No.	Equipments	Total
01	Excavator	2
02	Pay loader	2
03	Wagon/DTH Drill	3
04	Water Tanker Sprinkler	2
05	Jeep	3
06	Tipper 10t	16
07	Dozer	1
18	Crushing Unit	2
19	Explosive Van	-
10	Jack Hammer	5
11	Screening Unit	1
12	Mobile wet plant	-
13	Truck mounted Compressor	1
14	Tractor mounted Compressor	1
15	Ambulance	1

3.5.0 **Blasting:** Drilling wagon is done with Jack hammer drill of 32 mm dia, 1.0 m deep holes, single row with 0.75 x 0.75 m spacing and burden in Manganese mines. However, DTH drill of 100 mm dia, burden and spacing of 1.20 m and 1.50 m will be adopted in proposed drilling in Iron ore mining.

3.6.0 The blasting is carried out by using ANFO explosive in the proposed blasting; ANFO will be used as primer in proportion of 70:30 to 60:40. Safety fuse in conjunction with ordinary non-electric detonator and detonating fuse combination will be used for ignition. Hole depth in case of Jack Hammer & DTH drill will be 1.60 m and 5.50 m respectively. Powder factor will be 7t/Kg and 8t/Kg respectively.

3.7.0 **Employment:** Employment potentially of this mine per day is about 400 laborers.

3.8.0 **Use of mineral:** The Iron and Manganese ore raised from the mine is sized and supplied to various Steel Plants, Sponge Iron Plants and Silico & Ferro Manganese Plants. The manganese ore fines generated during the sizing process are also being

exported to various countries like China. Since there is a good market for the Manganese ore fines at present, the sub-grade ore, if any, is blended and utilized along with the Iron ore fines.

3.9.0 **Mineral beneficiation:** A screening & crushing unit of 650 tonnes per hour capacity consisting of screening, gyratory crusher with associated belts and screens is proposed to be established. However, the Manganese ore will be stored manually.

CHAPTER – IV

PERCEIVED IMPACT ON WILDLIFE AND ITS HABITAT

4.0.0 The lease area of Narayanposi iron and manganese ore mines covers an area of 349.263 Ha including forest area of 259.191 Ha. Of this, Kathmala R.F. area covers 92.113 Ha, proposed extension of R.F. 96.977 Ha and P.F. area 70.101 Ha.

4.0.1 This is old manganese mine worked since 1945, from which; State government approved raising of iron ore as well since 1978. The third renewal of lease has been applied for from 03.02.2005 to 02.02.2025 and based on this, Stage II forest diversion has been allowed for 244.327 Ha during 2007.

4.0.2 The terrain is undulating from 545m to 640m from MSL. Two small nalas originate from the area, which drain to Karo nala flowing on the western edge of the M.L. area. The buffer zone is divisible to 3 catchments, the Central Karo nala and the eastern Tehrai nala flowing to north and the western Samij nala flowing to south. The buffer zone is hilly with highest peak, Mayurnacha pahar to north. Generally western side is higher than eastern.

4.0.3 The forest growth of M.L. area is patchy in distribution and mostly of rooted waste of Sal, Sal pole crop and plantation of Acacia auriculaeformis. There are few scattered middle aged trees of Sal. Secondary growth confirms to Dry peninsular Sal [(3C/C2(ii)] with Sal – Anogeissus – Terminalia – Pterocarpus association.

4.0.4 The buffer zone has 8 R.F's, viz. Karo, Uliburu, Siddhamath, Mendhamaruni, Kathmala, Khajuridihi, Sarkanda and Toda R.F's, which with patches of Khesra forests account for 65.91% of landuse. This includes open forests which is less than 1%. Agriculture accounts for 2.22% and mining 1.33%, while waste land is 30.39%. There are 48 mines in buffer zone.

4.0.5 Forests of BZ confirm to moist peninsular high level Sal (3C/C2e) with Shorea-Xylia-Terminalia-Schleichera association. Throny bamboos

(Bambusa bambos) are found in valley bottoms, nala banks and northern slopes.

4.0.6 The fauna of core zone is represented by striped squirrel rats, crow indicative of extremely poor vegetation. The buffer zone has stripped squirrels, giant squirrels, langur, spotted deer, barking deer, hyena, jackal and the like. Schedule I fauna is represented by sloth bear, migratory elephant, rock python and pea fowl.

4.0.7 Earlier, there were 16 small quarries for iron ore and 11 small ones for Mn Ore, which have merged to 12 only. Of these, currently active quarries are Q1 top, Q3 & 3A, Q6, 6A, 6B and 6C. Manganese quarry Q4, 5 have been temporarily suspended. Similarly, there is only one active dump 'A' near quarry 1 top, dump D for Mn quarry waste is suspended, while dumps 'C' & 'D' are proposed in north & west respectively. Of the total forest area, 94.26% has been diverted (244.327 Ha), which includes 184.591 Ha virgin area & 59.736 Ha broken up area as on November 2007.

4.0.8 The mineable reserve of iron ore as on 1.1.2008 was 67,776,800 tons and Mn Ore 254,592 tons. With the increase in raising of iron ore from 0.6 tpa to 3 tpa and Mn Ore from 0.0078 tpa to 0.036 tpa, the mine life has been calculated as 23 and 8 years respectively.

4.0.9 Semi mechanized open cast method will be employed. Machineries include 16 x 10t tippers, 1 dozer, 2 compressors, J.H. drill 5 nos, DTH drill 3 nos, excavators 2 crushing & screening plant-1. In the proposed capacity build up, internal transportation will go up from 90 to 200 trips per day and external transport, will like wise increase from 40 to 160 trips.

4.1.0 **Impact within the mining lease area:** Mining pits, dumping of overburden, stacking of mineral, sub-grade dump, roads, crusher plant, office building, labour shed, garage for machineries, all involve clearance of forest growth. Pits bring about changes in geomorphology of the area as pits advance in all directions with increase in area and depth. About 400 persons will be engaged in the process. Mining will change about 89% of the original land use, except a green belt of 34.902 Ha (11%). The frequency of tipper movement will also

considerably disturb the area. The anticipated adverse impacts are summarized below:

4.1.1 **Habitat loss:** Habitat loss is the outcome of forest destruction or deforestation, which is inevitable in mining activity. This significantly alters or out rightly eliminates conditions needed for plants and animal to survive. The habitat is rendered functionally weak and unviable to support the resident species. This triggers loss of biodiversity and consequently, reduced carrying capacity of the area. The end result is the displacement of fauna. The present scenario is not conducive to medium or large animals except few smaller ones and birds in forest patches.

4.1.2 **Dust pollution:** The mining area is highly dusty due to blasting, loading, unloading, crusher site dust and haulage on earthen roads. Heavy dust deposit was seen on roads, buildings, vehicles, plant foliage and all over. The highest SPM & RPM levels recorded are 187.80 ug/m^3 and 50.31 ug/m^3 respectively. This level of dust is not conducive to plant and animal survival and growth in optimal conditions not withstanding higher permissible limits set under pollution norms.

The adverse effect on plants are:

- Reduced photosynthesis due to reduced light penetration and blockade of stomata openings.
- Reduced seeding affecting natural regeneration.
- Increased incidents of plant pests and diseases; the dust acting as a medium of growth of fungi and inhibiting the growth of predators of insect pests.

The adverse effects on animals are:

- Overly aggressive immune responses caused by inflammation of lungs and distressed breathing.
- Disruption of normal living conditions
- Alteration of normal heart rate
- Larger incidences of disease due to proliferation of bacteria, fungi and virus

4.1.3 **Noise pollution:** Noise produced from blasting, drilling, excavation, loading and unloading, haulage is very irritating and disturbing to all form of life. The effects of noise are 3 types viz. auditory, physiological and behavioural. Auditory effects include hearing impairment and threshold shifting to elicit response from mating or alarm calls. Physiological effects comprise of stress, metabolic changes and hormonal changes resulting in emigration, reproductive failure, failure in lactation and suckling and vulnerability to disease. Behavioural changes include signal marking and avoidance behaviour. Signal marking is inability to respond to call of a predator and its foot steps. Avoidance behaviour is reluctance in mating and running away from noise source.

4.1.4 **Light pollution:** Mine site office and surrounding area, particularly, gates, mineral stacks, haul roads and crusher plant is electrified. All wild animals have an active and passive phase based on natural light intensity. Some animals are diurnal, while others are nocturnal. Artificial light disturbs this conditioning of behaviour with natural light. Other effect is disorientation and zig-zag movements.

4.1.5 **Soil erosion:** Loss of ground cover, geo-morphological changes, bringing bottom soil to top result in loss of top soil. Soil disturbance, compaction by plying of tippers result in soil erosion. Soil erosion has been noticed in shape of sheet erosion from bald areas, shoe string erosion in overhead dumps & scouring of garland drains. The effects are breakdown of soil structure and aggregates resulting in loss of fertility and making the area refractory from the reforestation point o view. Soil erosion leads to water pollution.

4.1.6 **Water pollution:** The erosion from roads, O.B. dumps, barren slopes, ore stacks carry red silt with iron fines which may contaminate the stream down below affecting use of polluted water by wild animals. A hectare – metre of sediment may be produced annually for every 30-40 Ha of disturbed land. The aquatic environment may be degraded affecting turtles, snakes, fish, frogs and crabs directly and water birds indirectly. Run off water is somewhat toxic to animals due to high

concentration of iron. Turbidity affects growth of underwater plants affecting spawning of fish etc.

4.1.7 **Absence of water:** Nalas being seasonal, there is dearth of water in M.L. area, when it is required most. Moreover, mining has obliterated many depressions, which used to carry surface flow. Consequently, the habitat is not suitable for residence of any wild animal on a permanent basis.

4.1.8 **Accidental fall of animals:** There are 12 pits in the M.L. area varying from 5m to 40m deep, which may go upto 70-80 metres. Such deep pits are dangerous for wild animals and accidental fall may result in death or grievous injury. For reasons of safety, mining pits need to be barricaded and converted to smooth slopes.

4.1.9 **Ground fire:** Fire is the greatest scourge in the establishment of plantations, continuance of growth and establishment of regeneration. Fire is currently scarce due to lack of leaf litter as the over wood is patchy and discontinuous. But, keeping in view, the plantations to be established, fire protection awareness needs to be instilled in the work force.

4.1.10 **Garbage:** With 400+ people working in the area garbage is likely to be generated in the area in shape of waste paper, polythene, tetra packs, cans, glass bottles, left over food. Garbage offends all and is an eye sore. Left over food and kitchen scraps may attract crows, kites, jackals, pie dogs and even hyena. Special care will be taken for safe disposal of all garbage.

4.2.0 **Impact on wildlife in the surrounding buffer zone:** There are 48 mines in the buffer zone. Mining activity disturbs tranquility and serene environs of a forest. The synergic effect of all mines on the quality of the habitat of BZ is significant enough to cause displacement of species to comparatively undisturbed habitats. As all mines are largely over forest areas, there is honey combing of otherwise contiguous forests' resulting in a fragmented landscape of forest, mine, waste land and cultivation. Adverse impacts on wildlife in BZ is enumerated below:

4.2.1 **Loss of habitat quality:** The impact on habitat is both direct and indirect. Direct impact involves proliferation of plant species of edge

habitats at the expense of those of interior habitats. Indirect effect may be due to pollution load as a results which, regeneration & growth of food plants may be slower or altogether absent.

Noise factor and illumination of otherwise natural areas may limit habitat utilization even though food and water resources may be well distributed. Unexpected fluctuation in lights due to passing of trucks is quite disturbing and lower habitat quality indirectly. The above are short term effects, which may end once mining is closed. But long term effects are change in plant composition and structure and change in animal species due to disturbance related emigration. Loss of habitat quality results in lower fecundity, miscarriage or unsuccessful rearing of young to juvenile stage.

Large mammals and other animals displaced from their home ranges may be forced to use adjacent remote areas of buffer. This could potentially lead to overcrowding of individuals in smaller undisturbed areas. In turn, the remaining better habitats may be overstocked leading to degradation of vegetation. Consequently, carrying capacity of the habitat is lowered giving rise to inter & intra-specific competition. This ultimately results in greater losses in animal numbers than originally displaced animals from M.L. area through higher vulnerability to diseases and shortage of resources for survival.

4.2.2 **Fragmentation of forest habitat:** Before the mining was initiated in the area, Siddhamath R.F. (Keonjhar Division) in NE was almost contiguous to Toda R.F. and Karo R.F. in west and Sarkanda & Khajuridihi R.F's in south through Mendhamaruni R.F., Kathmala R.F. and numerous other Khesra forests. The mining activities have not only lowered the habitat quality but have fragmented once contiguous patch of forests. Habitat fragmentation includes 6 discrete phenomena, viz.

i) Reduction in total area of the habitat
ii) Increase in the quantum of interior habitats
iii) Decrease in the amount of interior habitats
iv) Isolation of habitat fragments
v) Breaking up of one patch to several smaller habitat patches
vi) Decrease in average size of each patch

Habitat fragments are rarely representative samples of the initial landscape. Small fragments support small populations of plants and animals. Distance between the fragments, if higher than cruising radius of the species, prevents the scope of movement. This has conservation implications as lack of viability in smaller habitat fragments make the species of animals threatened or endangered. Fragmentation of habitats has put a great stress on movement of elephants in particular. The species is exploring new habitats where habitat is more or less contiguous. Secondly, the movement of family groups is now restricted.

4.2.3 **Loss of biodiversity:** Apart from habitat impairment and deforestation, growing concern in mining belt is loss of biodiversity in species, eroding genetic variability within species, diversity in community structure and ecosystems. Rates of species loss are feared to proceed must faster than scientific assessment of different species not identified as yet. Lower plants and insects fall in this category. As compared to developmental stages of vegetation, mature forest has higher biomass supported/unit of energy flow, food chains are complex and web like, higher species diversity, well organized vertical and horizontal stratification, high niche specialization (many smaller micro habitats and food chains). The ecosystem is more stable to external perturbations, nutrient conservation is good and internal symbiosis is well developed. Diversity loss is due to direct drivers such as change in land cover, fragmentation, invasion of alien species, over drawl of biomass, pollution, habitat loss. Indirect drivers comprise of population build up, use of machineries, creating roads and other artifacts within a habitat. Biodiversity and ecosystems are resilient to certain extent meaning, they spring back to original form once the causal drivers are suspended. However, once, the threshold is crossed, biodiversity is irreversibly lost and so are the ecosystem functions. Indicator species, e.g. frogs have an acute sensibility to environmental harm and serve useful role in indicating the early warning signals through their death and decline in number as well as variety. Hence, biodiversity needs constant monitoring.

4.2.4 **Depredation of wild animals:** Movement of animals, particularly, elephants in a fragmented landscape brings them close to habitation. Elephants come in conflict with people during crop season and cause loss of crop, stored grains, damage houses and worse trample upon or toss over human beings to death. Country liquor, rice brew, stored Mahua flowers, semi ripe or ripe mangoes, jack fruit and banana grown in villages are great attractants. Occasionally, sloth bear comes out of forest limits in search of Mahua flowers, Kendu, Jhadi Barkoli fruits and termite mounds. Accidental encounter with sloth bear leaves a man either dead or severely mauled to lead a disabled life. Depredation needs to be controlled to save precious human life, save the errant animal and allow it a free passage to forest.

The erstwhile elephant migratory route from Saranda R.F. (Jharkhand) via Rakshi, Toda and Sarkunda R.F's of Barsuan Range appear to be deflected west wards to Sundargarh Division. Elephants rarely visit Toda R.F. but visit Koira, Mendhamaruni, Khajuripada and Sarkunda R.F's from Keonjhar Division in east. However, there is no elephant corridor within buffer zone used by viable populations.

Agression in elephants is a survival strategy to secure food and to supplement their nutritional requirement from cultivated areas. From the point of view of elephants, paddy crop is a palatable grass despite economic bankruptcy to the farmer due to repeated assault on his crop. The degree of aggression by individual elephants is conditioned partly by genetic trait and partly by frustrating experience in the past. Hence, depredating animals, particularly aggressive ones need careful management.

4.2.5 **Forest fire:**

4.2.6 **Disturbance & Road Accidents:** Keonjhar-Rourkela NH-215 via Barbil-Koira-Tensa passes 150m to the north-eastern side of the M.L. area but Koira-Kalta-Lahunipada link road pass right through the M.L. area. These roads are in bad shape and repair is in progress. Besides, there are several truck tracks connecting each mine to the main road. Transport of ore to railway sidings at Barbil, Rakshi, Barsuan or to Paradip Port takes place on these roads. There is continuous

movement of thousands of mineral laden trucks on these roads leading to dust, noise and light pollution. At times, there is road jam, which is definitely extremely unpleasant situation to all including wild animals. The latter are denied passage from one side of the forests to the other forcing them to remain confined on one side, which triggers stress related random movements. There are a few cases of accidents due to speeding trucks.

4.2.7 **Poaching:** Although this is not very acute, but occasional poaching takes place for bush meat. Cases of snaring wild pigs, trapping of jungle fowl and hare have surfaced. As high stakes are involved in killing pythons for skins, elephants for tusks and bear for alleged medicinal value of its bile and trapping of young of pea fowl, deer etc and outsiders entering the area may allure the local people to indulge in such activities, constant vigil need to be exercised. Poaching may accelerate wiping out of the species from the area, which has very low density of animals.

4.2.8 **Unauthorized mining:** With the increase in the price of iron ore, unauthorized mining has become a cottage industry with the people, particularly, in situations, where ore is available on the surface. Some unscrupulous traders and transporters are luring the villagers in this activity and even giving monetary help for surface stripping of ore. Now, local educated youth are in this illegal trade and they have organized the villagers for such work. They arrange transporters and dispatch the raised ore, which has a ready market and distribute the sale proceeds amongst the labourers. Such unauthorized mines, few inches deep, look like huge borrow pits, which are seen scattered in forest areas, hardly 200-300 metres of the road. Surface mining and extraction paths leads to loss of forest cover, honey combs the forest, are focal points of accidental conflagration and brings down the habitat utilization. This needs to be checked with an iron hand.

4.2.9 **Conflict over forest resources:** Mining involves destruction / depletion of forest resources and loss of biodiversity over which people rely as watersheds of drinking water, reservoir of non-timber forest produce, fishing or hunting grounds, religious sites, grazing lands,

wood lots and as foster mother of agriculture. If these forest dependent people are not involved in reforestation and decision making process in any developmental activity involving change in land use, a conflict will ensue, which will not be congenial for conservation in general and wildlife conservation in particular. As such, people not involved in mining must have alternative options of livelihood in the interest of conservation.

CHAPTER – V

HABIT AND HABITAT REQUIREMENTS OF SCHEDULE I FAUNA FOUND IN THE BUFFER ZONE OF 10 KM

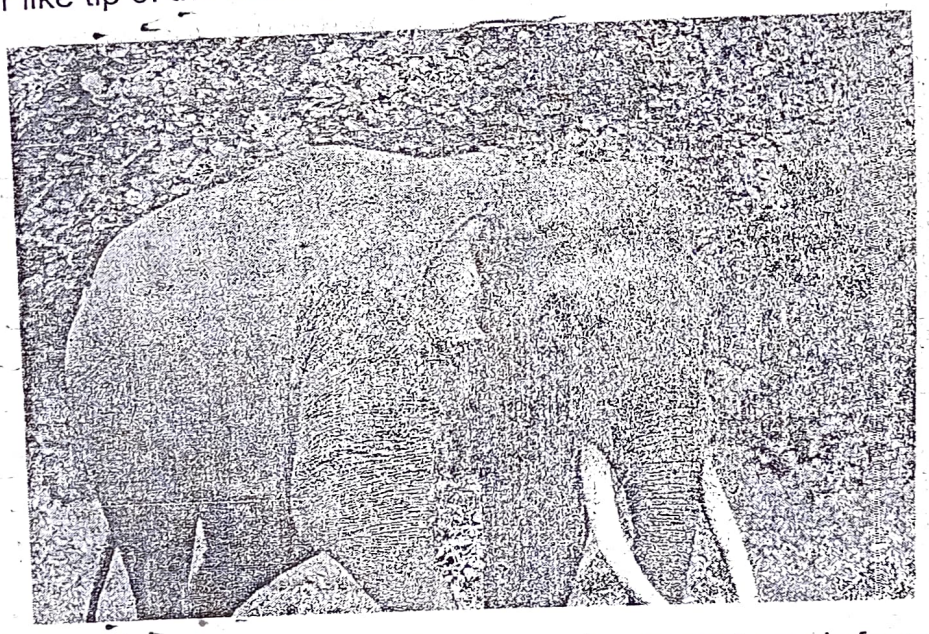
5.0 Elephant, probably python and sloth bear are the only three species of wild animals which are part of Schedule-I of the Wildlife (Protection) Act, 1972 found along the buffer zone of the mine and its neighboring area. Their habits and habitat preferences are given in the following paragraphs.

5.1 **Indian Elephant:** (*Elephas maximus indicus*)

5.1.1 **Habit:** Elephants are social animals and may form herds of 20-30 individuals led by the oldest female. Herds usually break into stable family groups of 4-7 animals for foraging and may rejoin. The large matriarchal groups' movement is coordinated by the older female for optimal sites of food and water. The different groups maintain long distance contact through sub sonic vocalizations. Males usually remain away from herds at a distance but join in when a female comes to oestrous. Generally, one dominant and super virile male mates with females in oestrous (polygamy). Old males, past prime reproductive life usually lead solitary life and so are sub-adult males. Sometimes, 2-4 sub-adult males form their own groups. During mating, it is common to see the dominant male escorting the oestrous female away from the family group. Elephant is intolerant of hot summer and retreats into a shady spot during noon. In the past, when forest ranges were continuous, elephants used to migrate seasonally in search of better pastures alternating with forests. Human activities like cultivation, highways, townships, railways, dams, industries and mines have now fragmented their habitat and made seasonal migrations virtually impossible. Individual temperaments vary from gentle natured to ill tempered, believed to be due to imprint of normal living or harassed living during juvenile period. An elephant may run at 45 km / hour for short distances for two or three minutes. Elephants live for 70 years. The oestrous cycle of the cow is about 22 days, out of which she is receptive for copulation on the first day only. There is no seasonality in copulation. The gestation period is 18-22 months and period of suckling of about an year and half though 6 months onwards soft grass diet is initiated. In good quality habitats, the inter birth interval may be 3-4 years while in poor ones; it may be prolonged to five. Mothers continue to bestow

maternal care to their offspring for several years after weaning. The senses of touch and hearing are acute but their eye sight is poor.

Only males have prominent tusks and cows, one or two rudimentary tusks known as tushes, which is hardly visible to outside. Elephants have a genetic aberration single tusked, right or left, usually known as Ganesh. Tusk less males are known as Makhna. An elephant develops 6 molars in each jaw, on either side during its life time. But at any one time, there is one exposed molar and one partly exposed molar on either side of each jaw. The first molar is shed at 2, the second at 6, the third at 9, the fourth between 20-25 years, the fifth at 60 and the sixth lasts for rest of the life. The nature of elephant dentition suggests that it is primarily meant to masticate rough siliceous grass. The trunk of the elephant is an organ of versatile utility, which is used in eating, drinking, smelling, and breathing, touching, vocalizing, washing, dusting and fighting. The sensitive finger like tip of the trunk is used in manipulation of objects.



5.1.2 **Habitat:** Elephants are animals of grass lands and scrub forests who have secondarily switched over to forests once grass lands were mostly brought under cultivation. The mosaic of grass, scrub forests, open forests and dense forests suits them well. Elephants are constantly on the move and may cover 10-15 km during a single night. Annual home ranges for bulls may vary from 200-1000 sq.km. where as, that of family group may be 50-300 sq.km. depending on the quality of the habitat. Elephants consume a variety of diet, bark, roots, leaves, stems and twigs, bamboos, vines, shrubs belonging to 100 plus species. An average day's intake for adults is 150 kg of vegetation (20-25% body weight). An equal quantity is damaged and

left half eaten, when the animal moves on. The efficiency of digestion is poor with only 44% with the symbiotic bacteria in the stomach. Elephant may drink 100-140 liters of water at least once in a day. They make small water pools in dry nala beds by digging sand by their front feet. Elephants enjoy cultivated foods such as ripe paddy, banana, mango, jack fruit, sugar cane. They take to crop depredation, where cultivation is interspersed with forest landscape or where the habitat is too degraded to meet their foraging needs or where the continuity of the habitat is broken with settlements, industries, mines or other similar developments, or where the habitat is linear, i.e. boundary of habitat/area ratio is near to 1. In areas, where this ratio is less than 0.5, crop raiding is generally less or occasional. They are fond of salt for which purpose, they gather at salt licks. They are also fond of mud wallowing and body rubbing. Elephants are in endangered category for tusk poaching and habitat loss and fragmentation.

5.2 Sloth bear (*Melursus ursinus*):

5.2.1 **Habitat:** Sloth bears have long snout and their lips are detached from the gum. Mobile and protrusible, lips are well adapted to the forceful intake and expulsion of air. Bears have a large protrusible tongue. The claws are longer in the fore feet than the hind and are good digging implements. The bear's palate is deeply concave. The gap between the teeth permits the passage of air as middle pair of incisors in the upper jaw is absent. The animal produces enough suction force to suck out termites from mounds.

Sloth bears are mainly nocturnal. Their sense of smell is well developed but their sight and hearing usually poor. They run away with human smell. But during accidental confrontation they defend and can cause nasty injuries by its claws and teeth. Not much is known about social life of bears. Sightings indicate that they are either solitary, in pairs with opposite sex or mother with cubs. Sloth bears are usually restrictive in their movement during the rains as insect food is plentiful. Mating occurs mostly in June and 1-2 cubs, sometimes 3 are born 6-7 months later. Most cubs are dropped between December-January. Birth and rearing takes place in a cave or climber thickets. Cubs are blind for about 3 weeks. The cubs leave the den when about 2 months

old and trail the mother. Males do not participate in parental care. Sloth bear leaves up to 40 years.



5.2.2 **Habitat:** Bears frequent drier and secondary forests but also found in dense forests. Rocky outcrops and grass lands are also preferred. The dentition indicates that bears are more herbivores and there is a departure from carnivory. In fact, they are omnivorous. Their diet includes largely insects and grubs which can be dug out from the ground or from the underneath of bark of standing trees or fallen logs. They eat termite and bee nests by suction and creating a vacuum in the nest by keeping snout close to the mound. Leaves, root, honey flowers (Mahua, Semul) and fruits (Ber, Tendu, Jamun, Baheda, Amla etc.) in season. Bears sometimes raid sugarcane and maize crop. Several human casualties or grievous injury occur due to bear attack. Bears disperse forest seeds from the fruit they eat and keep a control over termite population. In quest of food, bears may travel several km. Bears are endangered for their gall bladder and bile to which medicinal properties are attributed.

5.3 **Indian Rock Python (*Python molurus molurus*):**

5.3.1 **Habit:** This is a non venomous snake and can grow up to 4m and weigh 45 kg. The colour is dark brown and yellowish white in a blotched pattern. They are very good swimmers and take to water when disturbed but on land, they hiss and remain motionless. The

species in oviparous and lay up to 100 eggs in a clutch protected and incubated by the female. Being exothermic, python basks in open but can also raise body temperature by muscular contractions.



5.3.2 **Habitat:** Python occurs in wide range of habitats viz. rocky foot hills, grass lands, marshes, swamps, wood lands, open jungle. At times, they take refuge in mammal burrows, hollow trees etc. It has also been reported close to habitation and crop fields. The snake feeds on mammals, birds and reptiles but prefers the first. Chital deer, fawns, hares, mouse deers, jungle fowl are natural food. It can swallow prey bigger than its size as the jaw bones are not hinged. The prey is constricted to death by muscular movement and swallows head first. Once held in jaw, prey can not escape because of inward bent teeth.

Pythons are held endangered according to law. Many specimens are killed due to ignorance or out of fear when they enter habitation and capture goats or poultry. Specimens are also silently poached for their ornamental skin.

CHAPTER – VI
WILDLIFE MANAGEMENT PLAN

6.0.1 Narayanposi is one of 48 mines in Koira belt. East of this mine, forests are discontinuous but to west, north & south, forests are more or less in a dense continuum. There is no scope of large or even medium sized animals in M.L. zone. Therefore, the management of core zone will focus on reclamation and reforestation of the mined pits at the earliest possible and maintenance of safety zone and green belt as a habitat for smaller animals like hare, mongoose, civets, squirrels and bird life accustomed to human presence with option of colonization and transit of large animals after mining comes to an end. The management of buffer zone shall target maintenance of optimal forest habitat and its linkage to west and south for large animals like deer, sambar, sloth bear and elephants while fostering natural biodiversity through four pronged strategy. These are one beefing up protection mechanism, two, redressal of genuine livelihood needs of forest dependent people, three, management of man-elephant conflicting interaction and four, building up of alternate biomass resources in the village limits.

6.0.2 Conservation is a state of harmony between man and land (forest included) and all that is above and beneath this. The civil society has a dilemma: Whether mining as an enterprise, is really concerned about conservation imperatives of natural resources on which we are all dependent? Are we leaving scars all over the landscape and making the earth poorer in biodiversity? This scar, known as ecological foot print (EF) is a measure of consumption or 'load' imposed on the natural environment by man's consumptive use in a region. The EF also represents the biologically productive capacity of the land necessary to sustain current levels of resource consumption. It is now generally believed that mining activities exceed the EF, that is earth's capacity of near future with the present rate of use and hence, resources need to be perused more vigorously with the active support of the user agency through a well spelt out plan.

6.0.3 **Objectives of management:** Before planned actions are implemented, it is necessary to set objectives of management and these are:

i) To reduce severity of impact on the forest & wildlife by adoption of attenuation measures in mining process including reforestation in mined out areas.

ii) Systematically improve and maintain optimum habitat conditions for all wildlife in general and Schedule-I fauna in particular in buffer zone surrounding mines.

iii) Involve and energies village level institutions like VSS, EDC, SHGs etc in particular and people in general in conservation management.

iv) Management of animal depredations to elicit people's support for conservation.

v) Enlisting people's support and participation by providing alternate livelihood support to maximize above objectives.

6.0.4 **Conservation plan for M.L. area:**

6.1.1 **Reforestation:** An area of 40 Ha will be available for plantation over mine benches in reclaimed area of pits and O.B. dumps during the plan period, i.e. an average of 8 Ha per year. Plantation will be taken up from 2011 planting season and hence, preparatory activities will be taken up from 2010-11, which will comprise of site preparation, digging of pits, enriching the pits with farm yard manure and establishment of nursery. Nursery raised seedlings 6 months to one and half year old will be planted in 45 cm cube pits previously dug, withered and enriched with valley soil/FYM mixture. A plant population of 1600 will be aimed at. During planting, 30 gm of NPK, 20 gm of 'Ralli meal' and 10 gm of Neem Shield will be added to each pit. Soil working and weedings will be done as per requirement but not less than thrice in first year, twice in second year & once in third year. Clod breaking and pruning etc may be done in fourth & fifth year. Watering will be done as per necessity. Plantation will be tended for minimum of 5 years. Since safety zone has not come up well and not intelligible on the ground, this will be taken up urgently. Species of plants will be as under:

1) Sissoo (*Dalbergia sissoo*)
2) Ambolata (*Bauhinia racemosa*)
3) Ban Kapasia (*Kydia calycina*)
4) Dhaman (*Grewia tiliacfolia*)
5) Tentra (*Albizzia stipulate*)
6) Pani Kodalo (*Sterculia colorata*)
7) Gohira (*Acacia leucophloea*)
8) Salia Bamboo (*Dendrocalamus strictus*)
9) Chhatian (*Alstonia scholaris*)
10) Jamu (*Syzygium cuminii*)
11) Karanj (*Pongamia pinnata*)
12) Kangda (*Xylia xylocarpa*)
13) Neem (*Azadirachta indica*)
14) Karada (*Cleistanthus collinus*)
15) Kamlagundi (*Mallotus phillipensis*)
16) Fasi (*Anogeissus acuminate*)
17) Java Bara (*Ficus benjamina*)

During 5th year, plantation, when fully established can be seeded with Modaphal (*Helictres isora*) to form an under-storey, which is an excellent food plant for elephants.

6.1.2 **Coil geo-textile:** Dump stabilization will be done over 6 Ha through coir geo-textile, where the slope is pretty high and where afforestation is yet to be taken up. Dumps will be further made safer by making terraces and construction of retaining wall below the toe of the dump.

6.1.3 **Grass seeding:** Dumps and sloping lands bereft of vegetation will be further stabilized by seeding of grass pellets. Pellets of 2 cm dia can be made by mixing powdered clayey loam with FYM in 6:1 ratio, kneaded with water and grass seeds @ 5 kg/hectare and sun dried in March and dibbled in slopes and barren areas well before monsoon to strike roots effectively. This will provide a soil cover and minimize erosion.

6.1.4 **Protection of plantations:** About 22 Ha plantations exist on the safety zone and outer periphery within the plan period, 60 Ha plantations will

be added. Upto 5th year, 2 Van Sahayaks and thereafter, 3 such will be engaged to look after the plantations Rigid protection will ensure colonization of plants by air borne seeds and through bird droppings. Small animals may also return to the safety of plantations when left undisturbed and unmolested.

6.1.5 **Dust control:** Water spraying twice on roads, ore storage yard, sub-grade will reduce fugitive dust. Ore, during transport shall be covered with tarpaulin. In the crushing unit, dust will be substantially reduced by fogging system. Drills will be provided with dust collection bags etc plantations will act as useful dust trap.

6.1.6 **Noise / light pollution control:** Proper maintenance of equipments, subdued blasting, use of delay detonators, avoidance of air blast and blasting in an asynchronus manner between adjacent mines, blasting during lunch-break hours will have least impact on wildlife through noise. Dispersion of light can be minimized by painting upper half of headlights black, allowing light over required area only. Sky glow will be prevented with overhead shade. However, effective safety zone and other green belt will act as an acoustic and light barrier.

6.1.7 **Water pollution control:** This is very important as Karo nala flows on the western edge of the M.L. area. Water will be collected in garland drains all round the area. Garland drains will be 1-5m wide and 1m deep with sloping sides. The side slopes and bottom of the drain will be stone pitched to prevent scouring and bank erosion, water from the drains will be taken to a sedimentation tank at the toe of the dump, where water is allowed to travel in a zig-zag manner, which reduce the velocity and facilitates sedimentation of suspended solids. The clear water will be discharged to the nala. The garland drains will be taken on contour and water will be allowed to drop at masonary tanks, where there is abrupt change in contour. Further, check dams and contour trenches will reduce turbidity by trapping silt.

6.1.8 **HDPE tank:** Two HDPE tanks can be made at two different locations within the safety zone to provide water to small mammals and birds. This will be 60 cm deep and slanting on one side to emerge at ground level. The size will be 3x3m whose sides will be covered with HDPE

sheet. The edges of the sheet will be covered with a boulder line and eyes will be firmly anchored with iron spikes. Clear water will be filled in this every alternate day or twice a week and rotting leaves and soil etc removal from inside and disinfected with a mugful of $KMnO_4$ solution. Care will be taken that the tank received good sun light but lateral shade is okay from adjacent trees/shrubs, which may serve useful purpose as cover patch or as perching tree.

6.1.9 **Solar powered fencing:** With a view to prevent accidental fall of animals that may stray into the M.L. area, the pits will be kept fenced with solar powered fencing, particularly in deep sides. About 7 km steep sides need to be barricaded. As the reclamation proceeds and slopes are eased, the fencing can be removed and taken to cover deeper locations.

6.1.10 **Participatory fire control:** In addition to whole time Van Sahayaks, who will be patrolling the area during fire season, villagers of Roladihi, Lengdasahi & Kasira will be associated in fire prevention and fire fighting in case of accidental break up. For this purpose, villagers will be given financial incentive after fire season is over without any or minimal incidents of fire. Fire outbreak is an emergency, during which all workers and villagers will be pressed into service. However, fire lines will be kept cleaned ahead of fire season to prevent any outbreak. A lump sum provision will be made.

6.1.11 **Garbage disposal:** All garbage will be segregated in separately assigned bins for biodegradable and non biodegradable components. Biodegradable garbage will be made to vermin compost and non biodegradable garbage will be disposed for recycling or incinerated.

6.1.12 **Creation of awareness:** Conservation is effective only where all stakeholders understand their duties and responsibilities well. To make the workers and adjoining villagers aware of the issues involved and action plan under implementation, it with will be worthwhile to have meetings & seminars, where all villagers workers will be given opportunity to put forth their view points and suggestions. Suitable rewards may also be given to the best eco-sensitive worker and villager after prior evaluation.

6.2.0. Conservation plan for the buffer zone:

6.2.1 Assisted Natural Regeneration: Dense Sal scrub lying between Mendhamaruni R.F. & Karo R.F. will be rehabilitated over 50 ha. This will have the advantage in building up additional food and cover resources and also reinforcing the connectivity between two R.F's by nursing up of the coppice growth by regeneration cleaning, singling out shoots and enriching the growth by putting 300 plants/ha of browse value to elephants. For this purpose, at an interval of 10m grid lines will be cleaned and 45 cm cube pits will be excavated every 3m avoiding overhead shade. Nursery raised seedlings will be planted in these pits with basal dose of manure and tended for 5 years. The species and method of planting & post planting care will be the same as given in para 6.1.1. Villagers of Rengalbera will be completely involved in this work.

6.2.2 **Game tanks:** One game tanks will be made of 100x100m size in suitable locations, one each in Karo R.F. and Sarkanda R.F. by diverting small streams. Game tanks will be located in valley bottoms or such level areas, where water will be retained during summer, when it is most needed. Each tank will have an inlet and an outlet channel with well designed flood water escape weir. Each tank will hold 0.6 ha water of minimum 1.5m deep during summer. The sides of game tank will be of proper slope to eliminate chances of drowning due to accidental fall of young ones.

6.2.3 **Check dams:** Rubble check dams on the upper reaches of Karo, Samij and Sarkanda nalas will be constructed to improve percolation and consequently, optimum growth of browse plants and other herbaceous growth. Check dams will also arrest silt and prevent erosion and bring overall improvement in the habitat. One hundred such check dams will be constructed upto – 3m in width and height not exceeding a metre. With a view to channelise water flow, the centre of such dams should have a V-notch, where boulders are not available locally, as in valleys, brush wood check dams can be made. Spikes of easily rooting species e.g. Erythrina, Sissoo, Ficus, Lannea may be treated with Indolyl acetic acid, a rooting hormone and planted. Brush wood can be intertwined

and woven horizontally to the spikes. Spikes can further be reinforced with a layer of boulders downstream as additional support and to act as apron to the falling water. The distance between two check dams will depend on the slope of the nala bed. General principle to be adopted is the bottom of a check dam should be on the same horizontal line as the top of the dam downstream.

6.2.4 **Salt licks:** Artificial salt licks will be made close to game tanks to be excavated and other small water holes, where wild animals' signs are found. Salt licks will be made by mixing 96% common salt, 3% rock salt and 1% mineral mixture (having essential trace elements). Elephants, deer and wild pigs lick salt to meet the mineral requirements and for proper health. The lick should be placed on a higher ground so that it remains free from contaminants like urine and faecal matter.

6.2.5 **Monitoring biodiversity:** Permanent trend transects will be laid out along fertility gradient to represent the local diversity of flora and fauna. Transects will be laid perpendicular to appropriate baseline in Karo-Toda R.F's and Sarkanda-Khajuridihi R.F's. A minimum of 5 transects each 2 km long will be marked in each sector. Thus, a total transect length of 20 km will be marked. Each transect may be laid 500m apart. The starting point GPs reading and bearing of compass will be noted for future reference.

Transect lines can be marked in central red paint band with two white paint bands on either side on breast height of trees. While aligning the transect, care will be taken to avoid least damage to flora. Transects will be taken to avoid least damage to flora. Transects will be selected and laid out on the ground on the basis of stratified random sampling after marking on the map. Following readings will be taken.

a) Recording of herbs and shrubs every 2m on the sides and every 2.02m on the diagonals of a 10x10m plot every 100m on the transect. The central point of transect will be marked with a wooden peg.

b) Recording tree growth in 15 cm girth classes' species wise in 20m strip along the grid. Trees of less than 30 cm girth will not be listed.

c) Any animal sighted in 20m strip will be noted with its direction of movement and flushing distance carefully noted perpendicular from the grid line and also from the grid measured.

d) All elephant dung encountered on the grid and visible from the grid will be noted and its perpendicular distance from the grid measured.

e) Pellet groups of deer encountered and visible in 10x10m plots will be noted.

f) All other animal signs like feeding signs, bedding, faecal matter, rubbing posts, claw marks, ground scrapping, ground nests, pelage, shed antlers will be recorded. Alarm and mating calls will be recorded.

g) Nala beds and game trails will be intensively searched to find foot prints, pug marks and other animal signs including kills by predators.

h) Rare species will be recorded and its location noted through GPs reading.

Following indices of biodiversity will be estimated to know importance of species in community and the diversity of community itself.

a) Species richness index = $d = S-1 / \log N$

Where, S = Number of species in the sample

N = Number of individuals in the sample

b) Shanon Index of general diversity

$H = -\sum (ni / N).\log (ni / N)$

Where, ni = Importance value of a species based on its number/basal area

N = Total of importance values of all species

c) Relative frequency of a species

R = Number of individuals of the species / Total number of species x 100

d) Index of dominance = $C = \sum (ni / N)^2$

Where, ni = Number of individuals in a species

N = Total number of individuals of all species in the sample

e) Animal density in strip count

N/A = C/2L. ∑1/dj

N = Animals sighted from the transect

A = Area of strip covered (based on the average flushing distance)

N/A= Average density of animal surveyed

L = Length of the transect (strip)

dj = Flushing perpendicular distance of an animal from the survey line on either side

f) Elephant dung count:

E = (Y x R) / D

Where, E = Elephant density

Y = Dung density

R = Decay rate

D = Defecation rate = 16 piles per day

To assess the defecation rate, fresh dung piles are monitored every 15 days for over 4 months (8 readings), when more than 50% dung piles are seen totally obliterated. A minimum of 50 dung piles will be monitored.

g) Pellet group count (for deer)

t = 1/a. ∑y

Where, ∑y = Sum of pellet groups counted over 10x10m plots

a = Area of entire sample (ha) = number of plots x 100 sq.m. / 100x100

t = pellet groups per ha

N/A = t / r x d

Where, N = Number of deer in the habitat

A = Area of the habitat

N/A = Deer density per ha

r = Defecation rate

d = Days over which pellet groups have been deposited (Number of days needed for total obliteration)

The baseline studies will b ...d out in the first year and diversity and animal numbers monito ...ry alternate year, i.e. 3rd, 5th, 7th and 9th year. Thus, in all, 5 surveys will be done during the plan period. Rare fauna, flora and indicator species in particular, will be monitored specifically as indicator of pollution levels.

The survey can be done departmentally, particularly tree enumeration, animal strip count, dung density count, pellet count etc in collaboration of scientific institutions. Analysis of data can be outsourced. Survey of amphibians, algae, fungi, lichens, grasses and insects will be outsourced.

6.2.6 **Antidepredation squad:** This will consist of R.O. Koira, Section Forester, 2-3 forest guards and 5 trackers. Trackers will be deployed to move on foot in forest areas as per instruction of the R.O./Forester with a view to collect data on wild animals more specifically of elephants. Each tracker will be provided a haver sack, set of uniforms, whistle, pen knife, measuring tape, a note book, pencil, a set of polythene bags and a bamboo stick. Tracking will be done every morning between 5 AM – 8 AM. Information on number of elephants, location and probable line of movement is shared between villagers and staff members to plan driving in case of need. During evening hours, the squad may patrol the probable area and alert the villagers. This squad will also mount vigilance against poaching and illegal strip mining.

6.2.7 **Equipment for antidepredation work:** Following equipments will be purchased for the squad and for distribution in villages.

i) Rechargeable flash lights (heavy duty) – 30 nos
ii) Battery operated megaphone-cum-siren – 15 nos
iii) Mobile phone – 5 nos
iv) Fire crackers (rocket type) – As per need
v) Solar lights – 25 nos

6.2.8 **Corpus fund:** A lump sum amount will be deposited as corpus fund to be operated by the human deaths and grievous injury cases.

6.2.9 **Fireline:** Karo R.F. will be totally fire protected for which 5 km fireline will be maintained in R.F. boundary skirting villages to check ingress of fire from outside. Adjoining villagers will be involved on this work on payment of wages so that they develop a sense of ownership with the forest. The work may also be entrusted to the VSS if well organized. The line will be in a width of 10m and repeatedly fire traced to keep it clean of any inflammable material.

6.2.10 **Incentive to VSS:** Five villages will be kept incentivised through VSS for successful prevention and fire fighting. They will also assist in elephant watch and sharing information with the antidepredation squad. Incentive will be released after successful fire prevention/fighting and assisting the squad in antidepredation work.

6.2.11 **Check gates:** Two check gates will be fixed on forest roads in Karo and Sarkanda R.F's to prevent vehicular poaching. The check gate will be kept open during day and kept locked during night. The gate will be operated by a selected local, who will be paid a consolidated wage of Rs.3,000.00 per month. This will prevent poaching and illegal transport of ore after prescribed hours and also illegal mining.

6.2.12 **Eco-development:** To resolve the conflict over shrinking forest resources and changing land use, willing villagers will be selected for skill development training in alternative livelihoods. The selection will be entrusted to the VSS/SHG as is active in the village. After training is imparted, micro credit will be sanctioned and released through the aforesaid bodies for undertaking selected enterprises. Marketing of products can be done by these bodies with active support and facilitation by the Forest Department.

6.2.13 **Control of vehicular traffic:** Tipper movement will be regulated in a manner so as not to pass through forest areas after sunset. At other times, speed will not exceed 25 KmpH. The drivers will be advised to maintain 50m gap between vehicles to reduce dust pollution and to

stick the speed limits set to prevent accidents. Fitness of vehicle need to be periodically checked.

6.2.14 **Awareness promotion:** Apart from VSS, local youth in schools will be sensitized on forest and wildlife conservation and the necessity thereof. Meetings, debates, film shows can be held to impart cutting edge knowledge to students to enthuse them. Van Mahotsav and wildlife week may also be organized for the purpose. Eminent social worker of the area, NGO, local DFO, Collector etc may be invited to address the gathering and distribute prizes to the winners of competitions in debate, essays, paintings etc.

6.2.15 **Digitised maps and forest cover assessment:** Every second year, forest cover assessment will be made in the buffer zone from digitized maps to be procured from NRSA. The assessment can be taken up by ORSAC.

CHAPTER – VII
FINANCIAL FORECAST

7.0.0 The financial requirement of various interventions suggested in the plan is as per the current costs and is given in tables 7.1 and 7.2 for the M.L. area and BZ.

7.0.1. The activities within the M.L. area will be implemented by M/s. AMTC Limited and that within the BZ through the DFO Bonai Division.

7.0.2. The total cost of the plan is Rs.302.00 lakhs; Rs.138.00 lakhs for the M.L. area and Rs.144.00 lakhs for the BZ. In addition, a vehicle cost of driver and 100 litres diesel per month will be given in kind. Running cost of vehicle will be deposited with the DFO every month by cheque. This works out to an additional Rs.20.00 lakhs.

7.0.3. **Monitoring Committee:** There will be a Monitoring Committee to oversee the implementation of the plan for reasons of transparency. The committee will also guide implementation, resolve bottlenecks, select sites, and shall have the power to modify various provisions in the interest of conservation. The committee will be headed by the DFO with mine representative, 2 VSS Presidents, R.O. Koira and a member from local NGO as members.

CHAPTER-VII
FINANCIAL FORECAST

7.0.0 Based on activities suggested in the Chapter ad financial estimate for activities within the lease hold area and in the adjoining forest etc. areas are as under.

7.1.0 The activities proposed to be taken up inside the lease hold area are to be executed by the DFO, Bonai Forest Division under the guidance of C.F., Rourakela.

7.2.0 The following table indicates the cost estimate for measures to be taken up inside and outside the project area within 10-years. The cost of activities to be taken up in the Project area and in the project impact area (ZoI) i.e. outside leasehold area shall be deposited with the Forest Department to be utilized by the Divisional Forest Officer, Bonai Division for execution of works under the guidance of Conservator of Forests, Rourakela Circle. User agency will deposit Rs.288.00 lakhs with DFO, Bonai Forest Division under CAMPA for implementation of the plan.

7.1.1: Activities within the Project Area. (Rs. In lakhs)

Sl. No.	Item of work	Amount approved by CWLW
1	Plantation of intimate mixture of food and cover species over 40 ha @ Rs.50.00 lakhs per ha.	Dump reclamation & plantations are to be done as per dump reclamation plan for approval by competent authority separately & intimated to us.
2	Coir Geo textile over 6 Ha to stabilize steep dumps	
3	Grass seeding over 30 ha.	
4	Van Sahayaks	
5	Dust control	Pollution Control Board to separately approve such proposals
6	Noize /light pollution control	
7	Garbage disposal	
8	Water pollution control	
9	Creation of water sources in 184 ha. of virgin forest area in the ML area as per GOI stage – 1 & 2 clearance etc.	20.00
10	Solar powered fencing - to be done around mining pits to save straying wild animals and not to obstruct wildlife corridors existing in the mining lease area.	15.00
11	Fire incentive to 3 villages	6.00
12	Habitat improvement in 184 ha. of virgin forest area as per stage-1& 2 clearance of GOI with fruit, fodder and cover species for both avi-fauna and other wildlife in the area.	25.00
13	Soil and moisture conservation measures in the lease hold area to avoid silting up of nalas and to revive two nalas originating from the ML area	6.00
14	Distribution of seedlings under farm forestry to local villagers to augment fruit, fodder and fuel wood sources in the area	6.00
15	Creation of awareness, sinages of wildlife, livelihood activities, supplying of various types kits and livelihood training etc.	10.00
16	Unforeseen expenses	4.00
	Total	92.00

7.1.2: Activities within the Project Impact area (zone of influence).

Sl. No.	Item of work	Amount approved by CWLW
1	Habitat improvement measures with fruit fodder and cover species/ bamboo plantations/ meadow development/ ANR/ staggered trenches in forest areas.	30.00
2	Creation of water sources in forest areas with wallowing grounds on the down side of spill way by creating muddy and slushy area for wild animals to wallow and gambol.	25.00
3	Check dams of random rubble in upper reaches of Karo, Samij and Sarkanda nala And soil and moisture conservation measures in forest areas to avoid chocking of nalas, rivulets and drainage channels	8.00
4	Salt licks = 5 nos.	3.00
5	~~Trackers = 5nos. for anti-depredation squad~~ Anti-depredation/ anti-poaching squad with hired vehicle/ manpower/ equipment/ barracks/ crackers, megaphone, search lights/ flare guns/ tents & camping equipments for 10 years including engagement of elephant trackers	40.00
6	Equipments for 10 years: Flash light - 30 nos. Megaphone = 15 nos. Mobile phone with SIM card = 5nos. Fire crackers Solar light = 25 nos.	12.00
7	Corpus fund to meet ex-gratia payment	10.00
8	Creation of fire lines and maintenance of old fire lines/ fire fighting equipments/ fire fighting squads/ incentive to VSS for prevention of fire as encouragement incentive.	11.00
9	a) Check gates = 2nos. = 1.00 b) Remuneration to VSS members = 2 nos. = 6.00	7.00
10	Livelihood activities promotion, training, supplying of various kits/ machines/ equipments/ self-help groups formation/ micro credit seed money etc.	25.00
11	Awareness promotion, sinages for wildlife etc.	5.00
12	Biodiversity and animal status monitoring & Development of communication network / GIS based maps Satellite maps on GIS domain should be procured every year to know the changing profile of the project area in both dry season and wet season for 10 years preferably using the GIS lab of PCCF(WL), Orissa	15.00
13	Unforeseen & misc.	5.00
	Total	**196.00**
	Grand Total	**288.00**

N.B: All measures for dump reclamation, dust suppression, garbage bins, soil erosion measures should be taken up including retaining walls , plantation etc. as per the reclamation plan etc to be prepared in terms of the approved mining plan and other guidelines. This component is to be dealt separately as per the above guidelines. Hence no financial forecast on this account is indicated in the conservation plan.

Approved by PCCF(WL)& CWLW, Orissa.

Conservator of Forests(WL)

REFERENCES

1. Working Plan of Bonai Forest Division.
2. Man-elephant conflict of Bonai Forest Division.
   - Sur & Lahiri Choudhury
3. Wildlife Wealth of Orissa – Wildlife Wing, Forest Department.
4. Flora of Orissa, Saxena & Brahman.
5. District Gazetteer, Sundergarh District.
6. Statistical hand Book of Sundergarh District.
7. Modified Mining Plan of Narayanposi Iron & Manganese Mines.
8. E.M.P. report of Narayanposi Iron & Manganese Mines (2005).
9. Regional Wildlife Management Plan of Keonjhar & Bonai Divisions.
10. Right of Passage-elephant corridors of India; Wildlife Trust of India
11. State of India's Forest Report-2005; Forest Survey of India
12. Wildlife Census in Orissa (2008) – Wildlife Hqrs., Orissa.

ANNEXURE-1

50

F.No.8-34/2000-FC (Vol. I)
Government of India
Ministry of Environment & Forests
(F.C. Division)

Paryavaran Bhawan, C.G.O. Complex,
Lodi Road, New Delhi-110003.
Dated: 11-03-2005

19 MAR 2005

14

The Principal Secretary (Forests),
Government of Orissa,
Bhubaneswar.

Sub: Diversion of 244.327 ha. of forest land (including 184.591 ha. of virgin forest land) for 3rd renewal of Narayanposi Iron and Manganese Ore Mines in villages Koira and Kasira of Bonai Forest Division in favour of M/s AMTC (P) Ltd., in Sundergarh district of Orissa.

1493
24.3.05

Sir,

I am directed to refer to your letter No. 10F(Cons)-130/2004/18319/F&E dated: 09.-2004 on the above mentioned subject seeking prior approval of the Central Govt. under ction-2 of Forest (Conservation) Act, 1980, and to say that the proposal has been amined by the Forest Advisory Committee constituted by the Central Government under ction 3 of the aforesaid Act.

After careful consideration of the proposal of the State Government, and on the asis of recommendations of the above-mentioned Advisory Committee, the Central vernment, hereby, agrees in-principle for diversion of 244.327 ha. of forest land cluding 184.591 ha. of virgin forest land) for 3rd renewal of Narayanposi Iron and nganese Ore Mines in villages Koira and Kasira of Bonai Forest Division in favour of s AMTC (P) Ltd., in Sundergarh district of Orissa, subject to fulfilment of following nditions:

1. User agency shall carry out immediate transfer and mutation of 184.591 ha. of non-forest land in favour of State Forest Department.
2. The User Agency shall deposit the cost of raising and maintaining compensatory afforestation over 184.591 ha. of non-forest land with the State Forest Department.
3. The non-forest land for compensatory afforestation shall be notified by the State Government as RF under section - 4 or PF under section - 29 of the Indian Forest Act, 1927 or the State Forest Act within a period of 6 months and Nodal Officer (Forest Conservation) shall report the compliance.
4. User Agency shall deposit the Net Present Value (NPV) of the diverted forest land of 244.327 ha., with the State Forest Department as per the orders of the Hon'ble Supreme Court dated 30-10-2002 & 1-8-2003 in I.A No.566 in WP (C) No.202/1995 and the guidelines issued by this Ministry vide letter No.5-1/98-FC(Pt-II) dated 18-9-2003 and 22-9-2003 in this regard.
5. The State Government shall deposit all the above-mentioned fund in form of Fixed Deposits in the name of concerned DFO/ Nodal Officer of the State, till such time the CAMPA intimates the Head of Account for deposition of fund.

9. Demarcation of the area will be done on ground at project cost using four feet high RCC pillars, if not done earlier for entire area. The pillars shall indicate serial numbers, forward and back bearings and distance between adjacent pillars.
10. The user agency shall prepare a plan for soil conservation measures in project area in consultation with the State Forest Department and will submit it to the Central Government prior to Stage-II clearance.
11. User agency shall contribute to the State Government for the implementation of Regional Wildlife Management Plan prepared for Bonai and Keonjhar Divisions. The State Government shall submit the progress report of the Wildlife Management Plan.
12. The user agency shall protect the top soil at the project cost.
13. Concurrent Reclamation plan shall be executed by the user agency from the very first year, and an annual report shall be sent to the Nodal Officer and the Regional CCF, Bhubaneswar. If it is found from the Annual Report that the annual programme mentioned in Concurrent Reclamation Plan is not being adhered to by the user agency, the mining activities shall remain suspended till such time the annual programme is completed for that year.
14. The mining lease shall be coterminus with the current lease granted under MMRD Act, 1957.
15. Other standard conditions as applicable in respect of mining projects, shall apply in the instant case also.

After receipt of compliance report on the fulfilment of the above-mentioned conditions No.1,2,4,5,6,7 and 8 from the State Government, formal approval will be issued in this regard under Section 2 of the Forest (Conservation) Act, 1980. Transfer of forest land to user agency shall not be effected by the State Government till the final orders for diversion of forest land are issued by the Central Government. However, in accordance with para 4.18 of the guidelines issued under Forest (Conservation) Act, 1980, temporary working permission shall be allowed over already broken up area of 59.736 ha. for a period of 6 (six) months to comply with the above conditions.

Yours faithfully,

Sd/—

(ANURAG BAJPAI)
Asstt. Inspector General of Forests

Copy to:

1. The Principal Chief Conservator of Forests, Government of Orissa, Bhubaneswar.
2. The Nodal Officer, Forest Department, Government of Orissa, Bhubaneswar.
3. The Chief Conservator of Forests (Central), Regional Office(EZ), Bhubaneswar.
4. Regional Office (Hqs), New Delhi.
5. User Agency.
6. Monitoring Cell of FC Division.
7. Guard file.

14/3/05

(ANURAG BAJPAI)
Asstt. Inspector General of Forests

OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FORESTS, ORISSA, BHUBANESWAR

Memo No. 6455 /9F(MG)-103/04 Dt. 23-3-05

Copy forwarded to the D.F.O., Bonai Division for information and necessary action. He is requested to implement the Govt. order and repor compliance to this office at an early date.

Copy forwarded to the Conservator of Forests, Rourkela Circle for information and necessary action.

Chief Conservator of Forests (Nodal

IL Corporate Office

F. No. 8 – 34/2000-FC (Vol.-I)
Government of India
Ministry of Environment & Forests
(FC Division)

ANNEXURE – II

Paryavaran Bhawan
CGO Complex, Lodhi Road
New Delhi-110 003

Dated 15th November, 2007

To

The Principal Secretary (Forests),
Government of Orissa,
Bhubaneswar.

Sub: Diversion of 244.327 ha. of forest land (including 184.591 ha. of virgin forest land) for 3rd renewal of Narayanposi Iron and Manganese Ore Mines in Villages Koira and Kasira of Bonai Forest Division in favour of M/s AMTC (P) Ltd., in Sundargarh district of Orissa.

Sir,

I am directed to refer to your letter No. 10F (Cons) 130/2004/18319/F&E dated 09.12.2004, wherein the above proposal for diversion of 244.327 ha. of forest land (including 184.591 ha. of virgin forest land) for 3rd renewal of Narayanposi Iron and Manganese Ore Mines in villages Koira and Kasira of Bonai Forest Division in favour of M/s AMTC (P) ltd., in Sundargarh district of Orissa was submitted seeking prior approval of the Central Government in accordance with Section-2 of the Forest (Conservation) Act, 1980.

2. After careful consideration of the proposal of the State Government and on the basis of the recommendations of the Forest Advisory Committee, the Central Government granted in-principle approval to the said proposal under Section-2 of the Forest (Conservation) Act, 1980, on 14.03.2005, subject to the fulfilment of certain stipulated conditions. State Government of Orissa has now submitted a compliance report of the said stipulated conditions vide letter No. 10F (Cons)-6/2007/13514/F&E dated 23.08.2007. After considering the proposal and compliance of the stipulated conditions by the State Government, the Central Government hereby grants **final approval**, under the Forest (Conservation) Act, 1980, for diversion of 244.327 ha. of forest land (including 184.591 ha. of virgin forest land) for 3rd renewal of Narayanposi Iron and Manganese Ore Mines in villages Koira and Kasira of Bonai Forest Division in favour of M/s AMTC (P) ltd., in Sundargarh district of Orissa subject to fulfilment of following conditions :-

1. Legal status of the forest land shall remain unchanged.
2. Compensatory Afforestation shall be raised and maintained over equivalent non-forest land by the User Agency at the Project Cost.
3. The non-forest land identified for raising Compensatory Afforestation shall be transferred and mutated in the name of the State Forest Department and shall be declared as Reserved / Protected Forest under the Indian Forest Act, 1927, or any other relevant Act of the State. Nodal Officer (FC), Government of Orissa shall report compliance within 6 months.
4. The State Government shall charge the Net Present Value of the forest area diverted under this proposal from the User Agency as per the orders of the Hon'ble Supreme Court of India dated 30.10.2002 and 01.08.2003 in IA No. 566 in WP (C) No. 202/1995 and as per the guidelines issued by this Ministry vide letters No. 5-1/1998-FC (Pt. II) dated 18.09.2003, as well as letter No. 5-2/2006-FC dated 03.10.2006 in this regard.
5. The State Government shall deposit NPV and all other funds with the Ad-hoc Body of Compensatory Afforestation Fund Management and Planning Authority (CAMPA) in Account No. CA 1585 of Corporation Bank, Block-11, Ground Floor, CGO Complex, Phase-I, Lodhi Road, New Delhi-110003.
6. Additional amount of NPV of the diverted forest land, if any, becoming due after finalization of the same by the Hon'ble Supreme Court of India on receipt of the report from the Expert [illegible] shall be charged by the State Government from the User Agency.

7. The User Agency shall provide necessary funds to the State Forest Department to implement the Scheme for Suitable Need Based Soil and Moisture Conservation Measures.
8. The User Agency shall create, fence and maintain a proper safety zone around the mining area. The User Agency shall deposit funds with the Forest Department for the creation, protection and regeneration of the safety zone area, and also shall bear the cost of afforestation over one and a half time of the safety zone area.
9. Concurrent Reclamation Plan shall be carried out by the User Agency as per the approved Reclamation Plan at the Project Cost, and an annual report shall be sent to the Nodal officer and the Regional CCF, Bhubaneswar. If it is found from the Annual report that the annual programme mentioned in the Concurrent Reclamation plan is not being adhered to by the User-Agency, the mining activities shall remain suspended till such time the annual programme is completed for that year.
10. Demarcation of the area shall be done on the ground at the project cost using four feet high RCC pillars with serial numbers, forward and back bearings and distances from pillar to pillar.
11. Tree felling shall be done in a phased manner to coincide with the phasing of area to be put to mining with a view to minimize clear felling. The tree felling will always be carried out under the strict supervision of the State Forest Department.
12. The User Agency shall implement a 'Conservation Plan' in their lease hold area as per the guidelines of the Chief Wildlife Warden, Orissa.
13. The permission granted under the FC Act shall be co-terminus with the mining lease granted under MMDR Act, 1957 or any other relevant Act or for 20 years, whichever is less.
14. No labor camps shall be established on forest land.
15. Sufficient firewood shall be provided by the User Agency to the laborers at the project cost after purchase from the State Forest Department/Forest Development Corporation.
16. The forest land shall not be used for any purpose other than that specified in the proposal.
17. All other standard conditions stipulated for Mining Projects shall be complied with by the User Agency.
18. All other conditions that the CCF, (Central) Regional Office, Bhubaneshwar, may impose from time to time for the protection and improvement of the flora and fauna in the forest area shall also be applicable.

The State Government shall ensure compliance of all the above conditions.

Yours faithfully,

(A.K. Joshi)
Assistant Inspector General of Forests

Copy to:-

1. The Principal Chief Conservator of Forests, Government of Orissa, Bhubaneswar
2. The Nodal Officer, Office of the PCCF, Government of Orissa, Bhubaneswar
3. The Chief Conservator of Forests (Central), Regional Office, Bhubaneswar
4. User Agency
5. Monitoring Cell / FC Div.
6. Guard file.

15/4/97

(A.K. Joshi)
Assistant Inspector General of Forests

ANNEXURE - III

Phone Nos. (0674) 2744407/2743463
Fax No. (0674) 2744430
E- mail rcombbsr@sancharnet.in
rcombbsr@yahoo.com

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES
OFFICE OF THE REGIONAL CONTROLLER OF MINES

No. BBS/SG/Fe&Mn/MP-193

Mahanadi Complex, 2nd Floor
308, District Centre
Chandrasekharpur
Bhubaneswar - 751 016
Date: 10.05.2004

To

Shri Rajeswar Thakore
Director-in-Charge
M/s Aryan Mining & Trading Corporation (P) Ltd.
61, Strand Road
Kolkata- 700 006

Sub. Approval of Mining Plan for Narayanposhi Iron & Manganese Mine of M/s Aryan Mining & Trading Corporation (P) Ltd. over an area of 349.254 ha. in villages Koira & Kashira in Sundergarh district of Orissa state submitted under Rule 24A of MCR, 1960.

Ref. (1) Your RQP's letter No. Nil dated 07.04.2004.
(2) This office letter of even number dated 19.04.2004.
(3) Your RQP's letter No. Nil dated 14/17.05.2004.

Sir,

In exercise of the power conferred by the clause (b) of sub-section (2) of section 5 of Mines & Minerals (Development & Regulation) Act, 1957, read with Government of India Order No. S.O. 443 (E), dated 28.04.1987, I hereby **APPROVE** the aforesaid Mining Plan. This approval is subject to the following conditions :

(i) This Mining Plan is approved without prejudice to any other law applicable to the mine/ area from time to time whether made by the Central Government, State Government or any other authority.

(ii) The Mining Plan is approved without prejudice to any order or direction from any court of competent jurisdiction.

02. It is also clarified that the approval of your aforesaid Mining Plan does not in any way imply the approval of the Government in terms of any other provision of Mines & Minerals (Development & Regulation) Act, 1957, or the rules framed thereunder and any other law.

03. The details of **renewal** of the lease by the State Government, whenever such an order is passed, may be intimated to the Regional Controller of Mines, Indian Bureau of Mines, Bhubaneswar.

04. Your attention is invited to the Supreme Court interim order in W. P. (C) No. 202, dated 12.12.96 for compliance. The approval of the Mining Plan is, therefore, issued without prejudice to and is subject to the said directions of the Supreme Court as applicable in your case.

contd.....2

05. As per the requirement of Rule 22(5)(va) of Mineral Concession Rules, 1960, a Progressive Mi Closure Plan; as defined in clause (oo) of Rule 3 of Mineral Conservation & Development I 1988; should have been incorporated in the Mining Plan, which has not been done. The Mining Pl is, therefore approved, subject to the condition that Progressive Mine Closure Plan wo submitted to this office for approval, within a period of 60 days from the date of issue of l failing which, this approval shall stand withdrawn.

06. Further, this approval of Mining Plan is subject to the following conditions :

(a) Provisions of the Mines Act, 1952 and Rule & Regulations made thereunder including submissi of notice of opening, appointment of manager and other statutory officials as required by Mines Act, 1952 shall be complied with.

(b) The execution of Mining Plan shall be subjected to vacation of prohibitory orders/ notices, if any.

(c) If anything is found to be concealed as required by the Mines Act in the contents of the Mi Plan and the proposal for rectification has not been made, the approval shall be deemed to hav been withdrawn with immediate effect.

Yours faithfully

Encls. Two copies of approved Mining Plan.

(RANJEET SIN
Regional Controller of Mine

प्रतिलिपि निम्न को सादर सूचनार्थ अग्रेषित/Copy forwarded for kind information to:

1.	श्री एस. सी. नायक, आर. क्यू. पी., एम ए/ 17, जी. जी. वो. कॉलोनी, रसूलगढ़, भुवनेश्वर- 751 010.	Shri S C Nayak, RQP, MA/17, GGP Colony, Rasulgarh, Bhubaneshwar-751 010.
2.	डाइरेक्टर ऑफ माइन्स, डाइरेक्टरेट ऑफ माइन्स, उड़ीसा सरकार, हेड्स ऑफ डिपार्टमेंट बिल्डिंग, न्यू केपीटल, भुवनेश्वर- 751 001.	Director of Mines, Directorate of Mines, Government of Orissa, Heads of Department Building, New Capital, Bhubaneswar– 751 001.
3.	डाइरेक्टर ऑफ माइन्स सेफ्टी, डाइरेक्टोरेट जनरल ऑफ माइन्स सेफ्टी, चाईबासा क्षेत्र, एट एण्ड पोस्ट चाईबासा, जिला सिंहभूम पश्चिम (झारखण्ड), पिन- 833 201, को अनुमोदित माइनिंग प्लान की एक प्रति के साथ, रजिस्टर्ड पार्सल द्वारा.	Director of Mines Safety, Directorate General of Mines Safety, **Chaibasa Region**, At & P.O. **Chaibasa**, Dist. Singhbhum West (Jharkhand), PIN 833 201, along with one copy of approved Mining Plan, by **REGISTERED PARCEL.**
4.	खान नियंत्रक (मध्यांचल), भारतीय खान ब्यूरो, नागपुर – 440 001, को अनुमोदित माइनिंग प्लान की एक प्रति के साथ, रजिस्टर्ड पार्सल द्वारा.	Controller of Mines (CZ), Indian Bureau of Mines, Nagpur – 440 001, along with one copy of approved Mining Plan, by **REGISTERED PARCEL.**
5.	सम्बंधित माइन फाइल	Concerned mine file.

20/5/2015

(रणजीत सिंह / RANJEET SINGH)
क्षेत्रीय खान नियंत्रक / Regional Control of Mines

ANNEXURE XXXIII

Government of Odisha
Steel and Mines Department

****

VESTING ORDER

No. 4212 /SM Dated the 30 May 2020
IV(B)SM-21/2020

Whereas a mining lease of the following description, which was held by M/s Aryan Mining & Trading Corporation Pvt. Ltd. (hereinafter referred to as the previous lessee) with validity period upto 31.03.2020 has been auctioned and M/s JSW Steel Ltd., has been declared as the preferred bidder of the said mine.

Description of the Mining Block

- Name of Mineral(s) – Iron & Manganese
- Name of Mining lease - Narayanposhi Iron & Mn Block.
- Address/location of mining lease - Village Koira, Kashira and Kathamala RF under Koira Tahasil of Sundergarh district.
- Area of lease – 347.008 hects (As per DGPS)/ 349.254 hects(As per ROR).

And whereas, a letter of intent bearing no 2288 dated 02.03.2020 has been issued in favour of the preferred bidder for grant of mining lease for the above mentioned mining block;

And whereas, in terms of section 8B(2) of the MMDR Act, 1957 read with rule 9A(4) of the Mineral (Other than Atomic and Hydrocarbon Energy Minerals) Concession Rules, 2016 [herein after called the Rules'2016], the holder of the letter of intent for the said mining block shall be deemed to have acquired all valid rights, approvals, clearances, licenses and the like vested with the previous lessee.

Now therefore, the undersigned being the Nodal Officer for the State of Odisha having been nominated under rule 9A(1) of the Mineral (Other than Atomic and Hydrocarbon Energy Minerals) Concession Rules, 2016 [herein after called the Rules,2016], do hereby, pursuant to the provisions contained in rule 9A(2) of the Rules,2016 order that all the valid rights, approvals, clearances, licenses and the like vested in the previous lessee in respect of the aforementioned mining block are deemed to have vested in favour of the holder of the letter of intent on the same terms and conditions of every rights, approvals, clearances, licenses, and the like which vested with previous lessee.

Without prejudice to the generality of the provisions of section 8B(2) of the MMDR Act, 1957, the details of the valid rights, approvals, clearances, licenses, and the like held by the previous lessee and vested in favour of the holder of the Letter of Intent are given in the Annexure-I to this order.

This vesting order is valid for a period of two years from the date of execution of lease deed or till the date of getting fresh approvals, clearances, licenses, permits, and the like, whichever is earlier

(**S. K. Popli**)
Nodal Officer-cum-Special Secretary to Government

Memo No. 4213 / SM Dated: 30 May 2020

Copy to alongwith Annexure-I forwarded to M/s JSW Steel Ltd, JSW Centre, Bandra Kurla Complex, Bandra (East), Mumbai- 400051 for information and necessary action. It is requested that one copy each of the documents mentioned in the Annexure-I may be collected from the office of the Director Mines, Odisha, Bhubaneswar during office working hours.

Nodal Officer

Memo No. 4214 /SM Dated: 30 May 2020

Copy to alongwith Annexure-I forwarded to M/s Aryan Mining & Trading Corporation Pvt. Ltd., Aryan House, 8th Floor, P1- Hide Lane, Kolkata- 700073 for information and necessary action.

Nodal Officer

Memo No. 4215 / SM Dated: 30 May 2020

Copy alongwith Annexure-I forwarded to Indian Bureau of Mines, Bhubaneswar/ MoEF & CC, 534, Paryavaran Bhawan, CGO Complex, Lodhi Road, New Delhi 110003/ MoEF & CC (FC Divison), Indira Paryavaran Bhawan, Aliganj, Jorbagh Road, New Delhi 110003/ SPCB, Parivesh Bhawan, A/118, Nilakantha Nagar, Unit-VIII, Bhubaneswar, Odisha, 751012/ Director General of Mines Safety, Chaibasa Regiona, Chaibasa, 833201 /Ministry of Water Resource, River Development and Ganga Rejuvenation, West Block-2, Wing 3, Sector-1, R.K. Puram, New Delhi-110066 for information and necessary action.

Nodal Officer

Memo No. 4216 / SM Date: 30 May 2020

Copy alongwith Annexure-I forwarded to Director of Mines, Odisha, Bhubaneswar for information and necessary action. He is requested to provide one copy each of the documents described in the Annexure-I to the authorized representative of the LoI holder with proper acknowledgement and forward a copy of acknowledgement to the Department for record.

Nodal Officer
30/5/20

Memo No. 4217 / SM Date: 30 May 2020

Copy alongwith Annexure-I forwarded to Collector, Sundergarh/ Deputy Director of Mines, Koira / DFO, Bonai for information and necessary action.

Nodal Officer
30/5/20

Memo No. 4218 / SM Date: 30 May 2020

Copy alongwith Annexure-I forwarded to Forest and Environment Department/ PCCF(Nodal), Bhubaneswar for information and necessary action.

Nodal Officer
30/5/20

ANNEXURE-I

Name of the Block : **Narayanposhi Iron & Manganese ore Block**

LoI Holder : **JSW Steel Ltd.**

Area of the Lease : **349.254 Hects (As per ROR)**

347.008 hects (As per DGPS)

SL No	Nature of approval clearance etc	Issuing officer/authority	Reference No./ Date of Issue
1	Mining Plan	Regional Controller of Mines, Bhubaneswar, Govt. of India	MSM/FM/40/ORI/BHU/2015-16, Dated 02.06.2016
2	EC	MoEF & CC, Govt. of India	J-11015/288/2008-IA.II(M), Dtd 18.06.2019
3	FC	MoEF & CC, Govt. of India,	F. No. 8-34/2000-FC (Vol-I), Dtd. 15.11.2007 over 244.327 hects
4	Consent to Establish	State Pollution Control Board, Odisha	536/IND-II-CTE-6207, Dated 14.01.2019
5	Consent to Operate	State Pollution Control Board, Odisha	6785/IND-I-CON-2258, Dated 08.07.2019
6	Surface Right	District Collector, Sundargarh	Surface Right granted over 324.800 hects
7	Deep Hole Blasting & use of HEMM	Directorate General of Mines Safety, Chaibasa Region, Chaibasa, Govt. of India	[29020/45/2014/RC(SEZ)] No. 2410, Dated 23.12.2015
8	Ground Water Withdrawal	Member Secretary (CGWA), Central Ground Water Authority, Govt. of India	CGWA/NOC/MIN/REN/1/2019/5586 Dtd. 09.10.2019

1. Vesting of clearances/approvals/licences/permissions /rights as above does not have the effect of transfer of ownership of infrastructure established and the ore & minerals raised by the ex-lessee which shall be governed by the provisions of the rules 12(1)(gg) and 12(1)(hh) of the Minerals Concession Rules, 2016. However, on acquisition of such infrastructure from the ex-lessee and submission of evidence thereof, the new lessee may be vested with related clearances/ approvals etc at the relevant time.
2. Vesting of Forest Clearance is subject to payment of NPV as prescribed in letter dtd. 31.03.2020 of Government of India, Ministry of Environment, Forest & Climate Change.

GOVERNMENT OF ODISHA
STEEL AND MINES DEPARTMENT
*****

ORDER

No. 1335 /SM, Dated 15.02.2022
IV(B)SM-21/2020

Whereas, in pursuance to the "invitation of bids for grant of Mining Lease for Iron ore" dated 06.12.2019 issued by the Government and subsequent auction held on dated 01.02.2020, M/s JSW Steel Ltd., the successful bidder has been granted a mining lease for Iron ore in respect of Narayanposhi Iron & Manganese ore block over an area of 347.008ha (as per DGPS) / 349.254ha (as per RoR) in village Koira, Kashira & Kathamala R.F. under tahasil Koira of Sundergarh district for the period of 50(Fifty) years as provided under section 8A, sub-section 2 of the Mines and Minerals Development and Regulation Act, 1957 vide order No.5425/SM dated 26.06.2020.

And whereas, the lease deed has been executed and registered by the lessee.

And whereas, the new lessee was vested with all the valid rights, approvals, clearances, licences and the like vested in the previous lessee for a period of 2 (Two) years vide vesting order No.4212/SM dated 30.05.2020, No.9815/SM dated 13.11.2020 & No.462/SM dated 13.01.2021.

And whereas, in the meantime section 8B of the MMDR Act, and Rule 9A of M.C. Rules, 2016 have been amended w.e.f. 28.03.2021 and 02.11.2021 respectively as noted below.

"8B (1); Notwithstanding anything contained in this Act or any other law for the time being in force, all valid rights approvals, clearances, licenses and the like granted to a lessee in respect of a mine (other than those granted under the provisions of the Atomic Energy Act, 1962 and the rules made thereunder) shall continue to be valid even after expiry or termination of lease and such rights, approvals, clearances, licenses and the like shall be transferred to and vested, subject to the conditions provided under such laws, in the successful bidder of the mining lease selected through auction under this Act."

"Rule 9A(1) in subrule (1), for "in respect of leases expiring under the provisions of sub-sections (5) and (6) of section 8A of the Act, within one week from the date of the notification of the minerals other than Atomic and Hydro Carbons Energy Minerals) Concession (Amendment) Rules, 2020" the words figure and letter, "for the purpose of issuing vesting order for transfer and vesting of all valid rights, approvals, clearances, licences and the like in accordance with sub section (1) of section 8B" shall be substituted,

Rule 9A (5); It shall be lawful for the new lessee to commence and continue mining operation on the land in which mining operations were being carried out by the pervious lessee, after the execution of the lease deed till expiry or termination of mining lease granted."

And whereas, the Director of Mines vide letter No.10120/DM dated 22.12.2021 has proposed to issue the modified vesting and transfer order in respect of Narayanposhi Iron & Manganese mining lease.

Now therefore, in partial modification of the orders as communicated vide vesting orders No.4212/SM dated 30.05.2020, No.9815/SM dated 13.11.2020 & No.462/SM dated 13.01.2021, the undersigned being the Nodal Officer for the State of Odisha having been nominated under rule 9A(1) of the Mineral (Other than Atomic and Hydrocarbon Energy Minerals) Concessions Rules, 2016 (herein after called the Rules 2016), do hereby, pursuant to the provisions contained in rule 9A(2) of the Rules, 2016 issue this order that all the valid rights, approvals, clearances, licences and the like vested in the previous lessee in respect of the aforementioned mining block are now deemed to have been vested and transferred in favour of the holder of the letter of intent on the same terms and conditions of every rights, approvals, clearances, licences and the like which vested with previous lessee till expiry or termination of mining lease granted. ...

15/2/2022

(Sri Deepak Mohanty)
Nodal Officer & OSD-cum-Special Secretary to Government

Memo No. 1336 **/ SM** **Dated:** 15.02.2022

Copy to forwarded to M/s JSW Steel Ltd, JSW Centre, Bandra Kurla Complex, Bandra (East), Mumbai-400051 for information and necessary action.

15/2/2022

Nodal Officer

Memo No. 1337 **/ SM** **Date:** 15.02.2022.

Copy forwarded to Director of Mines, Odisha, Bhubaneswar for information and necessary action.

15/2/2022

Nodal Officer

Memo No. 1338 **/ SM** **Date:** 15.02.2022

Copy forwarded to Collector, Sundergarh / DFO,Bonai / Deputy Director of Mines, Koira for information and necessary action.

15/2/2022

Nodal Officer

Memo No. 1339 **/ SM** **Date:** 15.02.2022

Copy forwarded to Forest and Environment Department / PCCF(Nodal), Bhubaneswar / Regional Controller of Mines, Indian Bureau of Mines, Bhubaneswar for information and necessary action.

15/2/2022

Nodal Officer

ANNEXURE XXXIV

By Speed Post/ e-mail

GOVERNMENT OF ODISHA

FOREST, ENVIRONMENT & CLIMATE CHANGE DEPARTMENT

*****

No.FE-DIV-FLD-0067-2022- 17050 /FE&CC, Date 22.09.22

10F (Cons) 135/2015

From

Sri Lingaraj Otta,

OSD-cum-Special Secretary to Government

To

The Principal Chief Conservator of Forests & HoFF, Odisha,

Bhubaneswar.

Sub: Transfer of FC approval granted under the Forest (Conservation) Act, 1980 for mining lease from Old Lessee M/s AMTC (P) Ltd. to New Lessee M/s JSW Steel Ltd. as per the provision of the Mines and Minerals (Development and Regulation) Amendment Act, 2021 in respect of Narayanposhi Iron & Manganese Ore Block under Bonai Forest Division, Koira Tahasil, Sundargarh District for diversion of 244.327 ha of forest land-Compliance of Final approval order regarding.

Sir,

I am directed to invite a reference to your letter No.14351/9F(MG)-29/2022 dtd.21.07.2022, seeking transfer of FC approval granted under the Forest (Conservation) Act, 1980 for mining lease from Old Lessee M/s AMTC (P) Ltd. to New Lessee M/s JSW Steel Ltd. as per the provision of the Mines and Minerals (Development and Regulation) Amendment Act, 2021 in respect of Narayanposhi Iron & Manganese Ore Block under Bonai Forest Division, Koira Tahasil, Sundargarh District for diversion of 244.327 ha of forest land and with reference to letter File No.FC-11/112/2020-FC (Pt) dtd.07.07.2021 of Govt. of India, MoEF&CC, FC Division, New Delhi.

After careful consideration of the proposal of PCCF & HoFF, Odisha and in pursuance of the guidelines issued by Govt. of India, MoEF&CC vide File No. FC-11/112/2020-FC (Pt) Dated 7th July, 2021, the transfer of approval granted by Govt. of India, Ministry of Environment & Forests under Section-2 of the Forest (Conservation) Act, 1980 vide Letter F.No.8-34/2000-FC (Vol-I) dtd.15.11.2007 with additional condition imposed by Govt. of India, MoEF, Eastern Regional Office in their letter No.8(21)3/2000-

FCE dtd.12.12.2007 from the erstwhile User Agency M/s AMTC (P) Ltd. to the new lessee M/s JSW Steel Ltd. is hereby accorded by the State Govt. for non-forestry use of 184.59 ha (out of 238.201 ha eligible diverted forest land as per the land scheduled of new Mining Lease) of forest land for mining in Narayanposhi Iron and Manganese Block under Bonai Forest Division, Koira Tahasil, Dist-Sundargarh, Odisha subject to fulfilment of the following conditions.

i. DGPS Survey and demarcation of 184.591 ha part diverted forest area shall be done by the User Agency and the same may be ensured by DFO, Bonai Forest Division in the field before handing over the said area.
ii. The DFO, Bonai Forest Division shall upload the KML files of the area under diversion and the non-forest land for Compensatory Afforestation in the E-Green Watch portal of FSI before handing over forest land to the new lessee.
iii. Old lessee has deposited the NPV over 259.191 ha forest area (as per old mining lease) which includes the NPV of diverted forest area of 244.327 ha. The amount deposited by the new lessee @ Rs.7.50 Lakh per ha is the lumpsum amount realized by State Government on issue of LoI (for the total forest area within the mining lease), which may be adjusted towards balance CA and any compensatory levies payable in future.
iv. The new lessee shall furnish an undertaking to pay the additional NPV, if so determined, as per the decision of the Hon'ble Supreme Court of India.
v. The new lessee shall also comply the non-complied conditions and if any pointed out by the Govt. of India, MoEF&CC, IRO, Bhubaneswar, after conducting the inspection of the area for the appraisal of compliance of approval granted under Forest (Conservation) Act, 1980.
vi. The new lessee, after ceasing mining operation shall undertake re-grassing the mining area and any other areas which may have been disturbed due to their mining activities and restore the land to a condition which is fit for growth of fodder, flora, fauna etc.
vii. Forest Clearance of balance 53.61 ha (238.201 ha – 184.591 ha) diverted forest land will be transferred to the new lessee after providing non-forest CA land and acceptance of CA land by DFO, Bonai Forest Division as per the extant procedure for acceptance of CA land.
viii. The new lessee has to submit the fresh diversion proposal for obtaining approval under Section 2 (ii) of FC Act, 1980 for the balance forest area of 19.25 ha (257.451 ha – 238.201 ha).
ix. Execution of project activities by the new lessee will be subject to availability of all other statutory clearances required under relevant Acts/ Rules for this mining project and compliance of Court's order, if any.

Yours faithfully,

dt 22/9/2022

OSD-cum-Special Secretary to Government

Memo No. 17051 /FE&CC, Date 22.09.22

Copy forwarded to the Assistant Inspector General of Forests (FC), Government of India, Ministry of Environment, Forests & Climate Change (F.C. Division), Indira Paryavaran Bhawan, Alinganj, Jor Bagh Road, New Delhi-110003 for information and necessary action.

22/9/2022

OSD-cum-Special Secretary to Government

Memo No. 17052 /FE&CC, Date 22.09.22

Copy forwarded to the Deputy Director General of Forests (Central), Govt. of India, MoEF&CC, IRO, A/3, Chandrasekharpur, Bhubaneswar for information and necessary action.

22/9/2022

OSD-cum-Special Secretary to Government

Memo No. 17053 /FE&CC, Date 22.09.22

Copy forwarded to the Principal Chief Conservator of Forests (Wildlife) & Chief Wildlife Warden, Odisha/ Chief Conservator of Forests (FD&NO), FC Act, O/o PCCF & HoFF, Odisha for information and necessary action.

22/9/2022

OSD-cum-Special Secretary to Government

Memo No. 17054 /FE&CC, Date 22.09.22

Copy forwarded to the Regional Chief Conservator of Forests, Rourkela Circle/ Divisional Forest Officer, Bonai Forest Division for information and necessary action.

22/9/2022

OSD-cum-Special Secretary to Government

Memo No. 17055 /FE&CC, Date 22.09.22

Copy forwarded to Steel & Mines Department/ R&DM Department/ Director Environment-cum-Special Secretary to Government, FE&CC Department/ Director of Mines, Odisha/ Member Secretary, SPCB, Odisha/ Collector, Sundargarh for information and necessary action.

22/9/2022

OSD-cum-Special Secretary to Government

Memo No. 17056 /FE&CC, Date 22.09.22

Copy forwarded to the Authorized Signatory, M/s JSW Steel Ltd, Plot No.3, Forest Park, Sishu Bhawan Square, Bhubaneswar-751009 for information and necessary action.

22/9/2022

OSD-cum-Special Secretary to Government

ANNEXURE XXXV

JSW ited

Regd. Office: JSW Centre
BandraKurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

Ref. No.- JSW/NP/PAO/1968/23-24

Date: 02-08-2023

To
The Gram Panchayat,
Koira, Sundargarh
Odisha-770048

Sub: - **Submission of Environment Clearance in respect of Narayanposhi Iron and Manganese Mines of M/s JSW Steel Limited.**

Ref. – Environment Clearance Letter No-J-11015/288/2008-IA. II (M), Dated-18/06/2019 issued by MOEF & CC, GOI.

Dear Sir,

We are submitting herewith the **Environment Clearance** in respect of Narayanposhi Iron and Manganese Mines of JSW Steel Limited for your kind perusal.

Kindly Acknowledge the receive.

Thanking you

Yours faithfully,

Mines Manager
Narayanposhi Iron and Manganese Mines
JSW Steel Ltd.

Mines Manager
For JSW Steel Ltd.
Narayan Poshi Iron & Mn. Mines

Received
05/08/2023
SARPANCH
KOIRA G.P.

Scanned with OKEN Scanner

ANNEXURE XXXVI

PARIVESH

(Pro-Active and Responsive Facilitation by Interactive, and Virtuous Environment Single-Window Hub)

Government of India
Ministry of Environment, Forest and Climate Change
(Impact Assessment Division)

File No. : werw

EC Identification No. EC21A001OR114614

Proposal No. IA/OR/MIN/8345/2008

Date:11/12/2021

ACKNOWLEDGEMENT

This is to acknowledge that JSW STEEL LIMITED has been registered in the PARIVESH Portal in respect of transfer of EC vested with previous lessee under the provisions of S.O 2817 (E) dated 13th July , 2021.

Therefore, the prior Environmental Clearance vested with the previous lessee Aryan Mining & Trading Corporation Pvt Ltd. shall be deemed to have been transferred during its validity period in terms of the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957) as amended by the Mines and Minerals (Development and Regulation) Amendment Act, 2021 (16 of 2021) to the successful bidder of the mining leases (JSW STEEL LIMITED), from the date of commencement of new lease for the remaining validity period (Up to 17/06/2049), subject to comply with all the terms and conditions of the Environmental Clearance granted to previous lessee including non-compliance of EC conditions by the previous lessee, if any,

However, if on verification the Ministry or IRO or SPCB or UTPCC, holds that the information submitted found to be false or misleading at any stage, the transfer of EC shall stand revoked.

Remarks by Member Secretary :- werwef

Report URL is Enclosed below :

http://environmentclearance.nic.in/user/MineLease_FormReport.aspx?pid=155788&status=1

Date: 11/12/2021

(e-signed)
Pankaj Verma
Member Secretary
IA - (Non-Coal Mining sector)

Signature Not Verified
Digitally signed by Pankaj Verma
Director
Date: 12/11/2021 2:14:16 PM

ANNEXURE XXXVII

JSW Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

O/C

No. JSW/S/O/2021/94 Date: 08/04/2021

To,
The Member Secretary
State Pollution Control Board, Odisha,
Paribesh Bhawan, A/118, Nilakantha Nagar, Unit-8,
BHUBANESWAR- 751012

Sub: - Request to provide updated or create new CAAQMS Credentials details in the OSPCB, Portal for compliance of CTO Special Condition S. No. 19 & 33 dated 31.03.2021 for **Narayanposhi Iron & Manganese Ore Mine of M/s JSW Steel Ltd.**

Ref: - Consent Order No 2944 vide letter no 5453/IND-I-CON-2258 dated 31.03.2021.

Dear Sir,

With reference to aforesaid subject, we would like to submit that we have installed Three Continuous Ambient Air Quality Monitoring Stations (CAAQMS) and Digital Display Board in consultation with Regional Officer, Rourkela in Narayanposhi Iron & Manganese Ore Mine of M/s JSW Steel Ltd for compliance of CTO Special Condition S. No. 19 & 33. The Locations of the installed CAAQMS and digital display board are as below-

CAAQMS 1. Narayanposi_Mines_Office_AAQMS_01
CAAQMS 2. Narayanposhi_Gate_no_1_AAQMS_02
CAAQMS 3. Narayanposi_Gate_No._2 (New_BabaMath)_AAQMS_03
Digital Display Board- Near Gate No. 6 area

The above three CAAQMS are equipped with data transfer facility to SPCB and we have authorized Phoenix Robotix Pvt. Ltd. (Datoms) for transmitting data to OSPCB and already completed the necessary setup for data transfer from all 3 locations to OSPCB Server. However, the credentials available are in the name of erstwhile lessee i.e. Aryan Mining & Trading Company Ltd.

In view of the above, we humbly request you to **please provide the updated or create new credentials details (like site ID, station name, AES Encryption key, site private key, site public key, server public key etc) of Narayanposhi Iron & Manganese Ore Mine in the name of M/s JSW Steel Ltd** for all three CAAQMS in OSPCB portal for compliance of CTO Special Condition S. No. 19.

Seeking your co-operation as always.

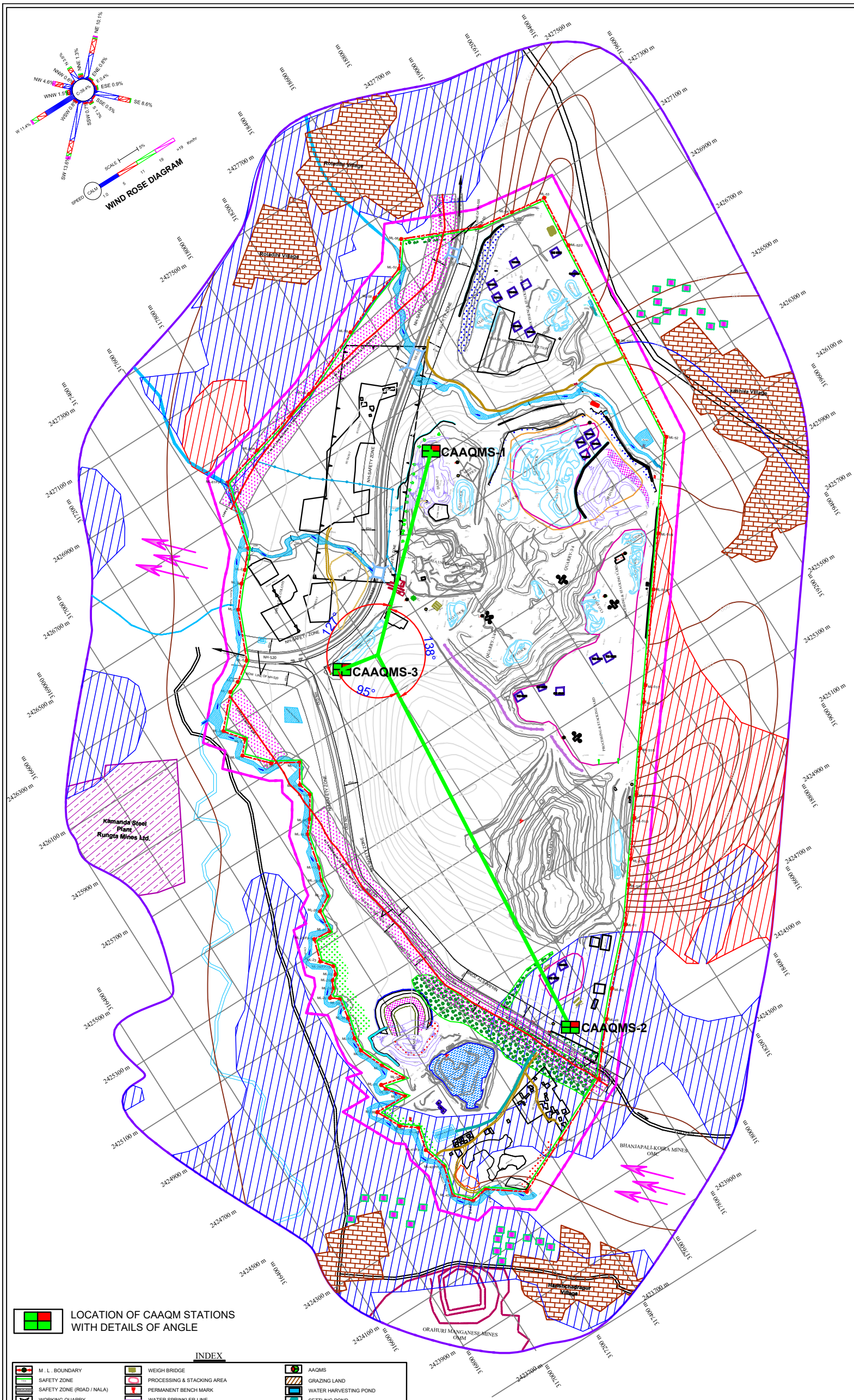
Thanking you,
Yours Faithfully
For JSW Steel Ltd

Baswaraj M Dalgade
(Authorized Signatory)
Encl: As above

Received 9/4/2021
No. Dt.
09 APR 2021
S.P.C. BOARD
BHUBANESWAR-12

Copy to- The Regional Officer, Regional Office, Rourkela, Office of the State Pollution Control Board, Rourkela Town Engineering Office Premises, Sector – 5, Rourkela – 769 002, Odisha

ANNEXURE XXXVIII



NARAYANPOSHI IRON & MANGANESE MINES

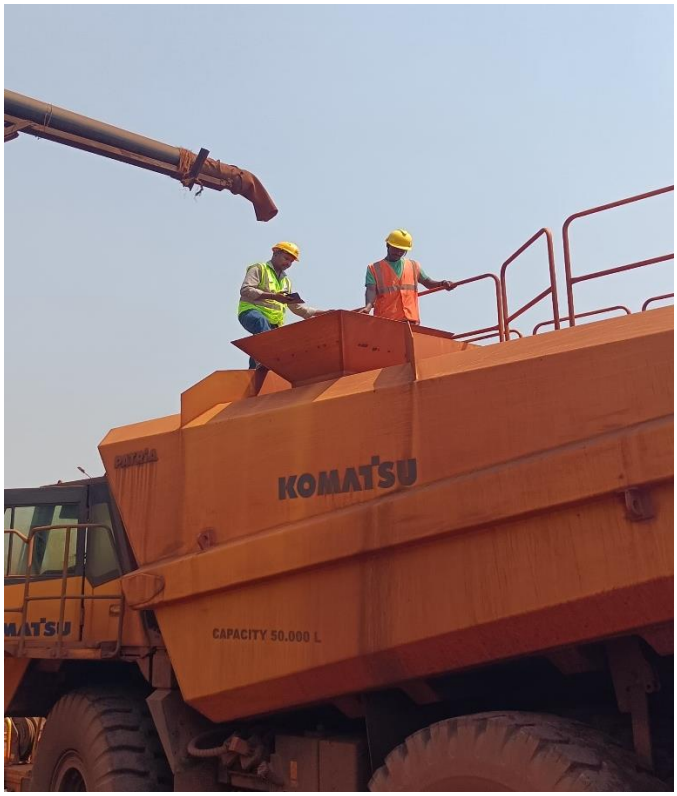
ENVIRONMENT PLAN

LEASE AREA - 347.008 Ha.	LESSEE: JSW STEEL LTD
VILLAGES - KOIRA & KASHIRA	Certified that the plan is up-date & correct to the best of my knowledge which is based on the true copy of original surface plan.
TEHSIL - KOIRA	
DISTRICT - SUNDARGARH	
STATE - ODISHA	
DATE OF SURVEY - 01/12/2023	
SCALE = 5000 : 1	SURVEYOR MINES MANAGER

ANNEXURE XXXIX

DUST SUPPRESSION USING CHEMICAL SUPPRESSANTS





ANNEXURE XL

Annexure-13

SURFACE RUNOFF WATER QUALITY

Test Report No: Envlab/25-26/TR-07555 **Date: 10.09.2025**

TEST REPORT

Customer Name & Address : **Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd, Sundergarh**

SAMPLE DETAILS

Sample Location & Code	**SWRF1: Quarry 4 SWRF2: Quarry 5**	**Sampled by**	**VCSPL'S Representative**
Sample Description	**Surface Runoff Water**	**Sampling Procedure**	**APHA 1060**
Sample Source	**Narayanposhi Iron Ore Mines, JSW**	**Sample Received on**	**22.08.2025**
Sample Condition	**Sealed Plastic & Sterilized Glass Bottle**		
Sampling Date & time	**21.08.2025 & 9.10 am, 9.40 am**	**Test Completed on**	**28.08.2025**

Sl. No	Parameters	Units	Standards as per IS 2296-Class C	Test methods	SW-1	SW-2
1	Color	Hazen, max	300	APHA 2120 B	35	30
2	Odour	--	Agreeable	APHA 2150 B	Agreeable	Agreeable
3	pH value	--	6.5-8.5	APHA 4500 H^+B	7.14	7.58
4	Suspended Solids	mg/l, max	--	APHA 2540 D	48.3	56.3
5	Total dissolved solids	mg/l, max	1500	APHA 2540 C	215.3	246.3
6	Temperature	^0C	--	--	27.3	25.9
7	Oil & Grease	mg/l, max	0.1	APHA 5220 B	ND	ND
8	Dissolved Oxygen (as DO)	mg/l, min	4	APHA 4500 O C	4.9	5.8
9	Biochemical Oxygen Demand (as BOD at 270C For 3 days)	mg/l, max	3.0	APHA 4500 P D	2.8	2.7
10	Chemical Oxygen Demand (as COD)	mg/l, max	--	APHA 3111 B	10.6	13.4
11	Free Ammonia (as NH3)	mg/l, max	--	--	ND	ND
12	Iron (as Fe)	mg/l, max	50	APHA 3500 Fe B	1.8	1.5
13	Fluoride (as F)	mg/l, max	1.5	APHA 4500 F^-D	0.24	0.34
14	Hexavalent Chromium (as Cr+6)	mg/l, max	0.05	APHA 3500 Cr B	<0.02	<0.02
15	Cyanide (as CN)	mg/l, max	0.05	APHA 4500 CN E	<0.01	<0.01
16	Sulphate (as SO_4)	mg/l, max	--	APHA 4500$SO_4^{2-}B$	15.9	15.8
17	Nitrate (as NO3)	mg/l, max	50	APHA4500NO_3^-B	7.20	7.4
18	Phenolic Compound (as C6H5OH)	mg/l, max	--	APHA 5530 C	<0.05	<0.05
19	Anion detergents (as MBAS)	mg/l, max	--	APHA:4500 NO3- B	ND	ND
20	Bio-assay Test	mg/l, max	90% survival of fish after 96 hrs in 100% effluent	IS 6582	89%	92%
21	Selenium (as S)	mg/l, max	0.05	APHA 3500 Se C	<0.001	<0.001
22	Manganese (as Mn)	mg/l, max	--	APHA 3111 B	<0.05	<0.05
23	Copper (as Cu)	mg/l, max	1.5	APHA 3111Cu B	<0.02	<0.02
24	Zinc (as Zn)	mg/l, max	15	APHA 3111 B	0.31	0.37
25	Cadmium	mg/l, max	0.01	APHA 3111 B	<0.01	<0.01
26	Lead (as Pb)	mg/l, max	0.1	APHA 3112 B	<0.01	<0.01
27	Mercury (as Hg)	mg/l, max	--	APHA 3111 B	<0.004	<0.004
28	Nickel (as Ni)	mg/l, max	--	APHA 3500As B	<0.05	<0.05
29	Arsenic (as As)	mg/l, max	0.2	APHA 3111 B	<0.004	<0.004
30	Total Chromium (as TCr)	mg/l, max	--	IS3025(P44)1993	<0.05	<0.05
31	Total Coli forms	MPN/100ml	Shall not be detected in any 100 ml sample	APHA 9221 B	96	120
Any unusual feature observed during determination				Nil		

Reviewed by **Approved by**

Test Report No: Envlab/25-26/TR-07556 **Date: 10.09.2025**

TEST REPORT

Customer Name & Address : **Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd, Sundergarh**

SAMPLE DETAILS

Sample Location & Code	**SWRF3: Gate No.2 SWRF4: RF Quarry**	**Sampled by**	**VCSPL'S Representative**
Sample Description	**Surface Runoff Water**	**Sampling Procedure**	**APHA 1060**
Sample Source	**Narayanposhi Iron Ore Mines, JSW**	**Sample Received on**	**22.08.2025**
Sample Condition	**Sealed Plastic & Sterilized Glass Bottle**		
Sampling Date & time	**21.08.2025 & 10.10 am, 10.30 am**	**Test Completed on**	**28.08.2025**

Sl. No	Parameters	Units	Standards as per IS 2296-Class C	Test methods	SW-3	SW-4
1	**Color**	Hazen, max	**300**	APHA 2120 B	**15**	**25**
2	**Odour**	--	**Agreeable**	APHA 2150 B	**Agreeable**	**Agreeable**
3	**pH value**	--	**6.5-8.5**	APHA 4500 H^+B	**7.34**	**6.98**
4	**Suspended Solids**	mg/l, max	--	APHA 2540 D	**37.8**	**38.6**
5	**Total dissolved solids**	mg/l, max	**1500**	APHA 2540 C	**226.3**	**222.8**
6	**Temperature**	^0C	--	--	**26.3**	**26.9**
7	**Oil & Grease**	mg/l, max	**0.1**	APHA 5220 B	**ND**	**ND**
8	**Dissolved Oxygen (as DO)**	mg/l, min	**4**	APHA 4500 O C	**6.2**	**5.1**
9	**Biochemical Oxygen Demand (as BOD at 270C For 3 days)**	mg/l, max	**3.0**	APHA 4500 P D	**2.5**	**2.6**
10	**Chemical Oxygen Demand (as COD)**	mg/l, max	--	APHA 3111 B	**12.3**	**12.8**
11	**Free Ammonia (as NH3)**	mg/l, max	--	--	**ND**	**ND**
12	**Iron (as Fe)**	mg/l, max	**50**	APHA 3500 Fe B	**0.9**	**0.9**
13	**Fluoride (as F)**	mg/l, max	**1.5**	APHA 4500 F^-D	**0.28**	**0.22**
14	**Hexavalent Chromium (as Cr+6)**	mg/l, max	**0.05**	APHA 3500 Cr B	**<0.02**	**<0.02**
15	**Cyanide (as CN)**	mg/l, max	**0.05**	APHA 4500 CN E	**<0.01**	**<0.01**
16	**Sulphate (as SO_4)**	mg/l, max	--	APHA 4500$SO_4^{2-}B$	**16.4**	**16.3**
17	**Nitrate (as NO3)**	mg/l, max	**50**	APHA4500NO_3^-B	**6.7**	**6.3**
18	**Phenolic Compound (as C6H5OH)**	mg/l, max	--	APHA 5530 C	**<0.05**	**<0.05**
19	**Anion detergents (as MBAS)**	mg/l, max	--	APHA:4500 NO3- B	**ND**	**ND**
20	**Bio-assay Test**	mg/l, max	**90% survival of fish after 96 hrs in 100% effluent**	IS 6582	**91%**	**91%**
21	**Selenium (as S)**	mg/l, max	**0.05**	APHA 3500 Se C	**<0.001**	**<0.001**
22	**Manganese (as Mn)**	mg/l, max	--	APHA 3111 B	**<0.05**	**<0.05**
23	**Copper (as Cu)**	mg/l, max	**1.5**	APHA 3111Cu B	**<0.02**	**<0.02**
24	**Zinc (as Zn)**	mg/l, max	**15**	APHA 3111 B	**0.24**	**0.26**
25	**Cadmium**	mg/l, max	**0.01**	APHA 3111 B	**<0.01**	**<0.01**
26	**Lead (as Pb)**	mg/l, max	**0.1**	APHA 3112 B	**<0.01**	**<0.01**
27	**Mercury (as Hg)**	mg/l, max	--	APHA 3111 B	**<0.004**	**<0.004**
28	**Nickel (as Ni)**	mg/l, max	--	APHA 3500As B	**<0.05**	**<0.05**
29	**Arsenic (as As)**	mg/l, max	**0.2**	APHA 3111 B	**<0.004**	**<0.004**
30	**Total Chromium (as TCr)**	mg/l, max	--	IS3025(P44)1993	**<0.05**	**<0.05**
31	**Total Coli forms**	MPN/100ml	**Shall not be detected in any 100 ml sample**	APHA 9221 B	**70**	**80**
Any unusual feature observed during determination				**Nil**		

Reviewed by **Approved by**

Test Report No: Envlab/23-24/TR-07558 **Date: 10.09.2025**

TEST REPORT

Customer Name & Address : **Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd, Sundergarh**

SAMPLE DETAILS

Sample Location & Code	**SWRF5: Near View Point**	**Sampled by**	**VCSPL'S Representative**
Sample Description	**Surface Runoff Water**	**Sampling Procedure**	**APHA 1060**
Sample Source	**Narayanposhi Iron Ore Mines, JSW**	**Sample Received on**	**22.08.2025**
Sample Condition	**Sealed Plastic & Sterilized Glass Bottle**		
Sampling Date & time	**21.08.2025 & 7.10 am, 11.20 am**	**Test Completed on**	**28.08.2025**

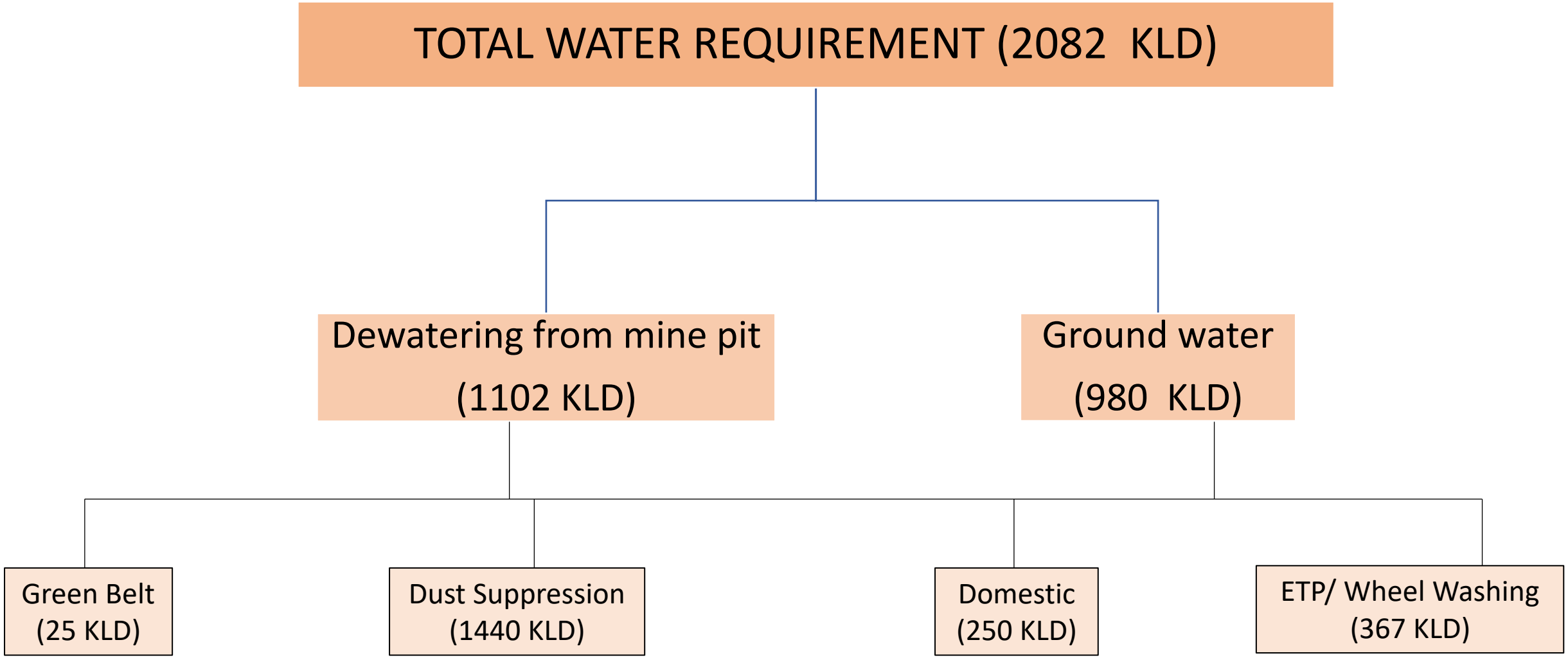
Sl. No	Parameters	Units	Standards as per IS 2296-Class C	Test methods	SW-5
1	Color	Hazen, max	300	APHA 2120 B	20
2	Odour	--	Agreeable	APHA 2150 B	Agreeable
3	pH value	--	6.5-8.5	APHA 4500 H^+B	7.58
4	Suspended Solids	mg/l, max	--	APHA 2540 D	52.8
5	Total dissolved solids	mg/l, max	1500	APHA 2540 C	247.5
6	Temperature	^0C	--	--	26.8
7	Oil & Grease	mg/l, max	0.1	APHA 5220 B	ND
8	Dissolved Oxygen (as DO)	mg/l, min	4	APHA 4500 O C	5.6
9	Biochemical Oxygen Demand (as BOD at 270C For 3 days)	mg/l, max	3.0	APHA 4500 P D	2.8
10	Chemical Oxygen Demand (as COD)	mg/l, max	--	APHA 3111 B	14.9
11	Free Ammonia (as NH3)	mg/l, max	--	--	ND
12	Iron (as Fe)	mg/l, max	50	APHA 3500 Fe B	0.8
13	Fluoride (as F)	mg/l, max	1.5	APHA 4500 F^-D	0.24
14	Hexavalent Chromium (as Cr+6)	mg/l, max	0.05	APHA 3500 Cr B	<0.02
15	Cyanide (as CN)	mg/l, max	0.05	APHA 4500 CN E	<0.01
16	Sulphate (as SO_4)	mg/l, max	--	APHA 4500SO_4^{2-}B	15.2
17	Nitrate (as NO3)	mg/l, max	50	APHA4500NO_3^-B	6.3
18	Phenolic Compound (as C6H5OH)	mg/l, max	--	APHA 5530 C	<0.05
19	Anion detergents (as MBAS)	mg/l, max	--	APHA:4500 NO3- B	ND
20	Bio-assay Test	mg/l, max	90% survival of fish after 96 hrs in 100% effluent	IS 6582	91%
21	Selenium (as S)	mg/l, max	0.05	APHA 3500 Se C	<0.001
22	Manganese (as Mn)	mg/l, max	--	APHA 3111 B	<0.05
23	Copper (as Cu)	mg/l, max	1.5	APHA 3111Cu B	<0.02
24	Zinc (as Zn)	mg/l, max	15	APHA 3111 B	0.26
25	Cadmium	mg/l, max	0.01	APHA 3111 B	<0.01
26	Lead (as Pb)	mg/l, max	0.1	APHA 3112 B	<0.01
27	Mercury (as Hg)	mg/l, max	--	APHA 3111 B	<0.004
28	Nickel (as Ni)	mg/l, max	--	APHA 3500As B	<0.05
29	Arsenic (as As)	mg/l, max	0.2	APHA 3111 B	<0.004
30	Total Chromium (as TCr)	mg/l, max	--	IS3025(P44)1993	<0.05
31	Total Coli forms	MPN/100ml	Shall not be detected in any 100 ml sample	APHA 9221 B	96
Any unusual feature observed during determination				Nil	

Reviewed by

Approved by

ANNEXURE XLI

WATER BALANCE DIAGRAM NARAYANPOSHI IRON & Mn ORE MINE



ANNEXURE XLII

Plantation Activities Carried Out In Narayanposhi Mines 2025-26



SAFETY ZONE PLANTATION



BENCH PLANTATION



DUMP PLANTATION WITH DRIP IRRIGATION

Sl. No.	Plantation type	Quantity
1	Plantation of forest species	4008 Nos
2	Plantation of fruit bearing species	310 Nos
3	Seed broadcasting	50 Kg
4	Distribution of fruit bearing plant saplings	355 Nos

Plantation Activities Carried Out In Narayanposhi Mines 2025-26





Plantation At Narayanposhi Mines During FY 2025-26		
Species	Area	Number of Plantations
Gulmohor, Karanj, Bakul, Neem, Chatim, Putranjiva, Pterocarpus Bamboo, Sal, Jamun	Safety Zone Plantation	1540
	Bench Plantation	400
	Dump & Berm Plantation	578
	Avenue Plantation	1400
	Total Plantation done	**4318**

Plantation Activities Carried Out In Narayanposhi Mines 2025-26

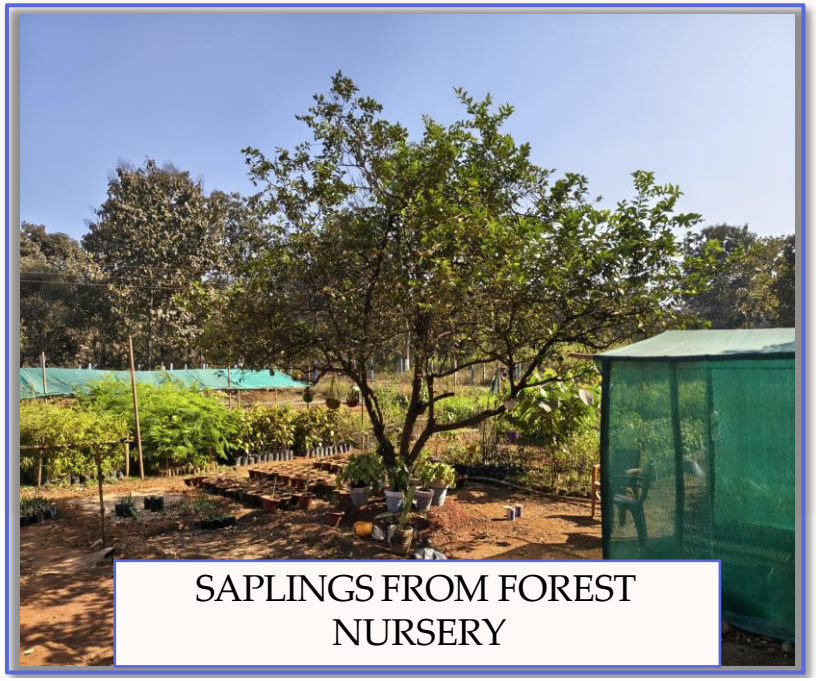


AVENUE PLANTATION





BERM PLANTATION



SAPLINGS FROM FOREST NURSERY

ANNEXURE XLIII

OFFICE OF THE PRINCIPAL CCF (WILDLIFE) & CHIEF WILDLIFE WARDEN,ORISSA5TH FLOOR, B D A APARTMENT, PRAKRUTI BHAWAN. NILAKANTHA NAGAR, BHUBANESWAR- 751012

Memo No. 6257 Dt. 04.9.2010
1WL-C-SSP- 260/2010

The Chief Conservator of Forests (Nodal),
O/o the Principal CCF, Orissa, Bhubaneswar.

Sub: Approval of Site Specific Wildlife Conservation Plan for Iron & Manganese Ore mining in village Koira & Kasira(Narayanposi mines) of Bonai Forest Division in Sundargarh district.

Sir,

I am directed to inform you that the Site Specific Wildlife Conservation Plan for Iron & Manganese Ore mining in village Koira & Kasira (Narayanposi mines) of Bonai Forest Division in Sundargarh district has been approved by PCCF(WL) & Chief Wildlife Warden, Orissa with financial forecast of Rs.288.00 lakhs for the following activities.

1. For activities in project area — Rs.92.00 lakhs.
2. For activities in project impact area. — Rs.196.00 lakhs.

Total Rs. 288.00 lakhs

User Agency will deposit entire amount of Rs.288.00 lakhs with DFO, Bonai Division under CAMPA account for activities to be taken up by the DFO as all the activities both inside the project area and in project impact area are very technical in nature involving habitat management for wildlife. The activities to be executed by DFO, Bonai Division under the guidance of CF, Rourakela.

Conservator of Forests (WL)

Memo No. 6258 dt. 04.9.2010
Copy forwarded to the DFO, Bonai Division for information & necessary action with reference to Memo No. 2870 dt. 26.6.10 of CF., Rourakela Circle.

Encl: One approved SS. WL Conservation Plan.

Conservator of Forests (WL)

Memo No. 6259 Dt. 04.9.2010

Copy forwarded to CF, Rourkela Circle for information & necessary action with reference to his office Memo No. 2868 dt.26.6.10.

Conservator of Forests (WL)

Memo No. 6260 dt. 04.9.2010
Copy forwarded to the Project Proponent for information & necessary action with reference to their letter No 25/PCCF(WL)/10-11 dt. 28.8.10.

Conservator of Forests (WL)

SITE SPECIFIC WILD LIFE CONSERVATION PLAN OF NARAYANPOSHI MINES

The SSWLCP for Narayanposhi Iron & Manganese mine in village Koira and Kasira has been approved by PCCF (WL) with financial forecast of 288 Lakh for following activities

1. For activities in project area : 92 lakh
2. For activities in Project impact area : 196 lakh

Further the total amount was deposited by AMTC in CAMPA account for activities inside the project area & project impact area for activities to be taken up by DFO, Bonai division as the nature of activities are very technical in nature involving habitat management for wildlife.

As per the approved SSWLCP the following activities are to be taken up within the project area

Sl No	**Item of work**	**Amount approved by CWLW (in Lakhs)**
1	Plantation of intimate mixture of food and cover species over 40 ha @ 50 lakh per ha	Dump reclamation and plantation are to be done as per dump reclamation plan for approval by competent authority separately & intimated to us
2	Coir Geo textile over 6 Ha to stabilise steep dumps	
3	Grass seeding over 30 ha	
4	Van Sahayaks	
5	Dust control	Pollution control board to separately approve such proposals
6	Noise/ light pollution control	
7	Garbage disposal	
8	Water pollution control	
9	Creation of water sources in 184 ha of virgin forest area in the ML area as per GoI stage 1& 2 clearance etc	20.00
10	Solar powered fencing – to be done around mining pits to save straying wild animals and not to obstruct wild corridors existing in the mining lease area	15.00
11	Fire incentive to 3 villagers	6.00
12	Habitat improvement in 184 ha. Of virgin forest area as per stage 1 & 2 clearance of GoI with fruit, fodder and cover species for both avi-fauna and other wildlife in the area	25.00
13	Soil and moisture conservation measures in lease hold area to avoid silting of nalas and to revive two nalas originating from the ML area	6.00
14	Distribution of seedling under firm forestry to local villagers to augment fruit, fodder and fuel wood source in the area	6.00
15	Creation of awareness, signages of wildlife, livelihood activities, supplying of various types kits and livelihood training etc.	10.00
16	Unforeseen expenses	4.00
	Total	92.00

As per the approved WLCP the following activities are to be taken up within the project impact area (zone of influence)

Sl No	Item of work	Amount approved by CWLW
1	Habitat improvement measures with fruit fodder and cover species/ bamboo plantation/ meadow development/ ANR/ staggered trenches in forest areas	30.00
2	Creation of water sources in forest areas with wallowing grounds on the down side of spill way by creating muddy and slushy area for wild animals to wallow and gambol	25.00
3	Check dams for random rubble in upper reaches of karo, samij and sarkanda nala and soil and moisture conservation measures in forest areas to avoid chocking of nalas, rivulets and drainage channels	8.00
4	Salt licks = 5 nos	3.00
5	Anti-depredation / anti-poaching squad with hires vehicle/ manpower/ equipment/ barracks/ crackers, megaphone, search lights/ flare guns/ tents and camping equipments for 10 years including engagement of elephant trackers	40.00
6	Equipment for 10 years Flash lights 30 nos Megaphone 15 nos Mobile phone with sim card 5 nos Fire crackers Solar light 25 nos	12.00
7	Corpus fund to meet ex-gratia payment	10.00
8	Creation of fire lines and maintenance of old fire lines/ firefighting equipment/ firefighting squads/ incentive to VSS for prevention of fire as encouragement incentives	11.00
9	a) Check gates = 2 nos = 1.00 b) Remuneration to VSS members = 2 nos = 6.00	7.00
10	Livelihood activities promotion, training, supplying of various kits/ machines/ equipments/ self help groups formation/ micro credit seed money etc.	25.00
11	Awareness promotion, signages for wildlife etc	5.00
12	Biodiversity and animal status monitoring & development of communication network/ GIS based maps satellite maps of GIS domain should be procured every year to know the changing profile of the project area in both dry season and wet season for 10 years preferably using the GIS lab of PCCF(WL), Orissa	15.00
13	Unforeseen and Miscellaneous.	5.00
	Total	196.00
	Grand total	288.00

ANNEXURE XLIV

Occupational Health Centre

JSW, JAJANG
BARBIL, KEONJHAR
REG NO- KEO/00036/2022

JSW Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

NARAYANPOSHI IRON AND MANGANESE ORE MINES

Medical Examination

1. After medical examination, it has been found that none of the employee has developed any Persistent Back Pain, Neck Pain, and the movement of their Hip, Knee and other joints have also been found to be normal
2. None of them have found to suffer loss of any body part.
3. It has also been found that no person working within mine lease was suffering from hearing loss.

OCCUPATIONAL HEALTH CENTRE

Dr. Arabinda Satpathy
MBBS, DPHA, DIH, DMCH
Retd. CMO-MCL, Burla
Sambalpur
Regd. No- 12605/BCMR/75

ANNEXURE XLV

JSW Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

NARAYANPOSHI IRON & MANGANESE ORE MINES

SL No.	Commitment Done by AMTC (ex-lessee) during PH	Budget allocated by AMTC	Expenditure by JSW Steel Ltd as on date
1.	Financial provision of Rs. 344.00 lakhs is made for various environmental control measures proposed in this report under capital cost	344 Lakhs	
	a) Air pollution control measures		25 Lakhs
	b) Water pollution control measures		73 Lakhs
	c) Dump management		46 Lakhs
2.	Parking Plaza	15 Lakhs	15 Lakhs
3.	constructing additional 6 new Deep bore Wells	22.5 Lakhs	35 Lakhs
4.	Community Sanitary Toilets and Individual Toilets.	6.5 Lakhs	Proposed in this FY
5.	Education facilities	41 Lakhs	35 Lakhs
6.	School Bus	20 Lakhs	20 Lakhs
7.	Sewing machine and training	18 Lakhs	Proposed in this FY
8.	SHG	18 Lakhs	30 Lakhs
9.	Solar Street Lights	30 Lakhs	15 Lakhs
10.	Upgradation of existing dispensary	47.5 Lakhs	40 Lakhs
11.	Health Clinic Van	20 Lakhs	20 Lakhs

ANNEXURE XLVI

Expenditure Incurred on Environmental Protection Measures for the Financial Year 2025-26		
Sl No	Expenditure head -Particulars	Cost incurred in INR
1	Construction of Retaining walls	-
2	Construction of Garland drains, desiltation of settling ponds	278880
3	Geotextile works for dump stabilization	836625
5	Greenbelt development- Pit digging, plantation and maintenance	3680000
6	Operation of Road sweeping machines	1095000
7	Operation of fixed sprinklers	75000
8	Operation of mobile sprinklers	12486120.00
9	Use of chemical dust suppresants in sprinkling	472000
10	Online air quality monitoring	728305.02
11	Environment monitoring through NABL Accredited third party	1083840
12	Operation of Sewage treatment Plant	336000
13	Study conducted on hydrogeology from CGWA Accredited Agency	410000
14	Nursery Development, Biocomposting	4130641
15	Landscape development	260100
16	Environmental Awareness Programmes	400000
17	Flowmeter calibration and stamping	105000
18	Drip irrigation for plantation	45600
19	Life Cycle Assessment Study	500000
20	Third Party hazardous waste audit	40000
Total		**26963111.02**

ANNEXURE XLVII

LANDUSE / LANDCOVER MAP OF NARAYANPOSI IRON & MN ORE MINE IN SUNDERGARH DISTRICT OF M/S JSW STEEL LTD.

0 0.25 0.5 1 Kilometers

SCALE - 1:5,000

N W E S

Roladihi

KATHAMAL RF

Lengarasahi

Legend

- Habitation
- Orchard
- Dense Forest
- Open Forest
- Degraded Forest
- Forest Plantation
- Plantation Over Dump
- Tree Clad Area
- Land With Scrub
- Land Without Scrub
- Waterlogging / Marshy / Swampy
- River / Stream
- Tank / Pond
- Mining Quarry
- Old Quarry
- Top Soil Dump
- OB Dump
- Stock Yard / Ore Stack
- Settling Pond
- Site Services
- Workshop
- Processing Yard
- Weigh Bridge
- Magazine
- National Highway
- State Highway
- Haul Road
- Other Road
- Bridge / Culvert
- Parking Plaza
- Safety Zone
- Forest Boundary
- Mining Lease Boundary

ORISSA SPACE APPLICATIONS CENTRE * BHUBANESWAR *
Map No. 2602/1
Date 09-12-2021
Auth. Signatory

SOURCE : -

Drone Image Supplied By M/s JSW Steel Ltd.
Month - August , Year - 2021

ORSAC

ANNEXURE XLVIII

Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

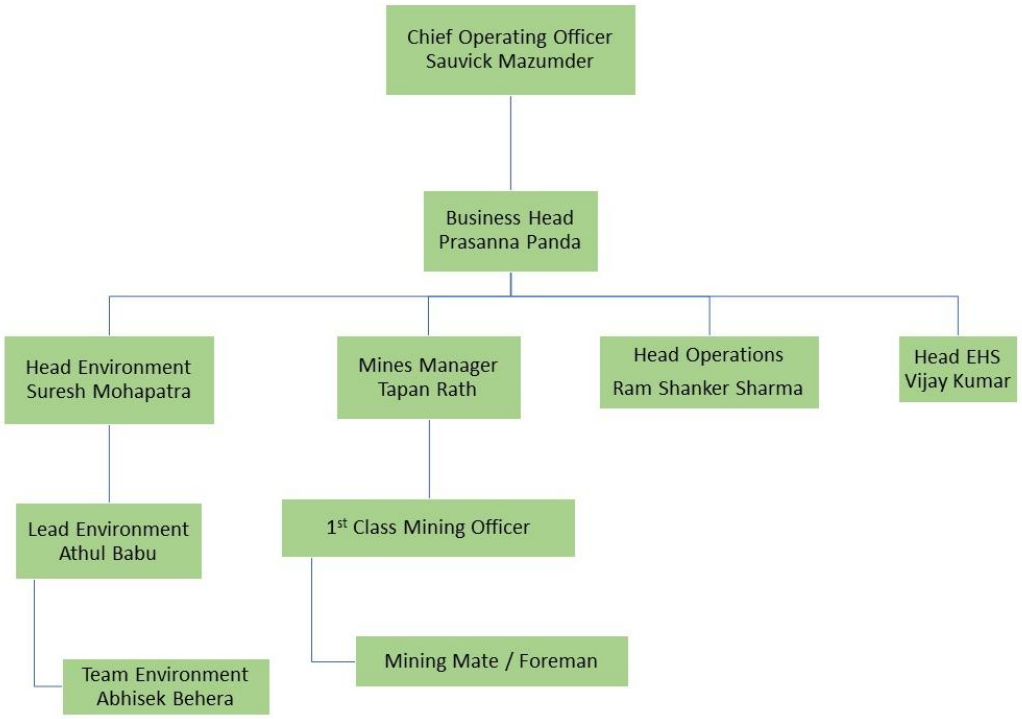
OFFICE ORDER

NARAYANPOSHI IRON AND MANGANESE ORE MINES
Environment Management Cell

Environment management cell (EMC) working for the management of Environmental monitoring of the mines and to act upon mitigation measures on the impacts of the production of mine with its surrounding environment so that pollution load, water and air quality can be maintained. Key functioning of EMC would be for compliance monitoring and to adhere with Environmental aspects and issues of the project during operation phase. EMC created with an objective of organizational framework for operating Environment Management System (EMS) and other functions of responsibilities for environmental betterment; and formulating Environmental Action Plans (EAPs) which specify mitigation, periodic and annual monitoring activities during project implementation and operation phase of mining.

The potential activities structured for the control mechanism by EMC, such activities are: Air pollution due to the emission of particulate matter, Gaseous pollutants and fugitive emissions; Noise pollution due to various noise generating equipment and mining activities; Wastewater generation from domestic activities; and Solid waste disposal. In order to minimize these impacts and to ensure that the environment in and around the project site as well as the neighboring population is well protected; an effective environment management plan to be developed and maintained by Environment management cell.

Organogram



ANNEXURE XLIX

(FORM - O)

(See rule 29F (2) and 29L)
Report of Medical Examination under rule 29B
(To be issued in Triplicate)

A -

Certificate No JSW/6494

Certified that ~~Shri~~/Shrimati* Rudhi Sundan Nayak

employed as Sr. Manager in Narayanposi mines.

Form A No ..... has been examined for an Initial / Periodical medical examination. ~~He~~/she* appears to be 39 Im years of age. The findings of the examining authority are given in the attached sheet. It is considered that ~~Shri~~/Shrimati* Rudhi Sundan Nayak

(a)* is medically fit for any employment/graduate/technician apprentice training in mines,

(b)* is suffering from..... and is medically unfit for

(1) any employment in mine : or

(2) any employment below ground : or

(3) any employment or work.....

(c)* is suffering from..... and should get this disability* cured-controlled and should be again examined within a period of ..... months. He/She will appear for re - examination with the result of test of ..... and the opinion of..... Specialist from ..... He/She* may be permitted/not* permitted to carry on his duties during this period.



Rudhi Sundan Nayak

Dr. Sashi Bhusan Nepak
M.B.B.S. M.D.
Regd No.-6029 (O)
JSW OHC, JAJANG

Signature of the Examining Authority

DR. SASHI BHUSHAN NEPAK

.....

(Name and Designation in Block letters)

Place : Jajang

Date : 26/09/25

---

* Delete whatever is applicable.

** One copy of the certificate shall be handed over to the person concerned and another copy shall be sent to the manager of the mine concerned by registered post : and the third copy shall be retained by the examining authority.

Report of the Examining Authority

(to be filled in for every medical examination whether initial or periodical or re-examination or after cure/control of disability).

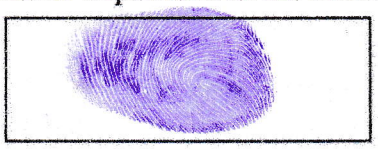
Annexure to Certificate No. 6494 as result of medical examination on 26/09/25

Identification Mark

i.

ii. A cut mark on left eye brow

Left thumb impression of the candidate



1. General Development : Good/Fair/Poor
2. Height 164 CMS
3. Weight 78 Kg
4. **Eyes :**
   (i) Visual Actuality - Distant vision (with or without glasses).
   Right Eye 6/6 Left Eye 6/6
   (ii) Any Organic Disease of Eyes :
   (iii) Night Blindness :
   (iv) Color Blindness :
   (v) Squint*
   (* to be tested in special case) > No
5. **Ears :**
   (i) Hearing Right Ear 18.64 dB Left Ear 18.64 dB
   (ii) Any Organic Disease : No
6. **Respiratory System :**
   Chest Measurement
   (i) After Full Inspiration 98 cms
   (ii) After Full Expiration 94 cms
7. **Circulatory System :**
   Blood Pressure : 122/82 mmHg
   Pulse : 86 min
8. **Abdomen :**
   - Tenderness No
   - Liver Normal
   - Spleen Normal
   - Tumor No
9. **Nervous System :**
   - History of Fits or epilepsy No
   - Paralysis No
   - Mental Health Normal
10. Locomotor System : Normal
11. Skin : Normal
12. Hernia : No
13. Hydrocele : No
14. Any Other Abnormality : No
15. **Urines :**
    - Reaction Acidic
    - Albumin Nil
    - Sugar Nil
16. Skiagram of Chest : No
17. Any other "C" test considered necessary by the examining authority. No
18. Any opinion of Specialist considered necessary : No

Place : Jajang

(Signature of the Examining Authority)

Dr. Sashi Bhusan Nepak
M.B.B.S. AFIH
Regd No -6029 (O)
JSW OHC, JAJANG

Report of Medical Examination as per the recommendations of National Safety Conferences in Mines

(To be used in continuation with Form O)

Certificate No. : 6494

Name : Rudhi Sundar Nayak

Identification Marks : A cut mark on left eyebrow

1. Cardio Logical Assessment :

Auscultation	S1	Normal
	S2	Normal
	Additional Sound	No
Electrocardiograph (12 leads) findings :		Normal / Abnormal

Enclosed ECG Yes

2. Neurological Assessment :

Findings	Normal / Abnormal
Superficial Reflexes	Normal
Deep Reflexes	Normal
Peripheral Circulation	Normal
Vibrational Syndromes	No

3. ILO Classification of Chest Radiograph :

Profusion of Pneumoconiosis opacities	Grade	Types
Present / Absent		

Enclosed Chest Radiograph

4. Audiometry Findings :

Conduction Type	Left Ear	Right Ear
Ear Conduction	Normal / Abnormal	Normal / Abnormal
Bone Conduction	Normal / Abnormal	Normal / Abnormal

Enclosed Audiometry Report Yes

5. Pathological / Microbiological Investigations :

Sl. No.	Tests	Findings
1.	Blood-Tc, Dc, Hb, ESR, Platelets	WNL/Abnormal
2.	Blood Sugar - Fasting & PP	WNL/Abnormal
3.	Lipid Profile	WNL/Abnormal
4.	Blood Urea, Creatinine	WNL/Abnormal
5.	Urine Routine	WNL/Abnormal
6.	Stool Routine	WNL/Abnormal

Enclosed Investigation Reports. Yes

6. Special Tests for MN exposure :

Behavioral Disturbances		Present / Not Present
Speech Defect		Present / Not Present
Neurological Disturbances	Tremor	Present / Not Present
	Adiadocokinesia	Present / Not Present
	Emotional Changes	Present / Not Present

7. Any other Special Test Required : No

Signature of the Ex

Dr. Sashi Bhusan Nepak
M.B.B.S AFIH
Regd No.-6029 (O)

Report of Medical Examination Under Mines Rule 29B
(To be used in continuation with Form 'O')

Certificate No. : 6494

Name : Rudhi Sundar Nayak

Identification Marks : A cut mark on left eye brow

Result of Lung Function Test (Spirometry)

Parameters	Predicted Value	Performed Value	% of Predicted
Forced Vital Capacity (FVC)	03.21	02.95	092
Forced Expiratory Volume 1 (FEV1)	02.65	02.67	101
FEVI/FVC	82.55	90.52	110
Peak Expiratory Flow	08.53	08.39	098

Spirometry Report enclosed Yes

Signature of the Examination Authority

Dr. Sashi Bhusan Nepak
M.B.B.S AFIH
Regd No.-6029 (O)
JSW OHC, JAJANG

OCCUPATIONAL HEALTH CENTRE

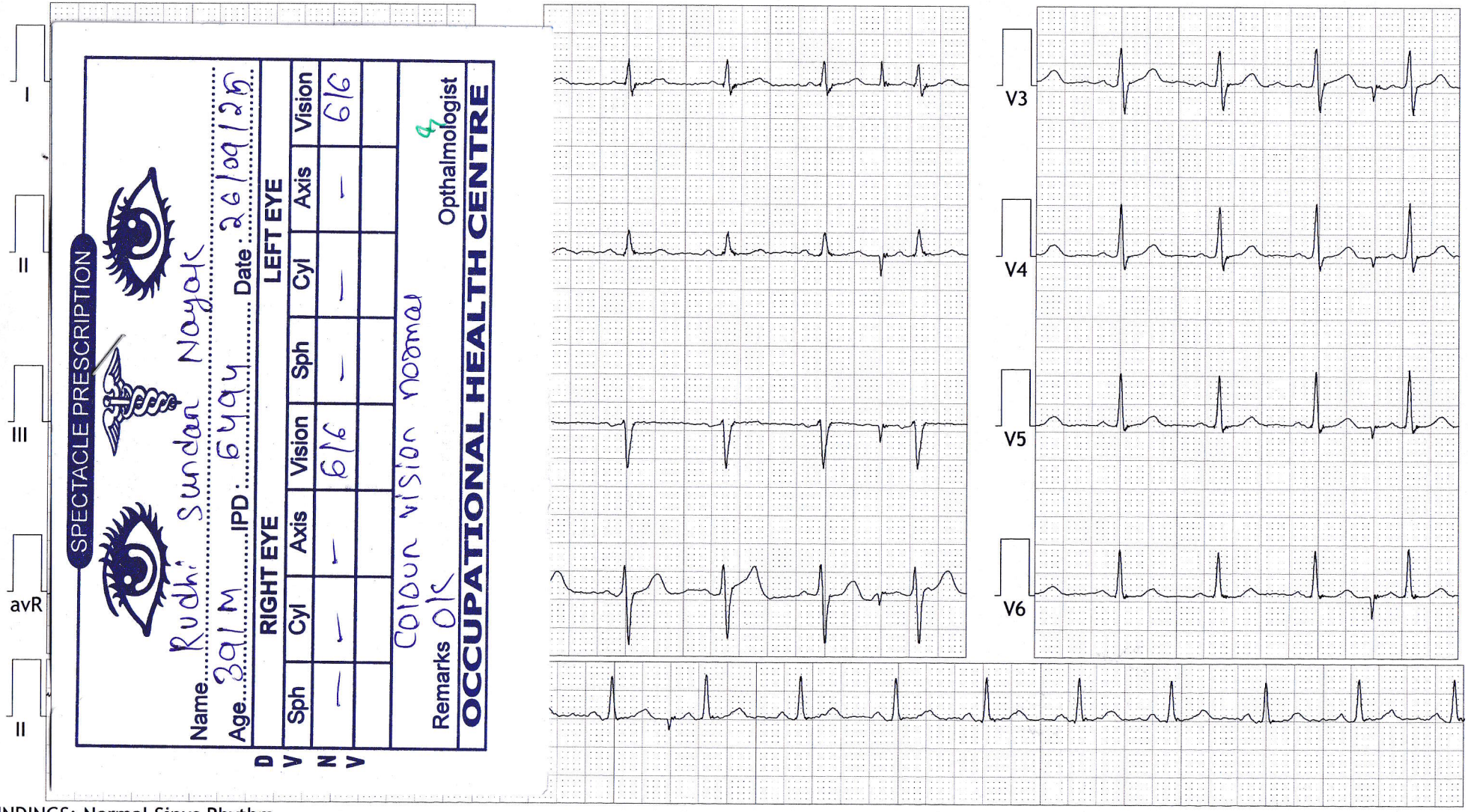
JSW.JAJANG

6494/Rudhi sundar nayak 39Yrs/Male Kgs/ Cms BP: ___/___ mmHg

Ref.: Test Date: 26-Sep-2025(11:09:10) Notch: 50Hz 0.05Hz - 100Hz 10mm/mV 25mm/Sec

HR: 89 bpm

PR Interval: 110 ms
QRS Duration: 124 ms
QT/QTc: 357/435ms
P-QRS-T Axis: 41 - 40 - 25 (Deg)



FINDINGS: Normal Sinus Rhythm

Vent Rate : 89 bpm; **PR Interval :** 110 ms; **QRS Duration:** 124 ms; **QT/QTc Int :** 357/435 ms

P-QRS-T axis: 41• 40• 25• (Deg)

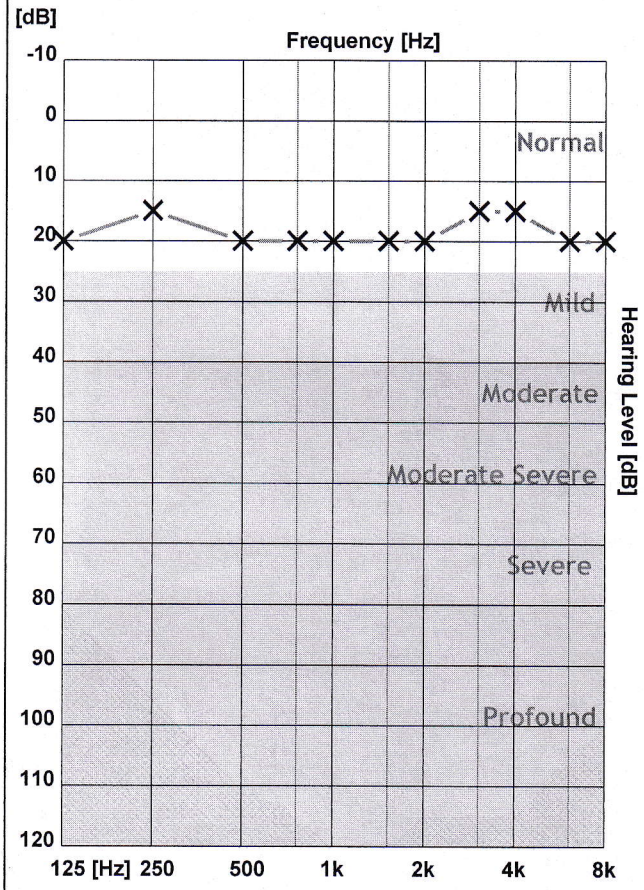
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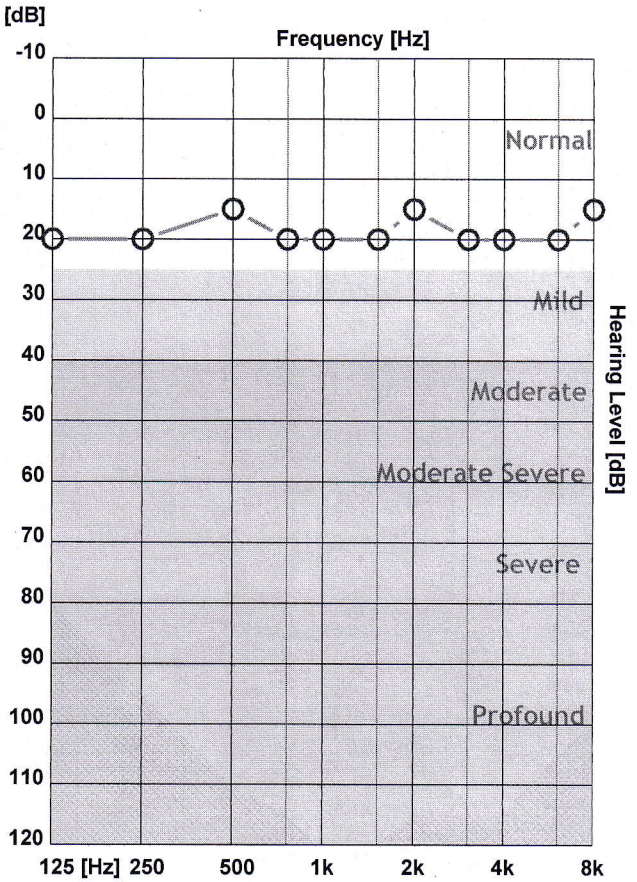
OCCUPATIONAL HEALTH CENTER

JSW.JAJANG

Patient ID : 21335
Name : RUDHI SUNDAR NAYAK
CR Number : 20250926114734
Registration Date : 26-Sep-2025

Age : 39
Gender : Male
Operator : admin admin





	125 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	1500 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
X - Air Left	20	15	20	20	20	20	20	15	15	20	20
O - Air Right	20	20	15	20	20	20	15	20	20	20	15
> - Bone Left											
< - Bone Right											

	Average	High	Mid	Low
AIR Left	18.64 dB	17.50 dB	20.00 dB	18.75 dB
AIR Right	18.64 dB	18.75 dB	18.33 dB	18.75 dB

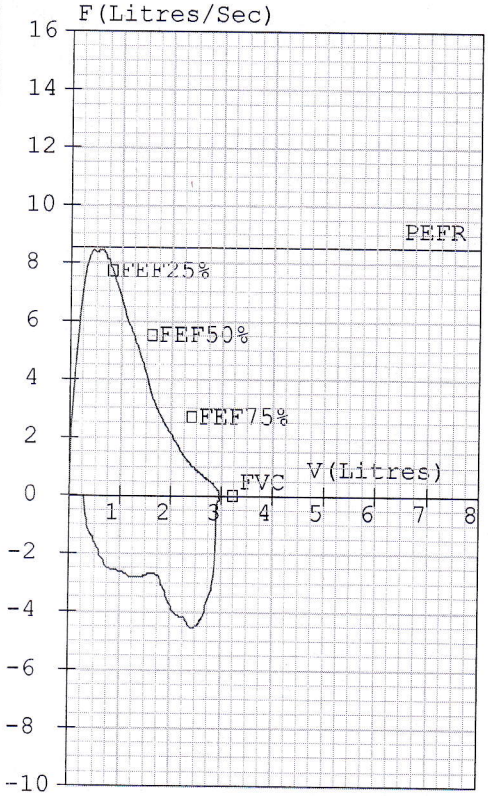
Clinical Notes :

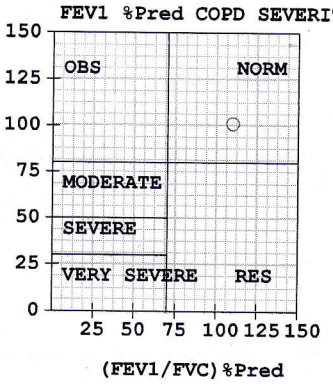
TEST WITHIN NORMAL LIMITS

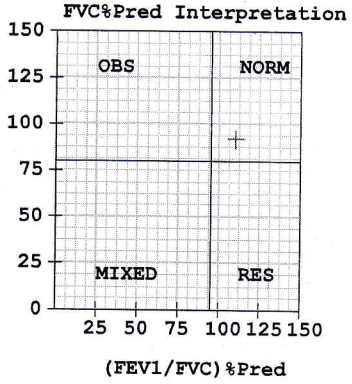
OCCUPATIONAL HEALTH CENTRE

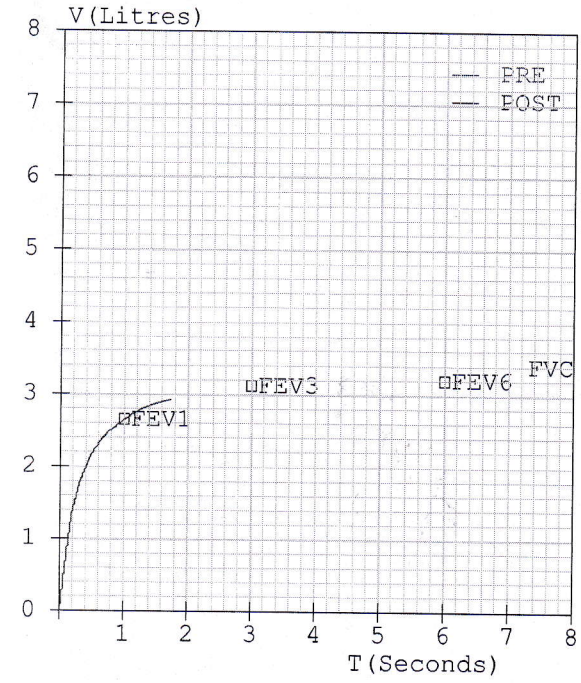
JSW.JAJANG

ient: RUDHI SUNDAR NAYAK		Age	: 39 Yrs	Gender	: Male
fd.By:		Height	: 165 Cms	Smoker	: No
red.Eqns: RECORDERS		Weight	: 78 Kgs	Eth. Corr	: 100
Date : 26-Sep-2025 11:46 AM		ID	: 6494J	Temp	:









FVC Results

Parameter		Pred	M.Pre	%Pred	M.Post	%Pred	%Imp
FVC	(L)	03.21	02.95	092	-----	---	
FEV1	(L)	02.65	02.67	101	-----	---	
FEV1/FVC	(%)	82.55	90.51	110	-----	---	
FEF25-75	(L/s)	03.89	03.42	088	-----	---	
PEFR	(L/s)	08.53	08.39	098	-----	---	
FIVC	(L)	-----	02.67	---	-----	---	
FEV.5	(L)	-----	02.19	---	-----	---	
FEV3	(L)	03.12	02.95	095	-----	---	
PIFR	(L/s)	-----	04.53	---	-----	---	
FEF75-85	(L/s)	-----	01.05	---	-----	---	
FEF.2-1.2	(L/s)	06.70	07.29	109	-----	---	
FEF 25%	(L/s)	07.72	08.02	104	-----	---	
FEF 50%	(L/s)	05.52	04.26	077	-----	---	
FEF 75%	(L/s)	02.69	01.44	054	-----	---	
FEV.5/FVC	(%)	-----	74.24	---	-----	---	
FEV3/FVC	(%)	97.20	100.00	103	-----	---	
FET	(Sec)	-----	01.79	---	-----	---	
ExplTime	(Sec)	-----	00.05	---	-----	---	
Lung Age	(Yrs)	039	039	100	-----	---	
FEV6	(L)	03.21	-----	---	-----	---	
FIF25%	(L/s)	-----	04.31	---	-----	---	
FIF50%	(L/s)	-----	03.40	---	-----	---	
FIF75%	(L/s)	-----	02.78	---	-----	---	

Pre Test COPD Severity

Test within normal limits

Pre Medication Report Indicates

Spirometry within normal limits as (FEV1/FVC)%Pred >95 and FVC%Pred >80

The contents of this report require clinical co-relation before any clinical action.

http://www.rmsindia.com © RMS Spirometer(Helios_v3.2.49)

,cupational Health Centre

,W, JAJANG
BARBIL, KEONJHAR
REG NO- KEO/00036/2022

JSW Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai-400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

PATIENTS NAME: RUDHI SUNDAR NAYAK	AGE:39Yrs SEX:M
SAMPLE ID: 6494	DATE: 26/09/2025

PATHOLOGICAL INVESTIGATION REPORT

TESTS		RESULTS		NORMAL RANGES
FBS	:	86.32	mg/dl	(70-110mg/dl)
PPBS	:	125.08	mg/dl	(70-160mg/dl)
Renal Profile				
Serum Urea	:	22.46	mg/dl	(10 – 45.0 mg/dl)
Serum Creatine	:	0.78	mg/dl	(0.5 – 1.5 mg/dl)
Serum Lipid Profile				
TOTAL CHOLESTROL	:	192.34	mg/dl	(125-200 mg/dl)
TRIGLYCERIDES	:	166.80	mg/dl	(50-170 mg/dl)
H.D.L.C	:	44.09	mg/dl	(35-70 mg/dl)
L.D.L.C	:	114.90	mg/dl	(<150.0 mg/dl)
V.L.D.L.C	:	33.36	mg/dl	
Haematology				
ESR	:	18 mm fall in 1st hour		(5-20 mm 1st hour)
Blood Group RH Typing	:	"B"(+ve)Positive		

********END OF THE REPORTS**********

OCCUPATIONAL HEALTH CENTRE

cupational Health Centre

W, JAJANG
BARBIL, KEONJHAR
REG NO- KEO/00036/2022

JSW Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai-400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

PATIENTS NAME: RUDHI SUNDAR NAYAK	AGE:39Yrs SEX:M
SAMPLE ID: 6494	DATE: 26/09/2025

URINE ROUTINE & MICROSCOPIC

Routine

COLOUR	:	Pale Yellow
VOLUME	:	About 10 ml
REACTION	:	Acidic
TURBIDITY	:	Nil.
SUGAR	:	Nil.
ALBUMIN	:	Nil.
PHOSPHATE	:	Nil.

Microscopic

PUS CELLS	:	0-2/HPF.
RBC	:	Nil.
EP. CELLS	:	2-4/HPF.
CAST	:	Nil.
CRYSTAL	:	Nil.
OTHERS	:	Nil.

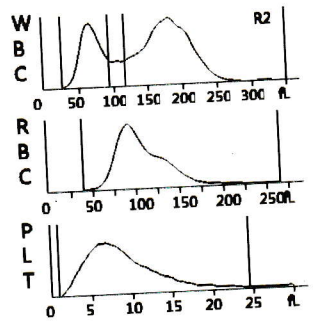
********END OF THE REPORTS**********

JSW JAJANGA

Hematology Analysis Report

ID:00000002430
Name:Rudhi sundar Nayak
Time:26/09/2025 15:39

PARAM.	RESULT		Info
WBC	7.6	10^3/uL	
LYM%	27.3	%	
MID%	7.1	%	
GRAN%	65.6	%	
LYM#	2.0	10^3/uL	
MID#	0.5	10^3/uL	
GRAN#	5.1	10^3/uL	
RBC	4.79	10^6/uL	
HGB	14.5	g/dL	
HCT	48.9	%	
MCV	102.1	fL	H
MCH	30.2	pg	
MCHC	29.6	g/dL	L
RDW_CV	15.9	%	H
RDW_SD	56.0	fL	H
PLT	236	10^3/uL	
MPV	10.6	fL	H
PCT	0.25	%	
P_LCR	36.6	%	
P_LCC	86	10^3/uL	
PDW	14.5	fL	H



OCCUPATIONAL HEALTH CENTRE